MATHEMATICS TOPICAL QUESTIONS AND ANSWERS

TOPICS COVERED

L.C.M

1. A piece of land is to be divided into 20 acres or 24 acres or 28 acres for farming and leave 7 acres for grazing. Determine the smallest size of such land.

2. When a certain number ***x*** is divided by 30, 45 or 54, there is always a remainder of 21. Find the least value of the number ***x***

3. A number **m** is such that when it is divided by 30, 36, and 45, the remainder is always 7. Find the smallest possible value of **m**.

4. Find the L.C.M of $x^2 + x$, $x^2 - 1$ and $x^2 - x$

1. Integers

1. $3x - 1 > -4$
   $2x + 1 \leq 7$

2. Find the value of ***x***
   $2^{(x-3)} \times 8^{(x+2)} = 128$

2. Decimals

1. Without using mathematical tables or calculators, evaluate: (3 mks)

$$\frac{0.0168 \times 2.46 \times 7}{5.74 \times 0.112}$$

2. A two-digit number is such that the sum of the ones digit and the tens digit is 10. If the digits are reversed, the number formed exceeds the original number by 54. Find the number (3 mks)

1. Use a calculator to find;
   (a) 8754.3 x 53.84
   (b) 0.8341 + 8.72

   Hence find; $\sqrt[3]{\frac{8754.3 \times 53.84}{0.8341 + 8.72}}$

2. Express the recurring decimal below to a fraction 5.72 and leaving your answer in the form $^{a}/_{b}$ where **a** and **b** are whole numbers

3. Evaluate:- **0.38 x 0.23 x 2.7** without using tables or a calculator

4. Without using mathematical tables or calculator, evaluate:

$$\frac{0.084 \times 1.32 \times 3.5}{2.87 \times 0.056}$$

   Leaving the answer as a fraction in its simplest form.

5. Find without using a calculator, the value of :

$$\frac{12\ \ 0.0625 - 12.4 \div 0.4 \text{ x } 3}{{}^{1}/_{8} \text{ of } 2.56 + 8.68}$$

3. Squares and square roots

1. Use tables to find;
   a) i) 4.978^2
   ii) The reciprocal of 31.65
   b) Hence evaluate to 4.S.F the value of
   $4.978^2 - {}^{1}/_{31.65}$

2. Use tables of squares, square roots and reciprocals to evaluate correct to 4 s.f

$$\frac{3}{0.0136} - \frac{2}{(3.72)2}$$

3. Without using mathematical tables or calculator, evaluate: $\frac{153 \text{ x } 1.8}{0.68 \text{ x } 0.32}$ giving your answer in standard form

4. Algebraic expressions

1. Five year ago, a mother's age was four times that of her daughter. In four years to come, she will be 2 ½ times the age of her daughter. Calculate the sum of their present ages

2. Mutua bought 160 trays of 8 eggs each at shs.150 per tray. On transportation 12 eggs broke. He later discovered that 20 eggs were rotten. If he sold the rest at shs.180 per tray, how much profit did he make?
3. Simplify;
   (a) $6a - 2b + 7a - 4b + 2$
   (b) $\frac{2x - 2}{2x} - \frac{3x + 2}{4x}$

4. Simplify $\frac{6x^2y^2 + 13xy - 5}{3x^2y^2 - 13xy + 4}$

5. Given that $x + y = 8$ and $x^2 + y^2 = 24$
   Find;
   (a) the value of $x^2 + 2xy + y^2$
   (b) Find the value of ; $2xy$
   (c) $x^2 - 2xy + y^2$
   (d) $x - y$
   (e) Value of x and y

6. Simplify the expression.
   $\frac{6x^2 + 35x - 6}{2x^2 - 72}$

7. Simplify the expression

$^2/_3$ (3x -2) – ¾ (2x -2)

8. Simplify by factorizing completely:

$$\frac{4y^2 - x^2}{2x^2 - yx - 6y^2}$$

9. Simplify as far as possible.

$$\frac{3}{x - y} - \frac{1}{x + y}$$

10. By calculation, find the coordinates of the intersection of the graphs **$y = x^2 + 2x - 5$** and **$y = 3x + 1$**

11. Simplify:

(a) $$\frac{y^2 + 2y}{y^3 - y^2 - 6y} = ¼$$

(b) hence solve:- $$\frac{y_2 + 2y}{y^3 - y^2 - 6y} = ¼$$

12. A rectangular field measures 63.9m by 104.6metres find the minimum number of poles to be erected for fencing if they are to be at most 2.4meters apart.

13. Factorize completely the expression

$75x^2 - 27y^2$

14. Every time an insect jumps forward the distance covered is half of the previous jump. If the insect initially jumped 8.4cm, calculate

(i) To the nearest two decimal places distance of the sixth jump

(ii) The total distance covered after the sixth jump

15. Simplify $$\frac{P^3 - Pq^2 + P^2q - q^3}{P^2 + 2pq + q^2}$$

16. Simplify the expression:- $$\frac{9x^2 - 4y^2}{12x^2 + yx - 6y^2}$$

17. Given that $(x-3)(Ax^2+bx+c) = x^3-7x-6$, find the value of A, B and C

18. a) solve for **y** in $8x(2^2)^y=6x2^y-1$

b) Simplify completely $$\frac{2x^2-98}{3x^2-16x-35} \div \frac{x+7}{3x+5}$$

19. Simplify the expression.:

$$\frac{4x^2 - y^2}{2x^2 - 7xy + 3y^2}$$

20. Simplify $\frac{P^2 - 2Pq + q^2}{P^3 - Pq^2 + P^2q - q^3}$

21. The sum of two numbers is 15. The difference between five times the first number and three times the second number is 19. Find the two numbers

22. Simplify the following expressions by reducing it to a single fraction

$$\frac{2x-5}{4} - \frac{1-x}{3} - \frac{x-4}{2}$$

23. Simplify the expression:- $\frac{3a^2 + 4ab + b^2}{4a^2 + 3ab - b^2}$

5. Rates, Ratio and percentages

1. If 5 men can erect 2 cottages in 21days, how many more men, working at the same rate will be needed to erect 2 cottages in the same period?

2. The length and width of a rectangular paper were measured to the nearest centimeter and found to be 18cm and 12cm respectively. Find the percentage error in its perimeter in 6 hrs.

3. a) Two pipes **A** and **B** can fill a tank in 3hrs and 4 hrs respectively. Pipe **C** can empty the full tank
   i) How long would it take pipes **A** and **B** to fill the tank if pipe **C** is closed?
   ii) Starting with an empty tank, how long would it take to fill the tank with all pipes running?
   b) The high quality Kencoffee is a mixture of pure Arabica coffee and pure Robusta coffee in the ratio 1 : 3 by mass. Pure Arabica coffee costs shs. 180 per kg and pure Robusta coffee costs sh 120 per kg. Calculate the percentage profit when the coffee is sold at sh 162 per kg.

4. A number of nurses working at Sotik Health Centre decided to raise shs.144,000 to buy a plot of land. Each person was to contribute the same amount. Before the contributions were collected five of the nurses retired. This meant that the remaining contributors had to pay more to meet the target.
   (a) If there were **n** nurses originally, find the expression of the increase in contribution per person
   (b) If the increase in the contribution per person was shs.2,400, find the number of nurses originally at the health centre
   (c) How much would each person have contributed to nearest shilling if the 5 people had not retired
   (d) Calculate the percentage increase in the contribution per person because of the retirement

5. 3 taps **X,Y** and **Z** can fill a tank in 40 hours, 15 hours and 20 hours respectively. The three taps are turned on at 8.00a.m when the tank is empty for five hours then **Z** is turned off. After two hours tap **Y** is turned off. Work out ;-
   (a) The proportion of water in the tank after seven hours
   (b) The proportion of water in the tank after seven hours
   (c) The time the tank will be completely full

6. Jane and Philip working together can do a piece of work in 6 days. Jane working alone takes 5 days longer than Philip. How many days does it take Philip to do the work alone?

7. Sixteen men working 9 hours a day can complete a piece of work in 14 days. How many more men working 7 hours a day would complete the same job in 12 days?

8. A group of people planned to contribute equally towards buying land at a price of shs.180000. However 3 members of the group withdrew from the project. As a result, each of the remaining members were to contribute kshs.3000 more.
(a) find the original number of members in the group
(b) How much would each person have contributed if the 3 people had not withdrew
(c) Calculate the percentage increase in the contribution per person caused by the withdrawal

9. Kori and Mue decided to start a business. Korir contributed shs.40,000 and Mue shs.64000. The two men agreed that in any year, 15% of the profit shall be divided equally between them and 20% of the profit will be used to meet the cost of running the business the following year. They also agreed to share the rest of the profit in the ratio of their contributions. The profit made after the first year was shs.43200.
a) How much did they set aside towards the cost of running the business for the second year?*
b) How much did Mue receive at the end of the first year?
(c) Korir bought cows with his share of the profit. If each cow cost shs.1800, how many cows did he buy?

10. Given the ratio x : y = 2:3, find the ratio (7x – 3y) : (2x + 3y)

11. Abdul bought five bulls and thirty goats at an auction spending a total of Kshs.117000. His friend Ali bought four bulls and twenty five goats at the same auction and spent Kshs.22,250 less.
(a) Find the cost of each animal at the auction
(b) Abdul later sold all his animals at a profit of 40% per bull and 30% per goat. Ali sold all his animals at a profit of 50% per bull and 40% per goat. Determine who made more profit and by how much?

12. The cost of providing a commodity consists of transport, labour and raw material in the ratio 8:4:12 respectively. If the transport cost increases by 12% labour cost 18% and raw materials by 40%, find the percentage increase of producing the new commodity

13. A mother is now 2½ times as old as her daughter Mary; four years ago the ratio of their ages was 3:1. Find the present age of the mother

14. Sixteen men working at the rate of 9hrs a day can complete a piece of work in 14 days. How many more men working at the rate of 7 hours a day would complete the same job in 12 days

15. Two business partners, Kago and Beatrice contributed 90, 000/= and 120,000/= in order to start a business. They agreed that 25% of the profit made after end of the year will be put back into the

business. They also estimated that 40% of the profit will cover salaries and other expenses for the year. The remainder would be shared between the partners in the ratio of their contributions. At the end of the first year the business realized a gross profit of shs.181,300.

a) Calculate how much each received after end of the year.

b) At the end of 2nd year the business realized the same gross profit as the previous year and the partners decided to dissolve the business and share everything . Determine how much money each received.

16. A number is such that the product of its digits is 24. When the digits are reversed, the number so formed exceeds the original number by 27. Find the number

17. The radius of a cylinder is increased by 30% while its height is decreased by 20%. Find the percentage change in the volume of the cylinder

18. Tap **A** fills a tank in 6 hours, tap **B** fills it in 8 hours and tap **C** empties it in10 hours. Starting with an empty tank and all the three taps are opened at the same time, how long will it take to fill the tank?

19. Sixteen men working 9 hours a day can complete a piece of work in 14 days. How many more men working 7 hours a day would complete the same job in 12 days?

20. Three businessmen Langat, Korir and Koech contributed shs.160,000, Shs.200,000 and shs.240,000 respectively and started a business. They agreed that 30% of the profit each year will go to expenses, 15% of the reminder would go back to the business. The rest of the profit would be shared in the ratio of their contribution. At the end of the first year, the business realized a profit of kshs.60,000.
Calculate how much;
(a) (i) Langat received
(ii) Korir received
(iii) Koech received
(b) Express what Korir received as a percentage of the total profit

21. The price of a book is increased by 25%.
(a) In what ratio has the price increased?
(b) What is the new price if the book was shs.400 before the change?

22. (a) A chemist added 120 liters of a solution A containing 25% alcohol to 180 liters of solution **B** containing 20% alcohol. What percentage of the resulting solution in alcohol?
(b) He removed **X** liters of resulting mixture and added an equal amount of pure alcohol to the resulting mixture. If the new mixture contains 22% of the alcohol, find the value of **X**

23. The length and width of a rectangular paper were measured to the nearest centimeter and found to be 18cm and 12cm respectively. Find the percentage error in its perimeter

24. Given that a:b = 1: 2 and b:c = 3:4. Find a:b:c

6. length

1 Simplify; by factorization:

$$\frac{15x^2 + xy - 6y^2}{5x^2 - 8xy + 3y^2}$$

2. Given the matrices M = $\begin{matrix} 3 & 0 \\ -1 & 4 \end{matrix}$, R = $\begin{matrix} -1 & 2 \\ 0 & 0 \end{matrix}$ and N = $\begin{matrix} {}^2/_3 & 1 \\ 2 & 4 \end{matrix}$. Find the value of value of 3n + ½ (R-M)

7. Area

1. Calculate the area of the shaded region below, given that AC is an arc of a circle centre B.

AB=BC=14cm CD=8cm and angle ABD = 75^0 (4 mks)

1. A student took the measurements of his classroom and gave the width as 7m and the length as 9m. If there is an error of 2% in each measurement, determine the greatest value of $\frac{\mathbf{x + y}}{\mathbf{x}}$

if **x** and **y** are the width and length of the classroom respectively.
Give your answer to 4 decimal places.

2. The floor of a room is in the shape of a rectangle 10.5 m long by 6 m wide. Square tiles of length 30 cm are to be fitted onto the floor.
(a) Calculate the number of tiles needed for the floor.
(b) A dealer wishes to buy enough tiles for fifteen such rooms. The tiles are packed in cartons each containing 20 tiles. The cost of each carton is Kshs. 800. Calculate
(i) the total cost of the tiles.
(ii) If in addition, the dealer spends Kshs. 2,000 and Kshs. 600 on transport and subsistence respectively, at what price should he sell each carton in order to make a profit of 12.5%
(Give your answer to the nearest Kshs.)

3. The figure below is a circle of radius 5cm. Points **A, B** and **C** are the vertices of the triangle

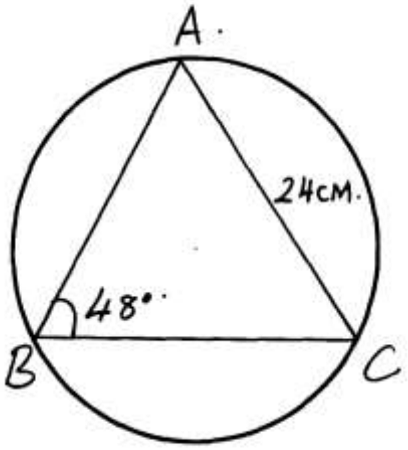
ABC in which ∠ABC = 60° and ∠ACB=50° which is in the circle. Calculate the area of ΔABC)

4. Mr.Wanyama has a plot that is in a triangular form. The plot measures 170m, 190m and 210m, but the altitudes of the plot as well as the angles are not known. Find the area of the plot in hectares

5. Three sirens wail at intervals of thirty minutes, fifty minutes and thirty five minutes. If they wail together at 7.18a.m on Monday, what time and day will they next wail together?

6. A farmer decides to put two-thirds of his farm under crops. Of this, he put a quarter under maize and four-fifths of the remainder under beans. The rest is planted with carrots. If 0.9acres are under carrots, find the total area of the farm

7 Find the area of the circle sector.



8. Volume and capacity

1. A village water tank is in the form of a frustrum of a cone of height 3.2m. The top and bottom radii are 18m and 24m respectively
   (a) Calculate:
      (i) The surface area of the tank excluding the bottom
      (ii) The capacity of the water tank

   (b) 15 families each having 15 members use the water tank and each person uses 65 litres of water daily. How long will it take for the full tank to be emptied

2. The diagram below shows a bucket with a top diameter 30cm and bottom diameter 20cm. The height of the bucket is 28cm

(a) Calculate the capacity of the bucket in litres

(b) Find the area of the metal sheet required to make 100 such buckets taking 10% extra for overlapping and wastage

3. A rectangular water tank measures 2.6m by 4.8m at the base and has water to a height of 3.2m. Find the volume of water in litres that is in the tank

4. The figure alongside shows a cone from which a frustum is made. A plane parallel to the base cuts the cone two thirds way up the vertical height of the cone to form frustum **ABCD**. The top surface radius of the frustum is labeled **r** and the bottom radius is **R**

a) Find the ratio r:R

b) Given that r = 7cm, find R

c) If the height VY of the original cone is 45cm, calculate to the nearest whole number the volume of the frustum

d) The frustum represents a bucket which is used to fill a rectangular tank measuring 1.5m long, 1.2m wide and 80cm high with water. How many full buckets of water are required to fill the tank

5. Three litres of water (density1g/cm^3) is added to twelve litres of alcohol (density 0.8g/cm^3. What is the density of the mixture?

6. A rectangular tank whose internal dimensions are 2.2m by 1.4m by 1.7m is three fifth full of milk.

(a) Calculate the volume of milk in litres

(b) The milk is packed in small packets in the shape of a right pyramid with an equilateral base triangle of sides 10cm. The vertical height of each packet is 13.6cm. Full packets obtained are sold at shs.30 per packet. Calculate:
  (i) The volume in cm^3 of each packet to the nearest whole number
  (ii) The number of full packets of milk
  (iii) The amount of money realized from the sale of milk

7. An 890kg culvert is made of a hollow cylindrical material with outer radius of 76cm and an inner radius of 64cm. It crosses a road of width 3m, determine the density of the material used in its construction in Kg/m^3 correct to 1 decimal place.

9. Mass, weight and density

1. A piece of metal has a volume of 20 cm^3 and a mass of 300g. Calculate the density of the metal in kg/m^3.
2. 2.5 litres of water density $1g/cm^3$ is added to 8 litres of alcohol density $0.8g/cm^3$. Calculate the density of the mixture

10. Time

1. A van travelled from Kitale to Kisumu a distance of 160km. The average speed of the van for the first 100km was 40km/h and the remaining part of the journey its average speed was 30km/h. Calculate the average speed for the whole journey. (3 mks)

1. A watch which looses a half-minute every hour was set to read the correct time at 0545h on Monday. Determine the time, in the 12 hour system, the watch will show on the following Friday at 1945h.

2. A watch which loses a half-minute every hour was set to read the correct time at 0445h on Monday. Determine the time in 12-hour system, the watch will show on the following Friday at 1845h

3. The timetable below shows the departure and arrival time for a bus plying between two towns **M** and **R**, 300km apart

Town	Arrival	Departure
M		0830h
N	1000h	1020h
P	1310h	1340h

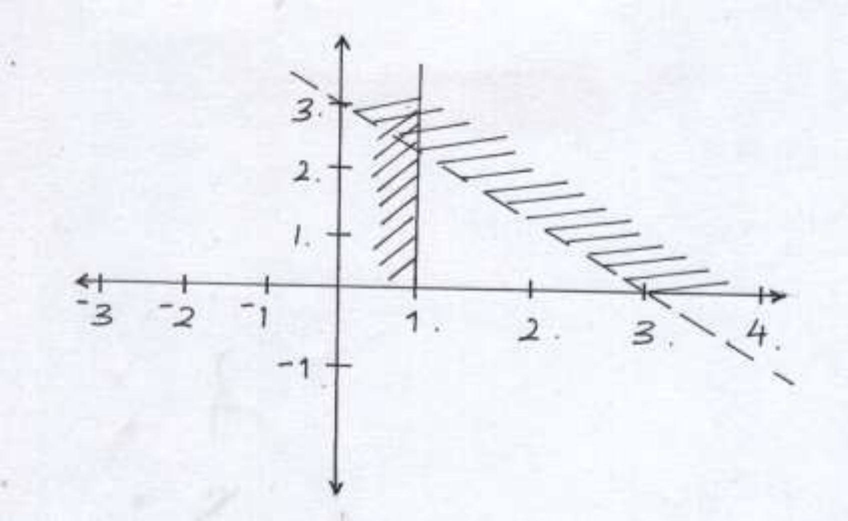
Q	1510h	1520h
R	1600h	

(a) How long does the bus take to travel from town **M** to **R?**

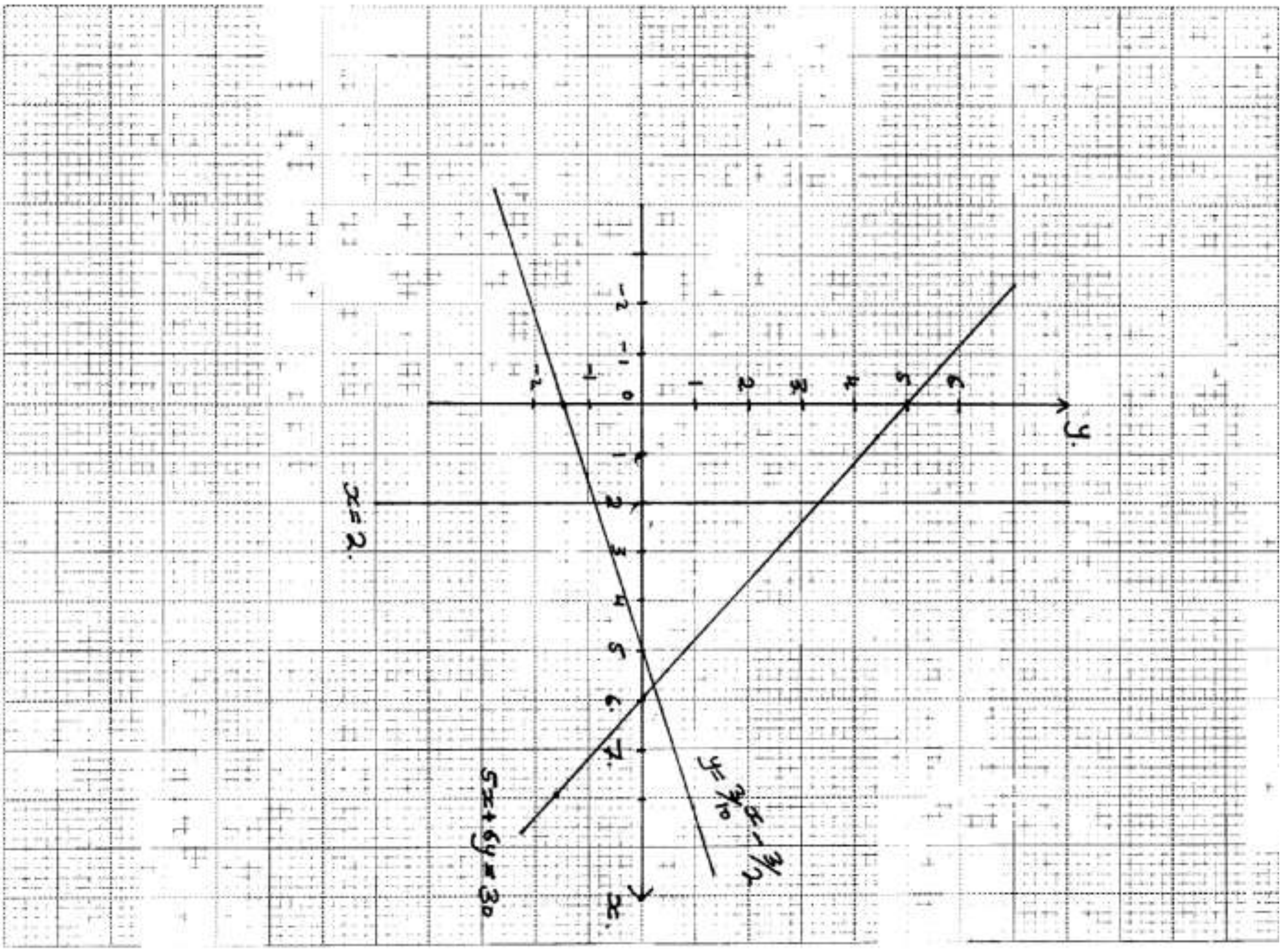
(b) What is the average speed for the whole journey?

11. Linear

1. Determine the inequalities that represent and satisfies the unshaded region (3 mks)



1. The diagram below shows the graphs of $y = {}^{3}/_{10}\,x - {}^{3}/_{2}$, $5x + 6y = 3$ and $x = 2$



By shading the unwanted region, determine and label the region **R** that satisfies the three inequalities; $y \geq {}^{3}/_{10}\, x - {}^{3}/_{2}$,

$5x + 6y \geq 30$ and $x \geq 2$

2. The cost of 7 shirts and 3 pairs of trousers is shs. 2950 while that of 5 pairs of trousers and 3 shirts is less by 200. How much will Dan pay for 2 shirts and 2 pairs of trousers?

3. Mr. Wafula went to the supermarket and bought two biros and five pencils at sh.120. Whereas three biros and two pencils cost him sh.114. Find the cost of each biros and pencils

4. A father is twice as old as his son now. Ten years ago, the ratio of their ages was 5:2. Find their present ages

5. List the integral values of **x** which satisfy the inequalities below:-
$2x + 21 > 15 - 2x \geq x + 6$

6. Find the equation of a line which passes through (-1, -4) and is perpendicular to the line:-
$y + 2x - 4 = 0$

7. John bought two shirts and three pairs of trousers at Kshs. 1750. If he had bought three shirts and two pairs of trousers, he would have saved Kshs. 250. Find the cost of a shirt and a trouser.

8. Express the recurring decimal 3.81 as an improper fraction and hence as a mixed number
9. Karani bought 4 pencils and 6 biro pens for shs.66 and Mary bought 2 pencils and 5 biro pens for shs.51
(a) Find the price of each item
(b) Ondieki spent shs.228 to buy the same type of pencils and biro pens. If the number of biro pens he bought were 4 more than the number of pencils, find the number of pencils he bought

10. Two consecutive odd numbers are such that the difference of twice the larger number and twice the smaller number is 21.Find the product of the numbers

11. The size of an interior angle of a regular polygon is $\mathbf{3x^{o}}$ while its exterior angle is $\mathbf{(x-20)^{o}}$. Find the number of sides of the polygon

12. Five shirts and four pairs of trousers cost a total of shs.6160. Three similar shirts and a pair of trouser cost shs.2800. Find the cost of four shirts and two pairs of trousers

13. Two pairs of trousers and three shirts costs a total of Shs.390. Five such pairs of trousers and two shirts cost a total of Shs.810. Find the price of a pair of trouser and a shirt

12.Equations

1. Solve the simultaneous equation (3 mks)

$$2x - y = 3$$
$$x^2 - xy = -4$$

1. A Kenyan businessman US$100 to a company in the United States of America. The Kenyan can either pay through his account in Kenya or through his account in the United Kingdom. Which method is cheaper and by how much? Give your answer in Kenya shillings given that;
1 US dollar = 76.84 Kenya shillings
1 Sterling Pound = 1.53 US dollars
1 Sterling pound = 115.70 Kenya shillings

2. Foreign exchange on 27/5/2010 was given as follows:.

Currency	**Buying** (Kshs)	**Selling** (Kshs)
1 Euro	84.15	84.26
1 Sterling pound	118.35	121.47

A tourist came to Kenya from London with 6000 Euros which he converted to Kenya shillings at a bank. While in Kenya he spent a total of Kshs.300,000 then converted the balance into sterling pounds at the Same bank. Calculate the amount in sterling pounds he received.

3. A Kenyan football fan visited South Africa from Kenya. He changed his currency from Kenya shillings to South African rand. The exchange rates in Kenya were as per the table below:-

Buying	**Selling**
9.9399	10.0166

He has a total of shs.2, 8000,265 and must spend 13 days. During his stay, he spent 8900 Rands on food and accommodation, 97,000 Rands on a return air ticket and 53689 Rands on entertainment. On his return, he converted the remaining amount into Kshs. How much did he receive to the nearest cents?

4. A French tourist changes 3000 Francs into Kenyan shillings at 1 Franc = Kshs.1.89. He spends shs.4695, then exchanges the remaining shillings back into Francs at 1 Franc =1.95. How many Francs does he receive?

5. Hamisi arrived in Nairobi from USA with 40 travelers cheques each with 75 US dollars. How much does she receive in Kshs from the bank on a day when 1 US dollar was equivalent to Kshs 81.40 and the bank charges commission at the rate of Kshs.100 per travelers cheque

6. A Kenya bank buys and sells foreign currencies as shown below

	Buying in Kshs.	**Selling in Kshs.**
1 Hong Kong dollar	9.74	9.77
1 South African rand	12.03	12.11

A tourist arrived in Kenya with 105,000 Hong Kong dollars and changed the amount to Kenya shillings. While in Kenya, she spent Shs.403,879 and changed the balance to South African rand before leaving for South Africa. Calculate the amount, in South African rand that she received

7. A Japanese tourist entered Kenya with Kshs.500,000 Japanese Yen which he converted to Kenya currency. While in Kenya, he spend Kshs.16200 in all. He then converted all the remaining money into Euros before leaving for Italy. If he carried out all his transactions at the Stanbic bank using rates shown below, calculate to the nearest Euro, how much money he left Kenya with. (*Do not use mathematical tables for this question)*

	Selling (Kshs	**Buying Kshs**
100 Japanese Yen	66.35	66.05
1 Euro	78.15	77.85

8. Do not use mathematical tables in this question. Equity bank buys and sells foreign currencies as shown:-

	Buying (Kshs.)	**Selling Kshs**.
1 US dollar	77.43	78.10
I South African Rand	9.03	9.51

A tourist arrived in Kenya with 5,600 US dollars and changed the whole amount to Kenya shillings while in Kenya he spend shs.201,367 and changed the balance to South African rand before leaving to S. Africa . Calculate the amount in S. African rand that she received

9. A tourist arriving from Britain had UK ₤ 9000. He converted the pounds to Kenyan shillings at a commission of 5%. While in Kenya he spent ¾ of his money. He exchanged the remaining to US dollars with no commission. Calculate to the nearest US dollars the amount using the exchange rate below.

Currency	**Buying Kshs.**	**Selling Kshs.**
1 US Dollar	63.00	63.20
1 UK Dollar	125.30	125.95

10. A company was to import goods worth Kshs.100,000 from U.K and changed the money to Sterling pounds. The company later realized that it was cheaper to import the same goods from U.S.A and changed the sterling pounds to dollar. Unfortunately the transaction failed and the money was converted to Kenya shillings. How much money did the company end-up with, given that;

1 US dollar = Kshs.78
1 Sterling pound = Kshs.120
1 Sterling pound = 1.79 U.S dollar

11. A tourist arrives in Kenya from England with S.**£** 50,000 and uses the money to buy Kenya shillings. He quickly changes his mind and sells the Kenya shillings to get back his s**£**. How much money in S.**£** did he get? Use the table below

buying **selling**

1 Sterling pound	120.7131	120.9294

12. A Kenyan bank buys and sells foreign currencies at the exchange rates shown below:

	Buying (Kshs.)	**Selling (Kshs.)**
1 Euro	147.86	148.00
1 US Dollar	74.22	74.50

An American arrived in Kenya with 20000 Euros. He converted all the Euros to Kenya shillings at the bank. He spent Kshs.25100 200 while in Kenya and converted the remaining Kenya shillings into US Dollars at the bank. Find the amount in dollars that he received

13. Simplify;

(a) $6a - 2b + 7a - 4b + 2$

(b) $\frac{2x-2}{2x} - \frac{3x+2}{4x}$

13. Commercial arithmetic

1. Jane is a sales executive earning a salary of Ksh. 20,000 and a commission of 8% for the sales in excess of Ksh 100,000. If in January 2010 she earned a total of Ksh.48, 000 in salaries and commissions.

a) Determine the amount of sales she made in that month (4 mks)

b) If the total sales in the month of February and March increased by 18% and then dropped by 25% respectively. Calculate

(i) Jane's commission in the month of February (3 mks)

(ii) Her total earning in the month of March (3 mks)

2. Wekhomba bought a laptop in Uganda for Ush.1, 050,000. He then paid 60 US dollars as transportation charges to Kenya. On arrival in Kenya he paid duty and sales tax amounting to 55% of the cost in Uganda. He then gave it to a friend in Tanzania tax free. If the exchange rates were I US dollar = Ush 1016, 1Ksh = Ush 24.83 and Tsh 1 = Ksh 0.0714

(a) Calculate the total expenses in Kenya shillings incurred by Wekhomba (3 mks)

(b) Find the expenditure on transportation and taxes as a percentage of the total expenditure (2 mks)

(c) What is the total value of the laptop in Tanzanian shillings (2 mks)

(d) Find the overall increase in value of the laptop as percentage of the buying price (3 mks)

1. Find the angle θ in degrees from the figure below

2. In the diagram below, determine the equation of the line **XY** in the form **y = mx + c**

3. Find the equation of a line which passes through the point (2, 3) and is perpendicular to $y - 3x + 1 = 0$, giving your answer in the form $y = mx + c$

4. **T** is the mid-point of line **XY** where **X** is point (1,4) and **Y** is the point (-5, 10). Find the equation of a line, L_2 which is perpendicular to line **XY** and goes through point **T**

5. (a) On the grid provided below, plot points A(2,1) B(-4,3) and C(2,5)
   b) Given that the gradient of CD = -1 and CD =AD locate D and complete the quadrilateral ABCD
   (c) What name is given to quadrilateral ABCD?

6. In the figure below (not drawn to scale), **PQRS** is a rectangle and **P** and **Q** are the points (3, 2) and (1,4) respectively

Given that the equation of the line PQ is $y = 3x - 7$, find:

(a) The equation of line QR
(b) The coordinates of point **R**
(c) The coordinates of point **S**

7. OABC is a trapezium such that the coordinates of O, A , B and C are (0, 0), (2, -1), (4, 3) and (0, y)

(a) Find the value of y
(b) M is the mid-point of AB and N is the mid-point of OM. Find in column form
 (i) the vector **AN**
 (ii) the vector **NC**
 (iii) Vector **AC**
(c) Hence show that A, N and C are collinear

8. Use ruler and a pair of compasses only in this question.

(a) Construct triangle ABC in which AB = 7 cm, BC = 8 cm and $\angle ABC = 60^0$.
(b) Measure (i) side AC (ii) ∠ ACB
(c) Construct a circle passing through the three points A, B and C. Measure the radius of the circle.
(d) Construct Δ PBC such that P is on the same side of BC as point A and ∠ PCB = ½ ∠ ACB, ∠ BPC = ∠ BAC measure ∠ PBC.

9. ABCD is a parallelogram with vertices A (1,1) and C(8,10). AB has the equation $4x - 5y = -1$ and BC has the equation $5x - 2y = 20$. Determine by calculation;

(a) the co-ordinates of the point M where the diagonals meet
(b) The co-ordinates of the vertices B and D
(c) the length of AB correct to 4 significant figures

10. The table shows corresponding values of *x* and y for a certain curve;

x	1.0	1.2	1.4	1.6	1.8	2.0	2.3
y	6.5	6.2	5.2	4.3	4.0	2.6	2.4

Using 3 strips and mid-ordinate rule estimate the area between the curve, x-axis, the lines $x = 1$ and $x = 2.2$

14. Coordinates and Graphics

1. The size of an interior angle of a rectangular polygon is 6 ½ times that of its exterior angle. Determine the number of sides of the polygon.

2. The sum of interior angles of two regular polygons of sides n and n + 2 are in the ratio 3:4. Calculate the sum of the interior angles of the polygons with n sides

3 . The area of a rhombus is 60cm^2. Given that one of its diagonals is 15cm long. Calculate the perimeter of the rhombus.

4. In the figure below AE is parallel to BD. BC = BD, AB = 7.25cm, AE = 15.25cm and ED = 5.25 cm

Find the perimeter of the figure .

5. The figure below shows a trapezium ABCD in which side AB is perpendicular to both AD and BC. Side AD=17cm, DC=10cm

(i) What is the length of side AB

(ii) Find the value of **cos(90^o – x^o)** in the form $\frac{a}{b}$ where a and b are integers

6. The size of an interior angle of a regular polygon is **3x^o** while its exterior angle is **(x-20)$^{o.}$**

Find the number of sides of the polygon

7.

In the figure above, angle **a** is half the sum of the other angles. Evaluate the triangle

8. The sum of the interior angles of an **n**-sided polygon is 1260^{o}. Find the value of **n** and hence deduce the polygon

9. Giving reason, find the angle marked **n**

10. Solve for **y** in the equation $125^{y+1} + 5^{3y} = 630$

11. The interior angle of a regular polygon is 108^{o} larger than the exterior angle. How many sides has the polygon?

12. The interior angle of a regular polygon is 4 times the exterior angle. How many sides has the polygon

13. In the figure below ABCD is a trapezium with DC parallel to AB. DC = 5cm, CB = 4cm, BD = 8cm and AB = 10cm

Calculate:
(a) the size of angle BDC
(b) the area of triangle ABD

14. In the figure below, DE bisects angle BDG and AB is parallel to DE. Angle DCF = 60^o and angle CFG = 100^o

Find the value of angle:-
(a) CDF
(b) ABD

15. The size of an interior angle of a regular polygon is $4x^o$, while its exterior angle is $(x – 30)^o$. Find the number of sides of the polygon

16. The sum of interior angles of a polygon is 1440^o. Find the number of sides of the polygon hence name the polygon

17. In the figure below PQ is parallel to RS. Calculate the value of **x** and **y**

18. The interior angle of a n-sided regular polygon exceeds its exterior angle by 132^o. Find the value of n

15. Angles and Plane Figures

1. The sum of angles of a triangle is given by the expression $(2a+b)^0$ while that of a quadrilateral is given by $(13a - b)^0$. Calculate the values of a and b (4 mks)

2. The figure below represents a quadrilateral ABCD. Triangle ABX is an equilateral triangle. If $\angle ADX = 50^0$, find $\angle AXD$ with $\angle BAD = 90^0$ (2 mks)

3. Wanjiku is standing at a point P, 160m south of a hill H on a level ground. From point P she observes the angle of elevation of the top of the hill to be 67^0

   (a) Calculate the height of the hill (3 mks)

   (b) After walking 420m due east to the point Q, Wanjiku proceeds to point R due east of Q, where the angle of elevation of the top of the hill is 35^0. Calculate the angle of elevation of the top of the hill from Q (3 mks)

   (c) Calculate the distance from P to R (4 mks)

16. Geometrical Constructions

1. Using a ruler and a pair of compasses only,

   a) Construct a triangle ABC in which AB = 9cm, AC = 6cm and angle BAC = $37½^0$

   c) Drop a perpendicular from C to meet AB at D. Measure CD and hence find the area of the triangle ABC

   d) Point E divides BC in the ratio 2:3. Using a ruler and Set Square only, determine point E. Measure AE.

1. Chebochok deposited shs.120,000 in a financial institution which offered a compound interest at 8% p.a, compounded quarterly for 9 months. Find the accumulated amount by the end of the period

2. Using a ruler and a pair of compasses only, draw a parallelogram ABCD in which AB = 6cm, BC = 4cm and angle BAD = 60^o. By construction, determine the perpendicular distance between the lines AB and CD

3. Without using a protractor, draw a triangle ABC where ∠CAB = 30^o, AC = 3.5cm and AB = 6cm. measure BC

4. (a) Using a ruler and a pair of compass only, construct a triangle ABC in which angle ABC =37.5°, BC =7cm and BA = 14cm
(b) Drop a perpendicular from A to BC produced and measure its height
(c) Use your height in (b) to find the area of the triangle ABC
(d) Use construction to find the radius of an inscribed circle of triangle ABC

5. In this question use a pair of compasses and a ruler only
a) Construct triangle PQR such that PQ = 6 cm, QR = 8 cm and <PQR = 135°
b) Construct the height of triangle PQR in (a) above, taking QR as the base

6. On the line AC shown below, point **B** lies above the line such that ∠BAC = 52.5° and]
AB = 4.2cm. (***Use a ruler and a pair of compasses for this question***)

A C

(a) Construct ∠BAC and mark point **B**
(b) Drop a perpendicular from **B** to meet the line **AC** at point **F .** Measure **BF**

7. Juma paid shs.450 for a trouser after getting a discount of 10%. The trader still made a *profit of 25% on the sale. What profit would the trader have made if no discount was allowed?*

17. Scale Drawing

1. Three mountains Mikai, Kembo and Chaka in a village are situated in such a way that Kembo is 900m on a bearing of 120^0 from Mikai. Mt. Chaka is 1200m on a bearing of 030^0 from Kembo.
(ii) Draw a sketch showing the position of the three mountains (1 mk)
(iii)Calculate the distance of Mt. Chaka from Mt. Mikai (2 mks)

1. Town **X** is 13.5km from town **Y** on a bearing of 028°. A matatu leaves **y** at 7:35a.m towards a bearing of 080°. The matatu is at point **Z** due south of **X** at 8:55a.m
(a) Calculate the average speed of the matatu from **Y** to **Z**
(b) If the matatu continues on the same bearing, calculate the distance it covers from **Z** when it is East of **X**

2. Three towns X, Y and Z are such that Y is 500km on a bearing of 315^{o} from X. Z is on a bearing of 230^{o} from X. given that the distance between Y and Z is 800km.
   (a) using a scale of 1cm to represent 100km, draw a scale diagram to show the position of the Towns
   (b) Find the bearing of;
      (i) X from Z
      (ii) Z from Y
   (c) Use the scale drawing to find the distance from X to Z

3. Two aeroplanes **S** and **R** leave an airport at the same time. **S** flies on the bearing of 240^{o} at 750Km/h while **R** flies due East at 600Km/hr..
   (a) (i) Calculate the distance of each aeroplane after 30minutes
      (ii) Using a scale of 1cm to represent 50km make an accurate scale drawing to show the positions of the aeroplanes after 30minutes
   (b) (i) Use the scale drawing to find the distance between the two aeroplanes after 30minutes
      (ii) If each aeroplane landed after 30minutes and **S** received a signal to join **R** in 45minutes. Find its speed
   (c) Determine the bearing of :
      (i) **S** from **R**
      (ii) **R** from **S**

4. The table below gives a field book showing the results of a survey of a section of a piece of land between A and E. All measurements are in metres.

	E	
D33	95	
	90	**F** 36
C21	70	
B 42	30	**G** 25
	25	**H** 40
	A	

   (a) Draw a sketch of the land.
   (b) Calculate the area of this piece of land.

5. Three towns A B and C are situated such that town A is 40km from B on a bearing of 280^{o}. C is 60km from B on a bearing of 130^{o}. Another town D is only 10km from C on a bearing of 210^{o}.
   (a) Drawing accurately and using a scale of 1cm to 10km find the:-
   (b) Distance from A to C and the bearing of A from C
   (c) (i) Distance of B from D
      (ii) Distance of A from D
      (iii) Bearing of A from D
      (iv) Bearing of C from D

6. A train left Naivasha for Nakuru at 1000hours. It traveled at an average speed of 45km/h and reached Gilgil after 40minutes. It then covered the remaining 50km in 1½ hours. A second train left Nakuru for Naivasha at 1015 hours and arrived at Gilgil at the same time as the first train arrived at Nakuru.

a) Using a scale of 1cm to represent 10minutes in the time axis and 1cm to represent 10km on the distance axis, draw on the same axes the graphs to show the movement of the two trains

b) use your graph to find;

i) the distance between Naivasha and Nakuru

ii) the time at which the train met

c) calculate the average speed, in km/h of the second train

7. On a certain map, a road 20km long is represented by a line 4cm long. Calculate the area of a rectangular plot represented by dimensions 2.4cm by 1.5cm on this map – leaving your answer in hectares

8. A port **B** is on a bearings of 080° from a port **A** and at a distance of 95km. a submarine is stationed at a port **D**, which is on a bearing of 200° from **A**, and a distance of 124km from **B**. A ship leaves **B** and moves directly southwards to an island **P**, which is on a bearing of 140° from **A**. the submarine at **D** on realizing that the ship was heading for the island **P**, decides to head straight for the island to intercept the ship.

(a) Using a scale of 1cm to represent 10km draw a diagram to show the positions of A,B,D, and P

(b) Hence;

Determine;

(i) the distance from **A** to **D**

(ii) the bearing of the submarine from the ship when the ship was setting off from B

(iii) the bearing of the island **P** from **D**

(iv) the distance the submarine had to cover to reach the island P

9. Use a scale of 1cm represents 50km in these questions. Five towns **A, B, C, D** and **E** are situated such that **A** is 200 km from **B** on a bearing of 050° from **E**. **C** is 300 km from **B** on a bearing of 150° from **B**. **D** is 350km on a bearing of 240° from **C**. **E** is 200km from **D** and the bearing of **D** from **E** is 100°

a) Draw the diagram representing the positions of the towns

b) From the diagram, determine;

i) The distance in km of A from E

ii) The bearing of D from B

10. Four towns **P, Q, R** & **S** are such that **P** is 280 km North of **R, S** is190 km from **R** on a bearing of 310° and **Q** is 240 km from **P** on a bearing of 105°.

a) Using scale of 1 cm rep. 50 km, locate the four towns.

b) Find; (i) distance **SQ**.

(ii) Bearing of **S** from **Q**.

(iii) The shortest distance between **P** and side **QR.**

11. Four ships are at sea such that a streamliner S is 150km on a bearing of 025° from a cargo ship **C**. A trawler **T** is 300km on a bearing of 145° from the cargo ship and a yacht **Y** is due West of **C** and on a bearing of 300° from **T**.

a) Using a scale of 1cm= 50km, draw on accurate scale drawing showing the positions of S, C, T and Y

b) By measurement from your scale drawing determine:
- i) The distance and bearing of Y from S
- ii) The distance ST
- iii) The distance YT

12. A tea farm in Kakamega forest was surveyed and the results were recorded in the surveyors note book as shown below. The measurements are in meters

	250	**Y**
	240	D70
C80	170	
	70	B60
A60	50	
X	**0**	

Using a scale of 1: 25, draw the map of the plot and hence calculate the area of the plot in Hectares

13. The information below shows the entries in a surveyor's field book after a survey of a farm. XY = 280m is the baseline. All measurements are in metres

	280	**Y**
B 105	230	110E
	190	
	160	45E
A 100	90	
	40	95G
X	O	

(a) Use a scale of 1cm represents 20m to draw the map of the farm

(b) Estimate the area of the farm in hectares

(c) If the point **Y** lies due north of **X**, find correct to 1 decimal place, the :
- (i) Bearing of **E** from **X**
- (ii) Distance of **E** from **X**

14. The measurements of a flower garden were recorded in a surveyor's field book as shown.

	250	Y
	240	D 70
C80	170	
	70	B 60
X	0	

Draw a sketch of the field and find its area. (Measurements are in m)

15. A map has a scale 1:40,000:

(a) Calculate the distance between two points on the ground if the corresponding distance shown on the map is 3.25cm

(b) Calculate the area in the map of woodland which occupies 36ha on the ground

16. Three scouts John, Peter and Samwel stand on three adjacent peaks of equal altitude on mountain range. The distance between John and Peter is 800metres and the bearing of Peter from John is 020°. The distance between John and Samwel is 1500metres, and the bearing of Samwel from John is 320°.

(a) Calculate the bearing of John from Peter

(b) **Calculate**:- (i) the distance

(ii) the bearing of Samwel from Peter

17. The figure below represents a surveyor's sketch of a plot of land. Calculate the area of the plot in square metres given that XY = 50m, XK = 20m, XM = 25m, XL = 35m, KA = 40m, MD = 38m and LB = YC = 60m.

18. Two boats **P** and **Q** are located 30km apart; **P** being due North of **Q**. An observer at **P** spots a ship whose bearing he finds as S 56°E from **Q**, the bearing of the same ship is 038°. Calculate the distance of the ship from **Q** to 2 decimal places

19. A map is drawn to scale of 1:100,000. What area in km^2, is represented by a rectangle measuring 4.5cm by 5.4 cm

21. Two places **A** and **B** are 900km apart on the earth's surface. If **A** is due North of **B** and given that the latitude of **A** is 5°N. Find the latitude of **B**. (Take radius of the earth to be 6370km)

22. A car starts from rest and build up a speed of 40m/s in 1min 40seconds. It then travels at this steady speed for 5minutes. Brakes are then applied and the car is brought to rest in 2minutes.

(a) Draw a velocity-time graph to show the journey

(b) Use your graph to find;

(i) the initial acceleration

(ii) the deceleration when the car is brought to rest

(iii) the distance traveled

23. The diagram below represents two vertical watch-towers AB and CD on a level ground. P and Q are two points on a straight road BD. The height of the tower AB is 20m and road BD is 200m

(a) A car moves from B towards D. At point P, the angle of depression of the car from point A is 11.3^{o}. Calculate the distance BP to 4 significant figures

(b) If the car takes 5 seconds to move from P to Q at an average speed of 36km/.hr. Calculate the angle of depression of Q from A to 2 decimal places

(c) Given that QC = 50.9m, calculate;

(i) the height of CD in metres to 2 decimal places

(ii) the angle of elevation of A from C to the nearest degree

24. Town B is 180 km on a bearing of 050^0 from town A. Another town C is on a bearing of 110^0 from town A and on a bearing of 150^0 from town B. A fourth town D is 240 km on a bearing of 320^0 from A. Without using a scale drawing, calculate to the nearest kilometer.

(a) The distance AC

(a) The distance CD

18.Common solids

1. The figure below represents a square based solid with a path marked on it

Sketch and label the net of the solid *

2. The below shows a solid prism:-

A

(a) Sketch the net of the prism above

(b) Use the net in **(a)** above to calculate the total surface area of the material used in making the solid

3. Draw the solid whose net is shown below.

4cm 4cm

4. Sketch the net of the solid shown in the figure below, measurements are in centimeters

19. Indices

1. Evaluate the value of x in
$81^{x+1} + 3^{4x} = 246.$

2. Solve for **y** in the equation:-
$5^{(2y+1)} = 4(5)^{y+1} - 15$

3. Without logarithm tables or calculators, evaluate: $\frac{25^{\frac{3}{4}} \text{ x } 0.9^2 \text{ x } 2^2}{5^{5/2} \text{ x } 3^3}$ in the form A/B where A and B are integers

4. Find the value of x given that :
$2^x = 0.0625$ (x is an integer)

6. Find the value of x which satisfies the equation $16^{x^2} = 8^{4x-3}$

7. Solve the equation;
$9^{x+1} + 3^{2x+1} = 36$

8. By letting **P** = 4^{-y} in the equation:
$4^{-2y+1} - 3 \text{ x } 4^{-y} - 10 = 0$
(a) Write the above equation in terms of **P**
(b) Hence find the possible values of **y**

9. Solve for **x** in the equation.

10. In the expansion of ${\mathbf{ax} - \frac{\mathbf{2}}{\mathbf{x^2}}}^{\mathbf{6}}$ the constant term is 4860. Find the value of **a**.

20. Reciprocals

1. Use reciprocal, square and square root tables to evaluate, to 4 significant figures, the expression.

$$\sqrt{\frac{1}{24.56} + 4.346^2}$$

(3 mks)

1. Use reciprocal table to evaluate giving your answer to three significant figures.
$\frac{10}{0.834} - \frac{3}{129.64}$

2. Find the reciprocals of the numbers 807 and 0.0591;
Hence evaluate $\frac{5}{807} + \frac{4}{0.0591}$

3. Use reciprocal tables to find the value of:

$$\frac{2}{0.6638} + \frac{5}{0.833}$$

4. Find without using a calculator, the value of :

$$\frac{12 \quad 0.0625 - 12.4 \div 0.4 \times 3}{{}^{1}/_{8} \text{ of } 2.56 + 8.68}$$

5. Use tables of cubes, cube roots and reciprocal to find the value of:-

$${}^{1}/_{3}$$

$$\frac{4}{(8.68)^3} + \frac{5}{34.46}$$

6. Determine the value of **a** for which $\frac{1}{127} + \frac{1}{11.5} = \frac{1}{a}$ Use mathematical tables only

7. Use tables of squares, square roots and reciprocals only to find the value of **x** correct to 4 significant figures:

8. Use reciprocal tables to find the value of ;

9. Use tables of reciprocals only to work out;

$$\frac{3}{0.6735} + \frac{13}{0.156}$$

10. Using tables of squares, cube roots and reciprocals find the value of **x**.

$$\frac{1}{x} = \frac{1}{0.002593^{1/3}} - \frac{1}{1.28^{2}}$$

21. Common Logarithms.

1. Use mathematical table to evaluate.

$$\frac{2849 \times 0.00574}{36.89 \div 0.023}$$

$\boxed{4}$

2. Given that $y = Bx^n$. Make n the subject of the formula and simplify your answer

3. Without using mathematical tables or calculators evaluate: $6\log_2 64 + 10\log_3 (243)$

4. Find the value of x that satisfies the equation $\log (2x - 11) - \log 2 = \log 3 - \log x$

5. Use logarithms to evaluate to 3 significant figures

$$(0.5241)^2 \times 83.59$$

$^{3}\ 0.3563$

6. Use logarithm tables in all your steps to evaluate:

leaving your answer to four decimal places

7. Make **L** the subject in :

H =

8. Using logarithm tables solve.

$$\frac{6.195 \times 11.82}{83.52}^{\boxed{\frac{1}{4}}}$$

9. Solve the simultaneous equation:-
Log (x-1) + 2log y = 2log3
log x + log y = log 6

10. Without using logarithms tables or calculator evaluate:-

$$\frac{4}{5}\log_{10}32 + \log_{10}50 - 3\log_{10} 2$$

11. Use logarithms to evaluate:-

$$\frac{6.598}{(0.9895)^2 \times 0.004974^{\,0.75}}$$ and express the answer in standard form

12. Solve for **x** given that :- log (3x + 8) – 3log2 = log (x-4)

13. In this question, show all the steps in your calculations, giving your answer at each stage.
Use logarithms correct to 4 decimal places to evaluate:

$$3\quad \frac{36.72 \times (0.46)^2}{185.4}$$

14. Use logarithms to evaluate correct to 4 s.f

$$\frac{\sin 44.5 \quad ^{\frac{1}{2}}}{\tan 14.90 \times \cos 82}$$

15. Without using logarithm tables evaluate:

$$\frac{3.264 \times 1.215 \times \ 12.25}{1.088 \times 0.4725}$$

16. Without using a calculator/mathematical tables, solve: $\text{Log}_8 (x + 5) – \log_8(x - 3) = \text{Log}_8 4$

17. Use tables to calculate ;$(6.57^2 + 6.57) \div (7.92^2 \times 30.08)$(Give your answer to 4 decimal places)

18. If $\log^2 = 0.30103$, and $\log^3 = 0.47712$, calculate without using tables or calculators the value of log120

19. Solve for x in the following equation; $\text{Log}_2(3x - 4) = \frac{1}{3} \log_2 8x^6 – \log_2 4$

20. By showing all the steps, use logarithms to evaluate: $\frac{5.627 \times (0.234)^3}{(8.237)^{½}}$

21. Solve the logarithimic equation: $\log_{10} (6x – 2) – 1 = \log_{10} (x-3)$

22. In this question, show all the steps in your calculations, giving your answers at each stage. Use logarithms, correct to 4 d.p to evaluate:-

$$\frac{(0.07526)^2}{3\ 1.789 + 4.863}$$

23. Evaluate using logarithms

$$\frac{4.283 \times (0.009478)^2}{\text{Log } 9.814}$$

22. Equations of straight lines

1. A solid right pyramid has a rectangular base 10cm by 8cm and slanting edge 16cm. calculate:
   (a) The vertical height
   (b) The total surface area
   (c) The volume of the pyramid

2. The line passing through the points A (-1, 3K) and B (K, 3) is parallel to the line whose equation is **2y + 3*x* = 9**. Write down the co-ordinates of A and B

3. Find the value of **a** if the gradient of the graphs of the function $y = x^2 - x^3$ and $y = x - ax$ are equal at $x = {}^1/_3$

4. Two perpendicular lines meet at the point (4,5). If one of the lines passes through the point (-2,1), determine the equation of the second line in the form ax + by + c =0.

5. Find the equation of the line passing through (-5, 2) and with X-intercept as 3. Leave your answer in the form of **Y = m*X* + C**

6. (a) copy and complete the table below:

x	0	1	2	3	4	5	6
$y = 2x - 4$							
$y = 12 - 2x$							

(b) (i) On the grid provided and using the same axes, draw the lines $y = 2x + 4$ and $y = 12 - 2x$

(ii) Hence use your graphs to solve the simultaneous equations

$\frac{1}{2}x - \frac{1}{4}y = 1$
$x + \frac{1}{2}y = 6$

(c) By use of substitution method, solve the simultaneous equations;

$6x + 4y = 36$
$x + 3y = 13$

7. Find the equation of a line through point -2, 4 which is parallel to $3y =- 2x + 8$. Express your answer in the form $y = mx + c$.

8. Determine the equation of a line passing through (-1, 3) and parallel to the line whose equation is $3x -5y = 10$

9. On a certain map, a road 20km long is represented by a line 4cm long. Calculate the area of a rectangular plot represented by dimensions 2.4cm by 1.5cm on this map – leaving your answer in hectares

10. A straight line passing through point (-3,4) is perpendicular to the line whose equation is $2y-5x=11$ and intersects the x-axis and y-axis at the points P and Q respectively. Find the co-ordinates of P and Q

11. A triangle ABC is formed by the points A(3, 4), B(-7, 2) and C(1, -2)
(a) Find the co-ordinates of the mid-points K of AB and P of AC
(b) Find the equation of the perpendicular bisector of the KP

12. The equation of line L_1 is $^{-3}/_{5}x + 3y = 6$. Find the equation of a line L_2 passing through point T (1, 2) and perpendicular to line L_1

13. Determine the equation of a line passing through (-1, 3) and parallel to the line whose equation is $3x -5y = 10$

14. A straight line through the points A (2, 1) and B (4, m) is perpendicular to the line, whose equation is $3y = 5-2x$. Determine the value of **m**

15. Determine the equation of a line which is perpendicular to the line $2x + 3y + 4 = 0$ and passes through P(1,1)

16. Koech bought 144 pineapples at shs.100 for every six pineapples. She sold some of them at shs.72 for every three and the rest at shs.60 for every two. If she made a profit of 40%; Calculate the number of pineapples sold at 72 for every three

17. Solve the equation $\frac{x + 2}{3} - \frac{x - 1}{2} = 5$

23. Reflection and Congruence

1. Given that A' (3, -3) is the image of A (-1, -5) under a reflection. Find the equation of the mirror line in the form of $ax+by+c=0$ (4 mks)

1. Three planes **A**, **B** and **C** leave an airport **P** simultaneously at 9.30a.m. Plane **A** flies on a bearing of 070° from P at a speed of 400km/h. Plane **B** flies on a bearing of 290°at a speed of 500km/h. Plane C flies on a bearing of 162° from **P** at a speed of 300km/h. (***Use scale drawing for this questio***n)
   (a) Show by scale drawing, the relative positions of the 3planes A, B and C three hours after leaving airport P. (Use scale 1cm represents 200km)
   (b) After 3 hours, **B** turns and head straight to the current position of **A** at the same speed it had. Determine the scale drawing , the time it takes to reach this point, to the nearest minute
   (c) Determine the bearing and distance of **B** from **C** after the first 3 hours of flight after leaving **P**

24. Rotation

1. The ratio of the lengths of the corresponding sides of two similar rectangular water tanks is 3: 5. The volume of the smaller tank is 8.1m^3. Calculate the volume of the larger tank

25. Similarities and Enlargement

1. Two tanks are similar in shape. The capacity of the tanks are 1,000,000 litres and 512, 000 litres respectively.
   (a) Find the height of the smallest tank if the larger is 300cm tall (4 mks)
   (b) Calculate the surface area of the larger tank if the smaller tank has a surface area of 1200m^2 (3 mks)
   (c) Estimate the mass of the smaller tank if the mass of the larger one is 800kg (3 mks)

1. The image of P(0,2) under an enlargement with a scale factor 3 is P^1 (4,6). Find the co-ordinates of Q

2. A model of a building is made using a scale 1:500.
   (a) Find the height of a room (in meteres) in the building which is 5cm long on the model?***S*******
   (b) A room has a floor area of 36m^2. What is the corresponding area on the floor of the model
   (c) A room has a volume of 120m^3. What is the corresponding volume of the model in cm^3?***S*******
3. In the triangle ABD, BA is parallel, to CE, given that BA= 9cm, CE = 4cm and AE =3cm, find the length of DE

4. In the following figure, PR = 12cm, TR = 4cm and ST is parallel to QR. Given that the area of triangle PQR is 336cm^2, find the area of quadrilateral QRTS

5. Two dogs regarded similar with the length in ratio 4:3:-
(a) If the bigger dog has a tail 64cm long, find the length of the tail of the smaller dog
(b) If the smaller dog requires 810g of meat per day how much meat per day does the bigger dog require

6. In the figure below, ADE is a triangle and BC is parallel to DE, AB, BD and BC are 4cm, 3cm and 8cm respectively.

Find the length of DE

7. The surface area of two similar bottles are 12cm^2 and 108cm^2 respectively. If the larger one has a volume of 810cm^3. Find the volume of the smaller one

8. Given that the area of the trapezium CDEB is 15.6 cm^2, find the length EA marked X.

26. The Pythagoras theorem

1. The angle of elevation of the top of a tree from a point P on the horizontal ground is 24.5°. From another point Q, five metres nearer to the base of the tree, the angle of elevation of the top of the tree is 33.2°. Calculate to one decimal place, the height of the tree

2. A block of wood in the shape of a frustrum of a cone of slanting edge 30 cm and base radius 10cm is cut parallel to the base, one third of the way from the base along the slanting edge. Find the ratio of the volume of the cone removed to the volume of the complete cone.

27. The Trigometric Ratio 1

1. At point A, David observed the top of a tall building at an angle of 30^o. After walking for 100meters towards the foot of the building he stopped at point B where he observed it again at an angle of 60^o. Find the height of the building

2. Find the value of θ, given that ½ sinθ = 0.35 for $0^o \leq \theta \leq 360^o$

3. A man walks from point **A** towards the foot of a tall building 240 m away. After covering 180m, he observes that the angle of elevation of the top of the building is 45^o. Determine the angle of elevation of the top of the building from **A**

4. The table below gives a field book showing the results of a survey of a section of a piece of land between A and E. All measurements are in metres.

	E	
D33	95	
	90	**F** 36
C21	70	
B 42	30	**G** 25
	25	**H** 40
	A	

(a) Draw a sketch of the land.
(b) Calculate the area of this piece of land.

5. Solve for x in 2 $Cos2x^0 = 0.6000$ $0^0 \leq x \leq 360^0$.

6. Wangechi whose eye level is 182cm tall observed the angle of elevation to the top of her house to be 32° from her eye level at point A. she walks 20m towards the house on a straight line to a point B at which point she observes the angle of elevation to the top of the building to the 40°. Calculate, correct to 2 decimal places the ;
a)distance of A from the house
b) The height of the house

7. Given that cos A = $^{5}/_{13}$ and angle A is acute, find the value of:-
2 tan A + 3 sin A

8. Given that tan 5° = 3 + 5, without using tables or a calculator, determine tan 25°, leaving your answer in the form a + b c

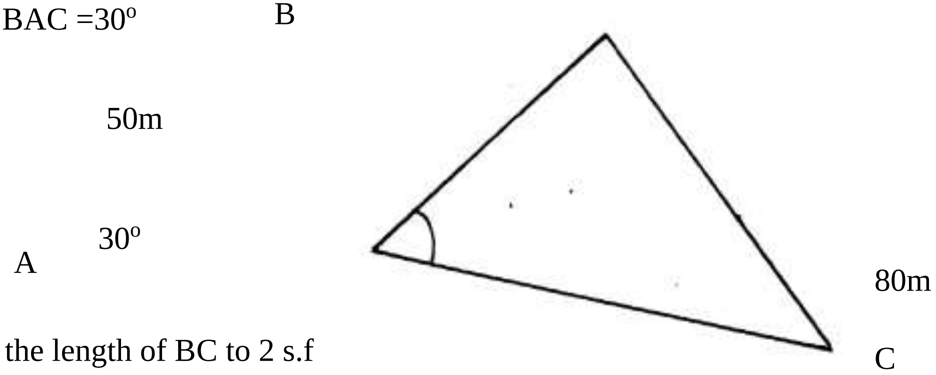
9. A student whose eye level is 182cm from the ground observed the top of their house at an angle of elevation of 32° at point **A**. She walked for 20m towards the house along a straight road to a point **B**, where she observed the top of the building again at an angle of elevation of 40°. Calculate correct to 2 decimal places the:-
(a) Distance of **A** from the house
(b) The height of the house

10. Given that tan **x** = $\frac{5}{12}$, find the value of the following without using mathematical tables or calculator:
(a) Cos x
(b) $\sin^2(90-x)$

11. If tan θ =$^{8}/_{15}$, find the value of $\frac{\mathbf{\sin\theta - \cos\theta}}{\mathbf{\cos\theta + \sin\theta}}$ without using a calculator or table

28. Area of a triangle

1. The figure below represents a triangular plot ABC. The lengths of AB = 50m, AC = 80m and angle BAC =30°



(a) Find the length of BC to 2 s.f
(b) Find the area of the plot in hectares
(c) The plot is fenced using 4 strands of barbed wire. The length of one roll of barbed wire is 600m and it costs shs.4000. Calculate;
(i) The length of fencing wire required
(ii) The number of complete rolls to be bought
(iii) The cost of the rolls

29. Area of polygons

1. Find the area of a regular polygon of length 10 cm and side **n**, given that the sum of interior angles of **n : n –1** is in the ratio 4 : 3.

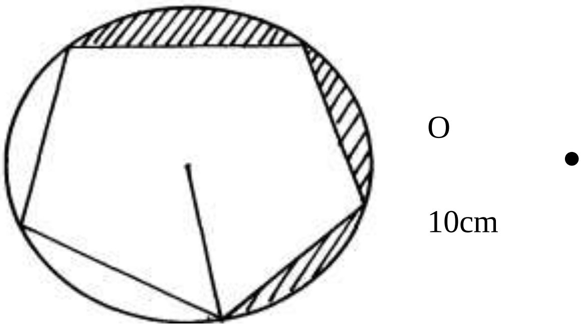
2. Calculate the area of the quadrilateral ABCD shown:-

30. Area of part of a circle

1. The ends of the roof of a workshop are segments of a circle of radius 10m. The roof is 20m long. The angle at the centre of the circle is 120^o as shown in the figure below:

(a) **Calculate :-**
  (i) The area of one end of the roof
  (ii) The area of the curved surface of the roof
(b) What would be the cost to the nearest shilling of covering the two ends and the curved surface with galvanized iron sheets costing shs.310 per square metre

2. The diagram below, not drawn to scale, is a regular pengtagon circumscribed in a circle of radius 10cm at centre O

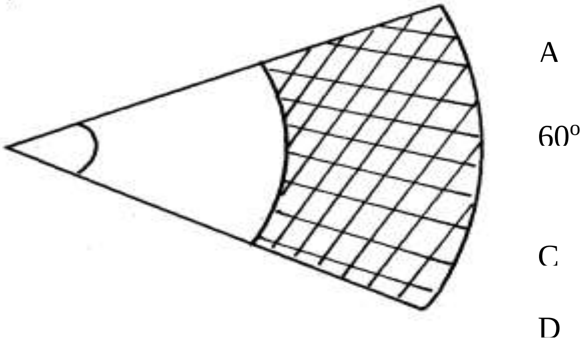


Find;
(a) The side of the pentagon
(b) The area of the shaded region

3. Triangle **PQR** is inscribed in he circle **PQ**= 7.8cm, **PR** = 6.6cm and **QR** = 5.9cm. Find:

(a) The radius of the circle, correct to one decimal place
(b) The angles of the triangle
(c) The area of shaded region

4. The figure below represents sector OAC and OBD with radius OA and OB respectively. Given that OB is twice OA and angle AOC = 60°. Calculate the area of the shaded region in m^2, given that OA = 12cm



31. Surface Area of Solids

1. A swimming pool water surface measures 10m long and 8m wide. A path of uniform width is made all round the swimming pool. The total area of the water surface and the path is $168m^2$

(a) Find the width of the path (4 mks)

(b) The path is to be covered with square concrete slabs. Each corner of the path is covered with a slab whose side is equal to the width of the path. The rest of the path is covered with slabs of side 50cm. The cost of making each corner slab is sh 600 while the cost of making each smaller slab is sh.50. Calculate

(i) The number of the smaller slabs used (4 mks)

(ii) The total cost of the slabs used to cover the whole path (2 mks)

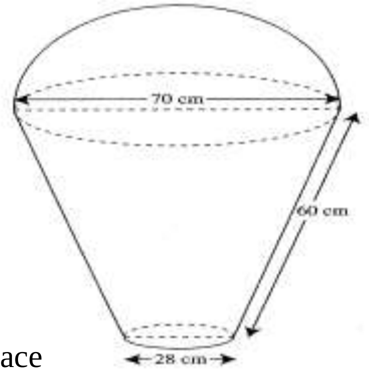
1. A lampshade is in the form of a frustrum of a cone. Its bottom and top diameters are 12cm and 8cm respectively. Its height is 6cm.Find;
(a) The area of the curved surface of the lampshade

(b) The material used for making the lampshade is sold at Kshs.800 per square metre.
Find the cost of ten lampshades if a lampshade is sold at twice the cost of the material

2. A cylindrical piece of wood of radius 4.2cm and length 150cm is cut lengthwise into two equal pieces. Calculate the surface area of one piece

3. The base of an open rectangular tank is 3.2m by 2.8m. Its height is 2.4m. It contains water to a depth of 1.8m. Calculate the surface area inside the tank that is not in contact with water

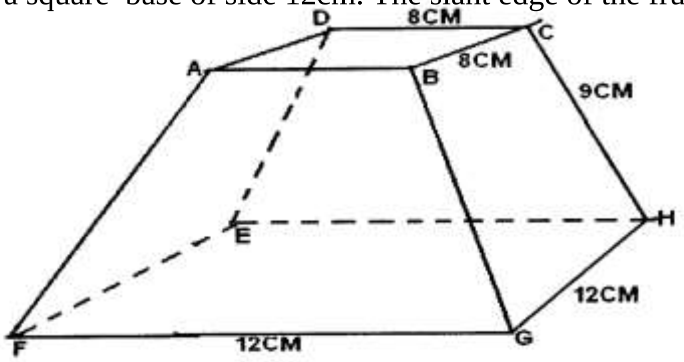
4. The figure below represents a model of a solid structure in the shape of frustrum of a cone with a hemisphere top. The diameter of the hemispherical part is 70cm and is equal to the diameter of the top of the frustrum. The frustrum has a base diameter of 28cm and slant height of 60cm.



Calculate :
(a) the area of the hemispherical surface
(b) the slant height of cone from which the frustrum was cut
(c) the surface area of frustrum
(d) the area of the base
(e) the total surface area of the model

5. A room is 6.8m long, 4.2m wide and 3.5m high. The room has two glass doors each measuring 75cm by 2.5m and a glass window measuring 400cm by 1.25m. The walls are to be painted except the window and doors.
a) Find the total area of the four walls
b) Find the area of the walls to be painted
c) Paint **A** costs Shs.80 per litre and paint **B** costs Shs.35 per litre. 0.8 litres of **A** covers an area of 1m^2 while 0.5m^2 uses 1 litre of paint **B**. If two coats of each paint are to be applied. Find the cost of painting the walls using:
i) Paint **A**
ii) Paint **B**
d) If paint A is packed in 400ml tins and paint B in 1.25litres tins, find the least number of tins of each type of paint that must be bought.

6. The figure below shows a solid frustrum of pyramid with a square top of side 8cm and a square base of side 12cm. The slant edge of the frustrum is 9cm



Calculate:
(a) the total surface area of the frustrum
(b) the volume of the solid frustrum
(c) the angle between the planes BCHG and the base EFGH.

32. Volume of solids

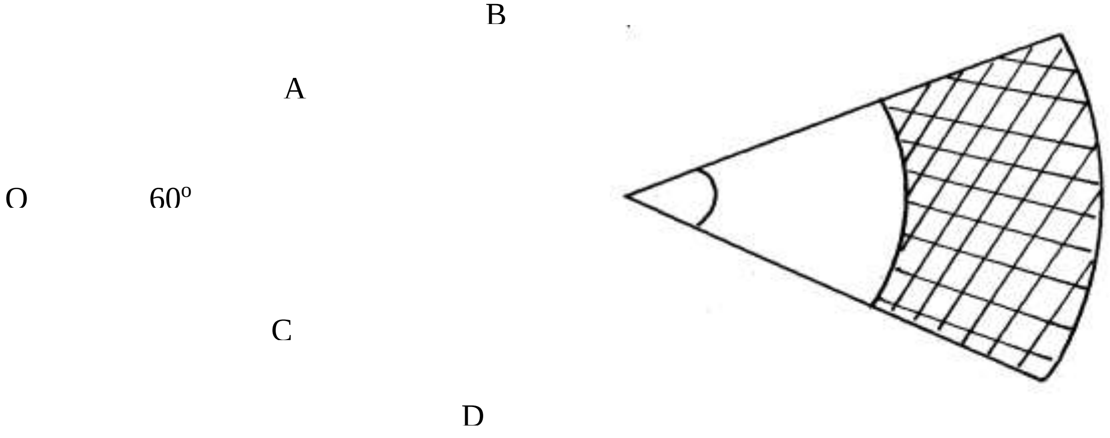
1. Metal cube of side 4.4cm was melted and the molten material used to make a sphere. Find to 3 significant figures the radius of the sphere $\left(take\ \prod = \frac{22}{7}\right)$ (3 mks)

1. A solid right pyramid has a rectangular base 10cm by 8cm and slanting edge 16cm. calculate:
   (a) The vertical height
   (b) The total surface area
   (c) The volume of the pyramid

2. A solid cylinder of radius 6cm and height 12cm is melted and cast into spherical balls of radius 3cm. Find the number of balls made

3. The sides of a rectangular water tank are in the ratio 1: 2:3. If the volume of the tank is $1024cm^3$. Find the dimensions of the tank. (4s.f)

4. The figure below represents sector OAC and OBD with radius OA and OB respectively. Given that OB is twice OA and angle AOC = 60°. Calculate the area of the shaded region in m^2, given that OA = 12cm



5. The figure below shows a closed water tank comprising of a hemispherical part surmounted on top of a cylindrical part. The two parts have the same diameter of 2.8cm and the cylindrical

part is 1.4m high as shown:-

(a) Taking $\pi = \frac{22}{7}$, calculate:

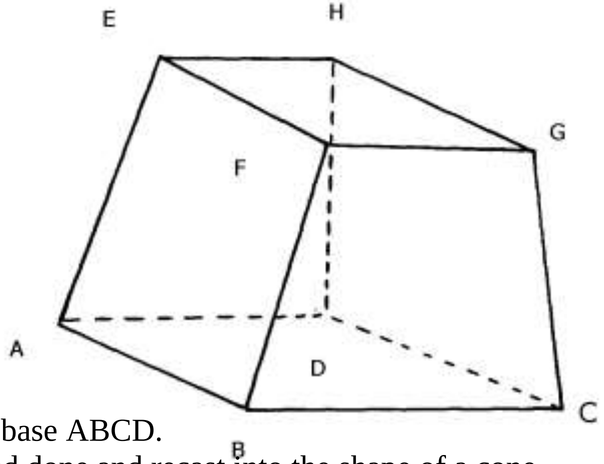
(i) The total surface area of the tank

(ii) the cost of painting the tank at shs.75 per square metre

(iii) The capacity of the tank in litres

(b) Starting with the full tank, a family uses water from this tank at the rate of 185litres/day for the first 2days. After that the family uses water at the rate of 200 liters per day. Assuming that no more water is added, determine how many days it takes the family to use all the water from the tank since the first day

6. The figure below represents a frustrum of a right pyramid on a square base. The vertical height of the frustrum is 3 cm. Given that EF = FG = 6 cm and that AB = BC = 9 cm



Calculate;

a) The vertical height of the pyramid.

b) The surface area of the frustrum.

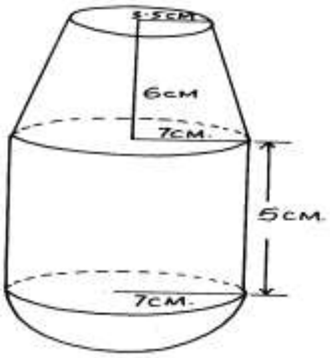
c) Volume of the frustrum.

d) The angle which line AE makes with the base ABCD.

7. A metal hemisphere of radius 12cm is melted done and recast into the shape of a cone of base radius 6cm. Find the perpendicular height of the cone

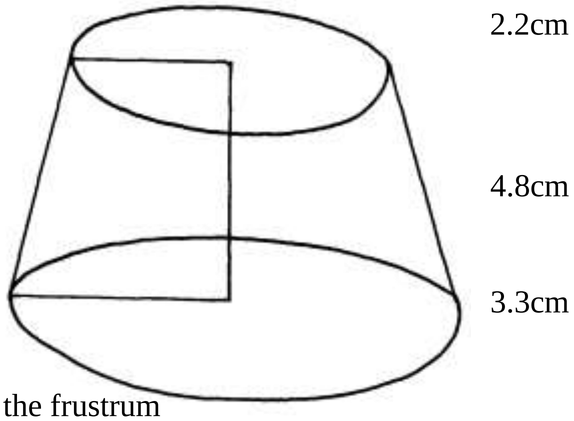
8. A solid consists of three discs each of 1½ cm thick with diameter of 4 cm, 6 cm and 8 cm respectively. A central hole 2 cm in diameter is drilled out as shown below. If the density of material used is 2.8 g/cm^3, calculate its mass to 1 decimal place

9. A right conical frustrum of base radius 7 cm and top radius 3.5 cm and height 6 cm is stuck onto a cylinder of base radius 7 cm and height 5 cm which is further attached to form a closed solid as shown below.



Find;
a) The volume of the solid.
b) The surface area of the solid.

10. The figure below shows a frustrum



Find the volume of the frustrum

11. The diagram below shows a metal solid consisting of a cone mounted on hemisphere. The height of the cone is 1½ times its radius;

Given that the volume of the solid is 31.5π cm^3, find:
(a) The radius of the cone
(b) The surface area of the solid
(c) How much water will rise if the solid is immersed totally in a cylindrical container which

contains some water, given the radius of the cylinder is 4cm

(d) The density, in kg/m^3 of the solid given that the mass of the solid is 144gm

12. A solid metal sphere of volume 1280 cm^3 is melted down and recast into 20 equal solid cubes. Find the length of the side of each cube.

13. The figure below shows a frustrum cut from a cone

Calculate the volume of the frustrum

33. Quadratic equations

1. In a triangle ABC, angle B is 90°. Find the value of x and hence the area of the triangle

2. Solve the following inequalities and represent the solution on a number line hence state the integral values **$7x - 4 \le 9x + 2 < 3x + 14$**

34. Linear inequalities

1. Find without using a calculator, the value of :

$$\frac{12\ \ 0.0625 - 12.4 \div 0.4 \text{ x } 3}{{}^{1}/_{8} \text{ of } 2.56 + 8.68}$$

2. Solve and write down all the integral values satisfying the inequality.

$X - 9 \leq -4 < 3x - 4$

3. Solve the inequality and show the solution on the number line.

$3 - 2x \angle x \angle \underline{2x + 5}$

4. Show on a number line the range of all integral values of ***x*** which satisfy the following pair of inequalities:

$3 - x \leq 1 - \frac{1}{2} x$

$-\frac{1}{2}(x-5) \leq 7 - x$

5. Solve the inequalities $\mathbf{4x - 3 \leq 6x - 1 < 3x + 8}$; hence represent your solution on a number line

6. Find all the integral values of **x** which satisfy the inequalities

$2(2-x) < 4x - 9 < x + 11$

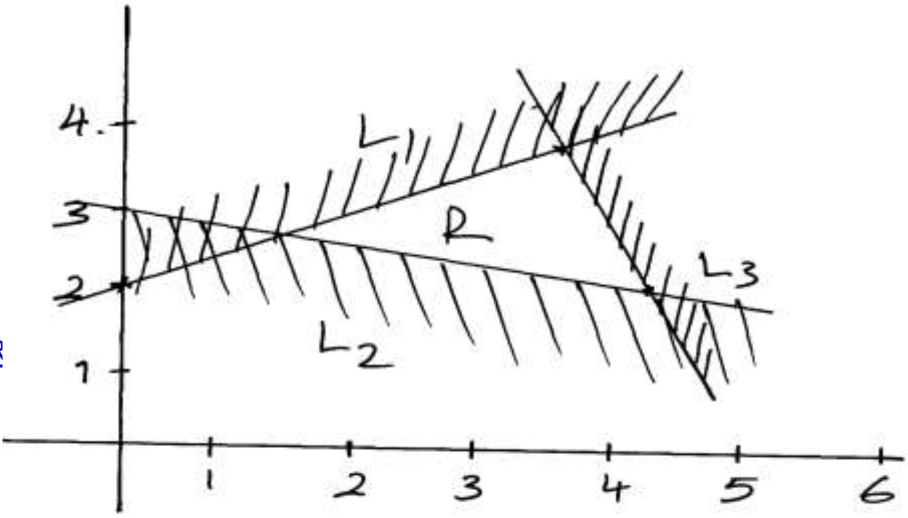
7. Find the inequalities that define the unshaded region

8. Given that $x + y = 8$ and $x^2 + y^2 = 34$

Find the value of:- a) $x^2 + 2xy + y^2$

b) $2xy$

9. Find the inequalities satisfied by the region labelled **R**



10. The region R is defined by $x \geq 0$, $y \geq -2$, $2y + x \leq 2$. By drawing suitable straight line on a sketch, show and label the region R

11. Find all the integral values of ***x*** which satisfy the inequality
$3(1+ x) < 5x - 11 < x + 45$

12. The vertices of the unshaded region in the figure below are O(0, 0) , B(8, 8) and A (8, 0). Write down the inequalities which satisfy the unshaded region

35. Angle Properties of Circles

1. Two circles of radii 4cm and 6cm intersect as shown below. If angle XBY = 30^o and angle XAY = 97.2^o.
Find the area of the shaded part.
(Take = $\pi \frac{22}{7}$)

2. In the diagram, O is the centre of the circle and AD is parallel to BC. If angle ACB $=50^o$ and angle ACD $= 20^o$.

Calculate; (i) ∠OAB

(ii) ∠ADC

3. Two intersecting circles have centres S and R. Given that their two radii are 28cm and 35cm, their common chord AB = 38cm and angles ASB = 85.46° and ARB = 65.76°,

Calculate the shaded area

4. In the figure below ABCD is a cyclic quadrilateral in which AD = DC and AB is parallel to CD. Given that angle ABC = 80°, Find the size of:

a) ∠DAC

b) ∠BAC

c) ∠BCD

5. Line QR = 6.5cm is given below:-(***Do not use a protractor for this question***)

(a) Draw triangle PQR such that **p** lies above line QR, ∠ PQR = 30° and PQ = 7cm

(b) By accurate construction on the diagram above, show the locus of a point which lies within the triangle such that:-

(i) T is more than 2.5cm from line PQ
and
(ii) T is not more than 4.5cm from Q
Shade the region in which **T** lies

(c) Lines QP and QR are produced to K and M respectively

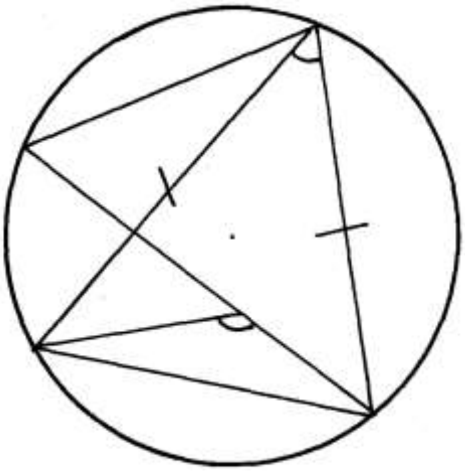
(i) Show by construction on the diagram above, the locus of a point C which is equidistant from each of the lines PK, PR and RM

(ii) With centre C and an appropriate radius, draw a circle to touch each of the lines PK, PR and RM only once

Measure the radius

What name is given to the circle drawn in **(c)** **(ii)** with respect to triangle QPR

6. The figure below shows a circle centre **O** and a cyclic quadrilateral ABCD. AC = CD, angle ACD is 80° and BOD is a straight line. Giving reasons for your answer, find the size of :-



(i) Angle ACB

(ii) Angle AOD

(iii) Angle CAB

(iv) Angle ABC

(v) Angle AXB

7. The figure below shows two circles of equal radius of 9 cm with centres A and B. Angle CAD = 80°

a) Calculate the area of:-

i) The sector CAD.

ii) The triangle CAD.

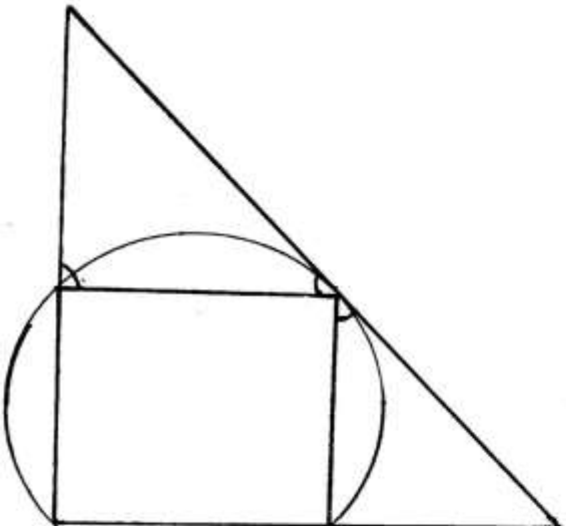
iii) The shaded region.

8. In the diagram below, ∠QOT is a diameter. ∠QTP = 48°, ∠TQR = 46° and ∠SRT = 37°

Calculate, giving reasons in each case:-
(a) ∠RST
(b) ∠SUT
(c) ∠ROT
(d) ∠PST
(e) Reflex ∠SOP

9. The diagram below shows a circle with a chord PQ= 3.4cm and angle PRQ=40°. Calculate the area of the shaded segment.

10. The figure below shows circle ABCD. The line EDF is a tangent to the circle at D. ∠ADF = 70° ∠FAD = 65° and ∠CDE = 35°



35°

B C E

Find the values of the following angles, stating your reasons in each case

(a) ∠ABC

(b) ∠BCD

(c) ∠DCE

(d) ∠ACD

10. In the figure below BD is the diameter of the circle and O is the centre.

F

B E O 33° D

Find the size of

(a) ∠ADC

(b) ∠ AEB

48°

C

36. Vectors

1. Given that $4p-3q=\begin{pmatrix}10\\5\end{pmatrix}$ and $p+2q=\begin{pmatrix}-14\\15\end{pmatrix}$ find

a) (i) $\underset{-}{p}$ and $\underset{-}{q}$ (3 mks)

(iv) $|p+2q|$ (3 mks)

(b) Show that A (1, -1), B (3, 5) and C (5, 11) are collinear (4 mks)

1. The position vectors of points x and y are $x=2i+j-3k$ and $y=3i+2j-2k$ respectively. Find x y as a column vector (2 mks)

1. Express in surds form and rationalize the denominator.

$$\frac{1}{\text{Sin } 60^\circ \text{ Sin } 45^\circ - \text{ Sin } 45^\circ}$$

2. If OA = 12i + 8j and OB = 16i + 4j. Find the coordinates of the point which divides **AB** internally in the ratio1:3

3. Find scalars **m** and **n** such that

$$\mathbf{m}\begin{pmatrix}4\\3\end{pmatrix} + \mathbf{n}\begin{pmatrix}-3\\2\end{pmatrix} = \begin{pmatrix}5\\8\end{pmatrix}$$

4. In a triangle OAB, M and N are points on OA and OB respectively, such that OM: MA = 2:3 and ON: NB = 2:1. **AN** and **BM** intersect at X. Given that $O\underset{\sim}{A}$ = a and $O\underset{\sim}{B}$ = b

(a) Express in terms of $\underset{\sim}{a}$ and b
  (i) BM
  (ii) AN
(b) By taking **BX** = t and **AX** = **h AN**, where **t** and **h** are scalars, express **OX** in two different ways
(c) Find the values of the scalars **t** and **h**
(d) Determine the ratios in which **X** divides :-
  (i) **BM**
  (ii) **AN**

5. OABC is a parallelogram, M is the mid-point of OA and AX = $^2/_7$ AC, $O\underset{\sim}{A}$=a and $O\underset{\sim}{C}$ = c

(a) Express the following in terms of $\underset{\sim}{a}$ and c
  (i) MA
  (ii) AB
  (iii) AC
  (iv) AX
(b) Using triangle MAX, express MX in terms of a and c
(c)The co-ordinates of A and B are (1, 6, 8) and (3, 0, 4) respectively. If O is the origin and P

the midpoint of AB. Find;
(i) Length of OP
(ii) How far are the midpoints of OA and OB?

6. a) If A, B & C are the points (2, - 4), (4, 0) and (1, 6) respectively, use the vector method to find the coordinates of point D given that ABCD is a parallelogram.
b) The position vectors of points P and Q are **p** and **q** respectively. R is another point with position vector r = $^3/_2$ q - ½ p. Express in terms of P and q
(i) PR
(ii) PQ, hence show that P, Q & R are collinear.
(iii) Determine the ratio PQ : QR

7. The figure shows a triangle of vectors in which OS: SP = 1:3, PR:RQ = 2:1 and T is the midpoint of OR

a) Given that OP = p and OQ = q, express the following vectors in terms of P and q
i) OR
ii) QT
b) Express **TS** in terms of **p** and **q** and hence show that the points **Q, T** and **S** are collinear
c) M is a point on OQ such that OM = KOQ and PTM is a straight line. Given that PT: TM = 5:1, find the value of **k**

8. Given that a = , b = and c = and that p = 3q – ½ b +$^1/_{10}$c
Express **p** as a column vector and hence calculate its magnitude /P/ correct to two decimal places

9. In a triangle OAB, M and N are points on OA and OB respectively, such that OM:MA= 2:3 and ON:NB= 2:1. AN and BM intersect at X. Given that OA = **a** and OB = **b**
(a) Express in terms of **a** and **b**:-
(i) BM
(ii) AN
(b) Taking BX = kBM and AX =hAN where **k** and **h** are constants express OX in terms of
(i) **a, b** and **k** only
(ii) **a, b**, and **h** only
(c) Use the expressions in **(b)** above to find values of **k** and **h**

.

10. In the figure below OAB is a triangle in which M divides OA in the ratio 2:3 and N divides OB in the ratio 4:1. AN and BM intersects at X

(a) Given that OA = $\underset{\sim}{a}$ and OB = $\underset{\sim}{b}$, express in terms of $\underset{\sim}{a}$ and $\underset{\sim}{b}$

(i) AN

(ii) BM

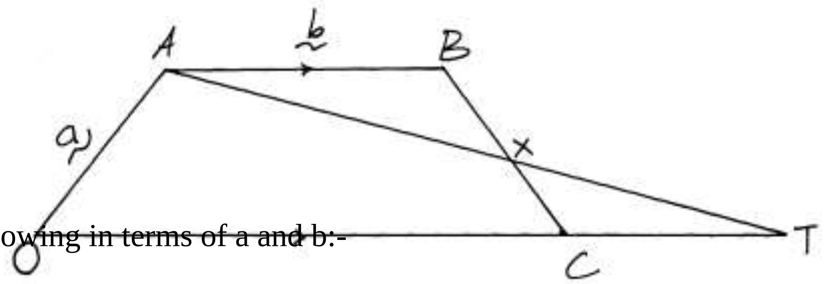
(iii) AB

(b) If AX = sAN and BX = tBM, where **s** and **t** are constants, write two expressions for OX in terms of **a**, **b**, **s** and **t**. Find the value of **s** and **t** hence write OX in terms of **a** and **b**

11. A student traveling abroad for further studies sets a side Kshs. 115800 to be converted into US dollars through a bank at the rate of 76.84 per dollar. The bank charges a commission of 2 ½ % of the amount exchanged. If he plans to purchase text books and stationery worth US$270, how much money, to the nearest dollar, will he be left with?

12. Given that:- r = 5i – 2j and m = -2i + 6j – k are the position vectors for R and M respectively. Find the length of vector RM

13. OABC is a trapezium in which OA = a and AB = b. AB is parallel to OC with 2AB = OC. T is a point on OC produced so that OC: CT = 2:1. At and BC intersect at X so that BX = hBC and AX = KAT



(a) Express the following in terms of a and b:-

(i) OB

(ii) BC

(b) Express **CX** in terms of a, b and h

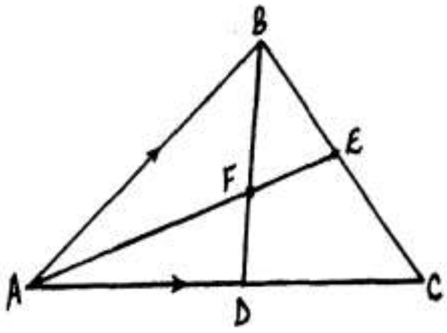
(c) Express **CX** in terms of a, b and k

(d) Hence calculate the values of h and **k**

14. Given that $\underset{\sim}{\mathbf{a}}$ = **2i + j – 2k** and $\underset{\sim}{\mathbf{b}}$ = **-3i + 4j – k** find :-

| a + b|.

15. In the figure below, **E** is the mid-point of **BC**. **AD**:**DC**=3:2 and **F** is the meeting point of **BD** and **AE**



If **AB = b** and **AC = c;**

(i) Express **BD** and **AE** in terms of **b** and **c**

(ii) If **BF =*t*BD** and **AF =*n*AE**, find the values of ***t*** ad ***n***

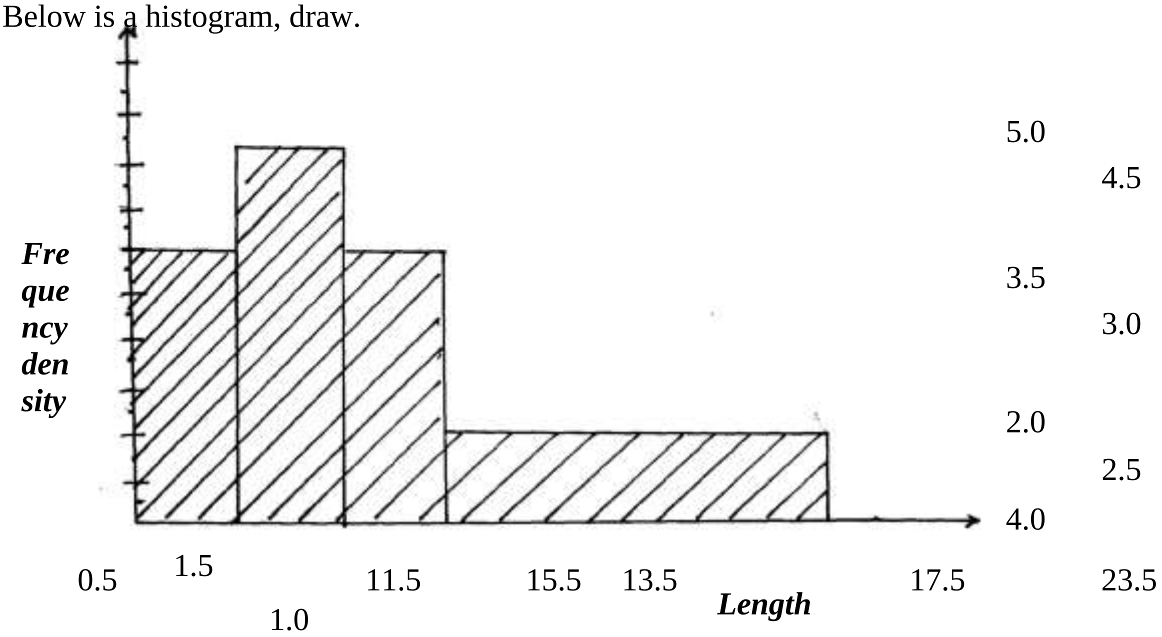
(iii) State the ratios in which **F** divides **BD** and **AE**

16. The coordinates of point **O, A, B** and **C** are (**0, 0) (3, 4) (11, 6)** and **(8, 2)** respectively. A point **P** is such that the vector **OP, BA, BC** satisfy the vector equation **OP = BA + ½ BC** Find the coordinates of **P**

17. A point Q divides AB in the ratio 7:2. Given that A is (-3, 4) and B(2, -1). Find the co-ordinates of Q

37. Representation of data

1. Below is a histogram, draw.



Use the histogram above to complete the frequency table below:

Length	Frequency
11.5 ≤ x ≤13.5	
13.5 ≤ x ≤15.5	
15.5 ≤ x ≤ 17.5	
17.5 ≤ x ≤23.5	

2. Wambui spent her salary as follows:

Food	40%
Transport	10%
Education	20%
Clothing	20%
Rent	10%

Draw a pie chart to represent the above information

2. The examination marks in a mathematics test for 60 students were as follows;-

60	54	34	83	52	74	61	27	65	22
70	71	47	60	63	59	58	46	39	35
69	42	53	74	92	27	39	41	49	54
25	51	71	59	68	73	90	88	93	85
46	82	58	85	61	69	24	40	88	34
30	26	17	15	80	90	65	55	69	89

Class	**Tally**	**Frequency**	**Upper class limit**
10-29			
30-39			
40-69			
70-74			
75-89			
90-99			

From the table;

(a) State the modal class

(b) On the grid provided , draw a histogram to represent the above information

4. The marks scored by 200 from 4 students of a school were recorded as in the table below.

Marks	41 – 50	51 – 55	56 – 65	66 – 70	71 – 85
Frequency	21	62	55	50	12

(a) On the graph paper provided, draw a histogram to represent this information.

(b) On the same diagram, construct a frequency polygon.

(c) Use your histogram to estimate the modal mark.

5. The diagram below shows a histogram representing the marks obtained in a certain test:-

(a) If the frequency of the first class is 20, prepare a frequency distribution table for the data

(b) State the modal class

(c) Estimate: (i) The mean mark
(ii) The median mark

6. The data below shows the number of sessions different subjects are taught in a week.

Draw a pie chart to show the data:

Subject	Eng	Maths	Chemistry	C.R.E
No. of sessions	8	7	4	3

7. The height of 50 athletes in Moi University team were shown below:

Height (cm)	150-159	160-169	170-179	180-189	190-199	200-209
Frequency	2	9	12	16	7	4

i) State the modal class

ii) Calculate the median height of the athletes

8. The table below shows the length of 40 mango tree leaves;

Length (mm)	Frequency	Cumulative frequency
118-126	3	3
127-135	4	7
136-144	10	17
145-153	12	29
154-162	5	34
163-171	4	38
172-180	2	40

(a) Determine the;
  (i) Modal class
  (ii) Median class
(b) Calculate; (i) the mean of the leaves
(ii) the median of the leaves

38. Measures of central tendency

1. The results of a mathematics test that a hundred students took are as shown below:-

Marks	No. of students

30-34	4
35-39	6
40-44	10
45-49	14
50-54	**X**
55-59	24
60-64	14
65-69	6

(a) Determine (i) the value of **X**
(ii) The modal class
(b) Calculate the mean
(c) The median

2. Without using logarithms or calculator evaluate:

$$2\log_{10}5 - 3\log_{10}2 + \log_{10}32$$

3. The table below shows heights of 50 students :-

Height (cm)	**Frequency**
140-144	3
145-149	15
150-154	19
155-159	11
160-164	2

(a) State the modal class
(b) Calculate the median height

4. In an experiment, the height of 100 seedlings were measured to the nearest centimeter and the results were recorded as shown below;

Height (cm)	20-24	25-29	30-34	35-39	40-44	45-49
Frequency	3	19	25	20	18	15

Calculate the median height

5. Given that x = -4 is a root of the equation $2x^2 + 6x - 2k = 0$; Find;
(a) the value of **k**
(b) the second root

Marks	60 – 62	63 – 68	69 – 73	74 – 80
Frequency	10	20	40	15

7. The table below shows the distribution of marks obtained by some candidates in a mathematics test

Marks	30-39	40-49	50-59	60-69	70-79	80-89	90-99
No. of candidates	2	3	10	12	8	3	2
c.f							

a) state the total number of candidates who sat the test
b) state the modal class
c) calculate the mean mark using an assumed mean of 64.5 marks
d) calculate the median mark

8. Find these statistics of the following data 4, 2, 2, 6, 1, 3, 4, 1, 4
a) Mode
b) Median
c) Mean

9. (a) The marks scored by a group of form two students in a mathematical test were as recorded in the table below:-

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	1	2	4	7	10	16	20	6	3	1

(a) (i) State the modal class
(ii) Determine the class in which the median mark lies
(iii) Using an assumed mean of 54.5, calculate the mean mark

10. Six weeks after planting, the height of maize plants were measured correct to the nearest centimeter. The frequency distribution is given in the table below:

Height (x)	$0 \leq x < 4$	$4 \leq x < 8$	$8 \leq x < 12$	$12 \leq x < 16$	$16 \leq x < 20$
Frequency	3	8	19	14	6

Estimate the median height of the plants

11. Below are marks scored by student in maths talk in science congress.

Marks	1 - 5	6 – 15	16 – 20	21 – 35	36 – 40	41 – 50
No. of students	1	3	6	12	5	3

Draw a histogram from the table above.

39. Linear motion

1. Two motorists Kinyua and Nyaboke travelled between two towns K and M which are 580km apart. Kinyua started from K at 6.20 a.m and traveled towards M at 90km/hr. Nyaboke started from town M 1 $^{2}/_{3}$ hours later and traveled towards town K at an average speed of 120km/h. At a small shopping centre along the way, Kinyua had a snack and car check for 20 minutes before proceeding
   (a) (i) How far from town M did they meet?
   (ii) At what time did they meet?
   (b) A rally driver starts from town **M** going to town k at 9.30a.m. If he averages 180km/hr, Calculate the distance from **K** and the time when the rally driver overtook Nyaboke

2. The distance between two towns A and B is 150km. A car starts from town A at 10.00a.m and travels at an average speed of 80km/h towards B. A transit lorry travels from B at 10:15a.m towards town A at an average speed of 40km/h. At what time will the two vehicles meet?

3. The diagram below shows the speed-time graph for a bus traveling between two towns. The bus starts from rest and accelerates uniformly for 50seconds. It then travels at a constant speed for 150seconds and finally decelerates uniformly for 100seconds.

   Given that the distance between the two towns is 2700m, calculate the ;
   (a) maximum speed in km/h, the bus attained
   (b) acceleration
   (c) distance the bus traveled during the last 50seconds
   (d) time the bus takes to travel the first half of the journey

4. A cyclist covers a distance of 45 kilometres at a speed of 10km/h and a further 45 kilometres at 15km/h. Find his average speed for the journey

5. A lorry left town **A** for town **B** 1¼ hours before a car. The lorry and the car are traveling in the same direction at 80kmh^{-1} and 120kmh^{-1} respectively. After the overtake, the car moved for $\frac{199}{800}$ another hours before reaching town **B**. Calculate:

(a) The time the car took before overtaking the lorry completely

(b) The distance between the two towns
(c) The time the lorry will take to reach town **B** after the arrival of the car

6. A country bus left Nairobi at 10.45a.m and traveled towards Mombasa at an average speed of 60km/h. A matatu left Nairobi at 1:15p.m on the same day and traveled along the same road at an average speed of 100km/h. The distance between Nairobi and Mombasa is 500km.
(a) Determine the time of the day when the matatu overtook the bus
(b) Both vehicles continue towards Mombasa at their original speeds. How long had the matatu waited before the bus arrived?

7. Two passenger trains **A** and **B** which are 240m apart are travelling at 164km/h and 88km/h respectively approach on another one a straight railway line. Train **A** is 150m long and train **B** is 100m long. Determine the time in seconds that elapses before the two trains completely pass each other

8. A bus 5m long completely overtakes a trailer 15m long travelling in the same direction in 4.8. seconds. If the speed of the bus is 40 km/hr, determine the speed of the trailer in km/hr.

9. Find the LCM and GCD of the following numbers: $2 \times 3 \times 5^3$ and $2^4 \times 3^2 \times 5^2$.

10. A boat sails from a point A to a point B upstream, a distance of 30 km and back to A in 3hrs 12 min. The current in the river is flowing at 5km/hr. Determine the speed of the boat in still water.

11.. Two friends Ojwang and David live 40 km apart. One day Ojwang left his house at 9.00 a.m. and cycled towards David's house at an average speed of 15 km/h. David left his house at 10.30 a.m. on the same day and cycled towards Ojwang's house at an average speed of 25 km/h.
a) Determine ;
  (i) The distance from Ojwang's house, where the two friends met.
  (ii) The time they met.
  (iii) How far Ojwang was from David's house when they met.
b) The two friends took 10 minutes at the meeting point and they cycled to David's house at an average speed of 12 km/h. Find the time they arrived at David's house.

12. Mr. Kamau left town **S** at 6.00a.m and travels at an average speed of 24km/hr towards **R**. Mrs. Ronoh left town **R** to town S 10minutes later and arrived at 7.00a.m. If distance **RS** = 42km , find;
(a) Where and when they will meet
(b) The time Kamau arrived at **R**
(c) If at 7.00a.m another traveler left **S** and travels towards R at speed twice that of Mrs. Ronoh, find where and when Mr. Kamau was overtaken by the traveler if so

13. A train 100m long travelling at 72km/hr, overtakes another train traveling in the same direction at 56km/hr and passes it completely in 54 seconds.

i) Find the length of the second train

ii) Find also the time they would have taken to pass one another if they had been traveling at these speeds in opposite directions

14. An unskilled worker may either walk to work along a route 5km to take a bus journey of 7km. The average speed of the bus is 24km/hr faster than his average speed. Taking the average walking speed as **x** km/hr;

(a) Write down expressions for time of the journey;
  (i) When walking
  (ii) When using the bus
(b) The journey by bus takes 36 minutes less than the journey on foot, find his walking speed
(c) Hence find the time he takes to talk to work

15. At 1.50 p.m. a matatu is traveling at 80 km/h and it is 40 km behind a motorcycle traveling at 60 km/h.
(a) After how long will the matatu overtake the motorcycle?
(b) At what time will the matatu overtake the motorcycle?

16. A bus left Nairobi at 8:00a.m and traveled towards Kisumu at an average speed of 80km/h. At 8.30a.m, a car left Kisumu towards Nairobi at an average speed of 120km/hr. Given that the distance between Nairobi and Kisumu is 400km, Calculate:-

(a) The time the car arrived in Nairobi
(b) The time the two vehicles met
(c) The distance from Nairobi to the meeting point
(d) The distance of the bus from Kisumu when the car arrived in Nairobi

17. Two trucks A and B travelling at 28km/hr and 26km/hr respectively approach one another on a straight road. Truck A is 10m long, while truck B is 15m long. Determine the time in seconds that elapses before the trucks completely pass each other

40.Quadratic expressions and equation 2

1. Complete the table below for the function $y = 2x^3 + 5x^2 - x - 6$ (2 mks)

x	-4	-3	-2	-1	0	1	2
$2x^3$	-128	-54			0	2	16

$5x^2$	80	45	20	5	0	5	20
-x	4	3			0	-1	
-6	-6	-6	-6	-6	-6	-6	-6
y	-50				-6	0	

(b) On the grid provided draw the graph $y = 2x^3 + 5x^2 - x - 6$ for $-4 \le x \le 2$. Use 2cm to represent 1 unit on the x-axis and 1 cm to represent 5 units on the y – axis (4 mks)

(c) By drawing a suitable line, use the graph in (b) to solve the

i. equation $2x^3 + 5x^2 + x - 4 = 0$ (2 mks)

ii. equation $2x^3 + 5x^2 - x + 2 = 0$ (2 mks)

1. (a) Use a convenient scale to draw the graph of $y = -x^2 + 5x - 3$ for the range $-2 \le x \le 6$
(b) Use your graph to determine the roots of the equation $5x - x^2 - 3 = 0$

(c) Use your graph to solve the equation $2x - x^2 + 3 = 0$ by drawing a suitable straight line

2. Find a quadratic equation whose roots are 2.5 + 3 and 2.5 – 3, expressing it in the form $ax^2 + bx + c = 0$ Where a, b and c are integers

3. Find the products of 17.3 and 13.8. Find also the percentage error in getting the product.
4. (a) Complete the table below for the equation :- $y = x^2 + 3x - 6$ for $-6 \le x \le 4$

x	-6	-5	-4	-3	-2	-1	0	1	2	3	4
y	12			-6			-6				22

(b) Using a scale 1cm to represent 2 units in both axes. Draw the graph of $y = x^2 + 3x - 6$
(c) Use your graph to solve:-
(i) $X^2 + 3X = 6$
(ii) $X^2 + 3X - 2 = 0$

5. (a) Complete the table for the function: $y = 2x^2 + 3x + 1$

x	- 4	-3	-2	-1	0	1	2	3
$2x^2$		18			0			18
3x + 1		-7			0			10
y		11			1	6		

(b) Use the table in **(a)** above to draw the graph : - $y = 2x^2 + 3x + 1$ for $-4 \le x \le 3$
(c) Use the graph in **(b)** to solve the equation :-

(i) $2x^2 + 4x - 3 = 0$

(ii) $x^2 + \frac{3}{2}x + 2 = 3$

6. A youth group decided to raise Ksh 480,000 to buy a piece of land costing Ksh. 80,000 per hectare. Before the actual payment was made, four of the members pulled out and each of those remaining had to pay an additional Kshs. 20,000.
(a) If the original number of the group members was **x**, write down;
(i) An expression of how much each was to contribute originally.
(ii) An expression of how the remaining members were to contribute after the four pulled out.
(b) Determine the number of members who actually contributed towards the purchase of the land.
(c) Calculate the ratio of the supposed original contribution to the new contribution.
(d) If the land was sub-divided equally, find the size of land each member got. (2 mk)

7. a) Draw the graph of $y = 2x^2 + x - 2$ given the range $-3 \leq x \leq 2$
b) Use your graph above to solve
i) $2x^2 + x - 2 = 0$
ii) $2x^2 + x - 3 = 0$
iii) $2x^2 + x - 5 = 0$

8. Three planes **A**, **B** and **C** leave an airport **P** simultaneously at 9.30a.m. Plane **A** flies on a bearing of 070° from P at a speed of 400km/h. Plane **B** flies on a bearing of 290°at a speed of 500km/h. Plane C flies on a bearing of 162° from **P** at a speed of 300km/h.
(***Use scale drawing for this questio***n)
(a) Show by scale drawing, the relative positions of the 3planes A, B and C three hours after leaving airport P. (Use scale 1cm represents 200km)
(b) After 3 hours, **B** turns and head straight to the current position of **A** at the same speed it had. Determine the scale drawing , the time it takes to reach this point, to the nearest minute
(c) Determine the bearing and distance of **B** from **C** after the first 3 hours of flight after leaving **P**

9. a) Use trapezoidal rule to find the area between the curve $y = x^2 + 4x + 4$, the x- axis and the co-ordinates x = - 2 and x = 1. Take values of x at intervals of ½ unit.
b) Use integration to find the exact area. Hence find the percentage error in your approximation.

10. a) Use trapezoidal rule to find the area between the curve $y = x^2 + 4x + 4$, the x- axis and the co-ordinates x = - 2 and x = 1. Take values of x at intervals of ½ unit.
b) Use integration to find the exact area. Hence find the percentage error in your approximation.

11. Draw the graph of $y = 2x^2 - 4x - 5$ for x between -3 and 5 on the grid provided

(a) State the line of symmetry for the graph
(b) State the range of values for which $2x^2 - 4x - 5 \leq 0$
(c) On the same set of axes, draw the graph of y=2x +3
(d) Determine the solutions to the equation: $2x^2 - 4x - 5 = 2x + 3$

12. Complete the table below for the equation $y = 5 + 3x - 2x^2$ by filling in the blank space

X	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5

Y	-9			3		6	6				-4	

(i) Use the values from the table above to draw the graph of $y = 5 + 3x - 2x^2$ (3mks

(ii) Use the graph to:-

(a) Find the maximum point of the function $5 + 3x - 2x^2$

(b) Determine the range of values and give the integral values which satisfy the inequality $5 + 3x - 2x^2 \geq -2$

13. (a) Complete the table below for the function $y = 2x^2 + 4x - 3$

x	-4	-3	-2	-1	0	1	2
$2x^2$	32		8	2	0		
$4x - 3$			-11		-3		5
y			-3			3	13

(b) Draw the graph of the function $y = 2x^2 + 4x - 3$ and use your graph to estimate the roots of the equation $2x^2 + 4x - 3 = 0$.
(c) In order to solve graphically the equation $2x^2 + x - 5 = 0$, a straight line must be drawn to intersect the curve $y = 2x^2 + 4x - 3$. Determine the equation of this line, draw it and hence obtain the roots of the equation $2x^2 + x - 5 = 0$ to 1 decimal place.

14. a) Complete the table for the function $\mathbf{y = 1 - 2x - 3x^2}$ $\mathbf{-3 \leq x \leq 3.}$

x	-3	-2	-1	0	1	2	3
$\mathbf{-3x^2}$	-27		-3	0		-12	
-2x		4		0			-6
1	1	1	1	1	1	1	1
y	-20			1		-15	

b) Using the table above, draw the graph of $\mathbf{y = 1 - 2x - 3x^2}$ (Scale 1 cm represent 0.5 units on **x-axis** and 1 cm rep 2 units on the **y – axis** on the grid provided.

c) Use the graph in **(b)** above to solve.

(i) $\mathbf{1 - 2x - 3x^2 = 0}$

(ii) $\mathbf{2 - 5x - 3x^2 = 0}$

15. A quadratic equation $\mathbf{x^2 + ax - b = 0}$ has roots **1** and **-5** , determine the values of **a** and **b**

16. Find a quadratic equation whose roots are 1.5 + 2 and 1.5 – 2 , expressing it in the form $ax^2 + bx + c = 0$, where a, b, and c are integers

17. If $a^2 + b^2 = 89$ and $a + b = 13$
(a) Find the values of;
  (i) $a^2 + 2ab + b^2$
  (ii) 2ab
  (iii) $a^2 - 2ab + b^2$
  (iv) a - b
(b) Determine the values of a and b

41. Approximation and errors

1. A rectangular room has length 12.0 metres and width 8.0 metres. Find the maximum percentage error in estimating the perimeter of the room.

2. In this question mathematical tables or calculator should not used. The base and perpendicular height of a triangle measured to the nearest centimeters are 12cm and 8cm respectively;
Find ;
(a) the absolute error in calculating the are of the triangle
b) the percentage error in the area, giving the answer to 1 decimal place

3. A rectangular plate has a perimeter of 28cm. determine the dimensions of the plate that give the maximum area

4. A wire of length 5.2m is cut into two pieces without wastage. One of the pieces is 3.08m long. What is the shortest possible length of the second piece?

5. The dimensions of a rectangle are 10cm and 15cm. If there is an error of 5% in each of the Measurements. Find the percentage error in the area of the rectangle.

6. Find the products of 17.3 and 13.8. Find also the percentage error in getting the product.

7. The mass of a metal is given as 14kg to the nearest l0g. Find the percentage error in this measurement.

8. Complete the table below for the functions $y = \cos x$ and $y = 2\cos(x + 30°)$ for $0° \leq X \leq 360°$

X	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
Cos X	1	0.87	0.5		-0.5	0.87	-1.0		0.5	0		0.87	1
2 cos (x+ 30°)	1.73		0	-1.0		-2.0	-1.73	-1.0		1	1.73	2.00	1.73

a) On the same axis, draw the graphs of $y = \cos x$ and $y = 2\cos(x + 30°)$ for $0° \leq X \leq 360°$
b) i) State the amplitude of the graph $y = \cos x°$
ii) State the period of the graph $y = 2\cos(x + 30°)$
c) Use your graph to solve
$\cos x = 2\cos(x + 30°)$

9. Given that $8 \leq y \leq 12$ and $1 \leq x \leq 6$, find the maximum possible value of:

$$\frac{y + x}{y - x}$$

42. Trigometry 2

1. If $\tan x^{o} = {}^{12}/_{5}$ and x is a reflex angle, find the value of $5\sin x + \cos x$ without using a calculator or mathematical tables

2. Find θ given that $2\cos 3\theta - 1 = 0$ for $0^{o} \leq \theta \leq 360^{o}$

3. Without a mathematical table or a calculator, simplify: $\frac{\textbf{Cos300}^{o}\textbf{ x Sin120}^{o}}{\textbf{Cos330}^{o}\textbf{ – Sin 405}^{o}}$ giving your answer in rationalized surd form.

4. Express in surds form and rationalize the denominator.

$$\frac{1}{\text{Sin } 60^{o} \text{ Sin } 45^{o} - \text{ Sin } 45^{o}}$$

5. Simplify the following without using tables;
Tan 45 + cos 45sin 60

6. Simplify the following surds in the form of **a + b c** where **a, b,** and **c** are constants

$$\frac{5}{2\ \ 2 - \ 5} + \frac{2}{2\ \ 2 - \ 5}$$

8. John cycles from shopping centre **A** on a bearing of 120° for 5 km to shopping centre **B**. He then cycles on a bearing of 200^{0} for 7 km to the shopping centre **C**. Calculate to 1 decimal place.
a) The direct distance from A to C.
b) The bearing of A from C.
c) Bearing of B from C.

43. Surds

1. Simplify; $\frac{3}{7 - 2}$ $\frac{1}{7}$ leaving the answer in the form **a + b c** , where **a, b** and **c** are rational numbers

2. Given that:-
Find the values of **a** and **b** where **a** and **b** are rational numbers

3. If:- $\frac{14}{7 - \ 12} - \frac{14}{7 + \ 2} = a\ \ 7 + b\ \ 2$ Find the values of **a** and **b**, where **a** and **b** are rational numbers *****

4. Rationalize the denominator $\frac{\mathbf{2- \ \ 2}}{\mathbf{(\ 2 - 1)^3}}$ and express your answer in the form of **a + c 2**

5. The figure below is a right pyramid with a rectangular base ABCD and vertex V.

O is the centre of the base and M is a point on OV such that OM = $^{1}/_{3}$ OV, AB = 8 cm, BC = 6 cm and VA = VB=VD = VC = 15 cm. Find ;
i) The height OV of the pyramid.
ii) The angle between the plane BMC and base ABCD.

6. Find the value of **y** which satisfies the equation

$$\log_{10} 5 - 2 + \log_{10}(2y + 10) = \log_{10}(y - 4)$$

7. Simplify the expression $\frac{\sqrt{3} - \sqrt{2}}{\sqrt{3} + \sqrt{2}}$ giving your answer in the for of $a + b\sqrt{c}$.

44. Further logarithms

1. In this question, show all the steps in your calculations, giving the answer at each stage. Use logarithms correct to 4 decimal places, to evaluate; $\frac{(1934)^2 \times 0.00324}{\log 746}$

2. The table below shows monthly income tax rates

Monthly taxable pay in KE	**Rate of the tax (Kshs/ E)**
1 – 342	2
343 – 684	3
685 – 1026	4
1027 – 1368	5
1369 – 1710	6
1710 and above	7

Mr. Kamau who is a civil servant earns a Monthly salary of Kshs.20000 and is provided with a house at a nominal rent of Kshs.700 per month

a) Taxable pay is the employee's salary plus 15% less nominal rent. Calculate Mr.Kamau's taxable pay

b) Calculate the total tax Mr. Kamau pays

c) Mr. Kamau is entitled to a personal relief of Kshs.600 per month. What was his net tax .

d) Mr. Kamau has the following deductions made on his pay;

Loan repayment of Kshs.2100 per month
NSSF Kshs.200 per month
WCPS calculated at 2 % of monthly salary

Calculate Mr. Kipchokes net pay

3. A man bought a matatu at Kshs.400,000 in January 1999. It depreciated at a rate of 16% per annum. If he valued it six months, calculate its value in January 2003

4. The table shows corresponding values of *x* and y for a certain curve;

x	1.0	1.2	1.4	1.6	1.8	2.0	2.3
y	6.5	6.2	5.2	4.3	4.0	2.6	2.4

Using 3 strips and mid-ordinate rule estimate the area between the curve, x-axis, the lines $x = 1$ and $x = 2.2$

5. Evaluate without using a calculator or mathematical tables.

$$\frac{\log 32 + \log 128 - \log 729}{\log 32 + \log 2 - \log 27}$$

6. Find the value of **x** that satisfies the equation:-
log (x+5) = log 4 – log(x+2)

7. Find the least number of terms for which the sum of the GP 100 + 200 + 400 + ……………….. exceeds 3100.

8. A two digit number is formed from the first four prime numbers.
a) Draw the table to show the possible outcomes, if each number can be used only once.
b) Calculate the probability that a number chosen from the digit numbers is an even number

9. Find the gradient of a line joining the centre of a circle whose equation is $\mathbf{x^2 + y^2 - 6x = 3 - 4y}$ and a point P(6,7) outside the circle..

10. A lady invests shs.10,000 in an account which pays 16% interest p.a. The interest is compounded quarterly. Find the amount in the account after 1½ hrs

11. Use logarithm tables to evaluate

$$\frac{13.6 \cos 40^o}{63.5}$$

12. Without using logarithms or calculator evaluate:

$$2\log_{10}5 - 3\log_{10}2 + \log_{10}32$$

13. Evaluate without using tables or calculators.
Log 3x + 8 - 3 log2 = log x - 4

45. Commercial Arithmetic 2

1. Chepkemoi bought a new washing machine for Kshs.420,000. Its value depreciated over the next 5years at the following rates; 15%, 13%, 12%, 9% and 7%. For the next 6 years, the rate of depreciation remained constant at 5% then the rate of depreciation remained at 4% each. How long did it take for the value of the washing machine to be $^1/_3$ of its original value?

2. The table below shows income tax rates for the year 2006

Taxable income in shs. Pa	Rate of tax in %
1 – 120,000	10
120,001 – 240,000	15
240,001 – 360,000	25
360,001 – 480,000	35
Over 480,000	50

Nafula is married and claims a tax relief of shs.1,120 per month. She stays in a company house For which she pays a nominal rent of shs.1200 per month. She found that in a particular month, her employer deducted shs.4830 as tax. If she is entitled to a maximum insurance policy; relief of shs.600 per month. Calculate her monthly salary. (10mks)

3. The figure below represents two pulley wheels, centres A and B with a rubber band CDEFGHC stretched round them. Radius of wheel centre A = 16cm, AB = 30cm. CD, GF are tangents to the circles < CAB = 86.3°

a) calculate the length of the belt CD
b) Find the angle ABD
c) Find the length of the belt that would go round the pulleys (CDFGHC)

4. In the figure below, ABCD is a cyclic quadrilateral and BD is a diagonal. EADF is a straight line, ∠CDF = 68º, ∠ BDC = 45º and ∠ BAE = 98º.

Calculate the size of:
a) ∠ ABD.

b) ∠ CBD

5. A customer deposited Ksh.15,500 in a savings account. Find the accumulated amount after 3½ years if interest was paid at 16% per annum compounded semi-annually

6. A retailer mixes three types of rice, Bismatti costing shs.120 per tin with Pishori costing shs.150 per tin and Ahero rice costing shs.80 per tin in the ratio **x : 1 : 2** respectively. If he sells the mixture at shs.137.50 per tin making a profit of 25%. Calculate the value of **x**.

7. Ashanti is a saleswoman and earns a commission on sales based on the monthly rates shown in the table below:-

Sales (Kshs)	**Commission rate % of sales**
The first 5000	10%
The next 3000	15%
Sales above 8000	20%

In addition, she earns a basic monthly pay of Kshs.6700. During a certain month, she earned a total salary amounting to Kshs.8368. How much worth of sales did she make?

9. The table below shows the annual income tax rates for a certain year.

Total income per month in Kshs.	**Rates in Kshs. Per £**
1-10164	2
10165 – 19740	3
19741 – 29316	4
29317 – 33892	5
388983 and above	6
Automatic personal relief shs.1162	

Kiptoo earns a monthly salary of Kshs.25000. He is entitled to house and medical allowances of Kshs.12000 and Kshs.3000 respectively

Calculate:

(a) His taxable income per month

(b) His monthly tax payable

(c)His annual tax payable

10. A company employee earns a basic salary of Kshs.25,000 and is also given taxable allowances amounting to Kshs.10,480.

Monthly taxable income	Rate in Kshs. /Pound
1- 4350	2
4351 – 8900	3
8901 - 13455	4
13451 – 18005	5
18006 and above	6

Using the table of taxation above:-

(a) Calculate the employee’s taxable income

(b) If the employee is entitled to a personal tax relief of Kshs.800 per month, determine the net tax

(c) If the employee was given 40% increase in his income, calculate the percentage increase in his income tax

11. A certain amount of money was invested at compound interest of 10% compounded every two years for ten years. Given that the investor invested a total of 500,000/= at the end of the ten years, find the amount of money invested to the nearest shillings

12. The cash price of a T.V set is Ksh. 26,000. Linda bought the set on hire purchase terms by paying a deposit of Ksh. 6,000 and the balance by 24 equal monthly installments of Khs. 1,045.30. Find the compound rate of interest per year.

13. What would Kshs.15000 amount to after 3years at 16% per annum compounded quarterly?

14 . Income rates for income earned were charged as follows:

Income in Kshs. p.m	**Rate in Kshs. per sh.20**
1- 8400	2
8401- 18,000	3
18,001- 30,000	4
30,000 - 36,000	5
36,001 - 48,000	6
48,001 and above	7

A civil servant earns a monthly salary of Ksh.19,200. His house allowance is Ksh12,000 per month. Other allowces per month are transport Ksh.1300 and medical allowance Ksh.2300. He is entitled to a family relief of Kshs. 1240 per month.

Determine:

a) (i) His taxable income per month.

(ii) Net tax.

b) In addition, the following deductions were made

NHIF	shs. 230
Service charge	Kshs. 100
Loan repayment	Kshs. 4000
Co-operative shares of	Kshs. 1200.

Calculate his net salary per month.

15. Use the taxation rates in the table below to answer the questions that follow;-

Taxable income in K £ p.a	**Rate % per K£**
1-4500	10
4501-7500	15

7501 – 10500	20
10501 – 13500	25
13501 – 16500	30
0ver 16500	35

The manager of a certain company is entitled to a monthly personal relief of shs.3000 and her tax (PAYE) is kshs.9000 per month she is also deducted NHIF shs.350 per month, WCPS shs.800 per month and cooperative shares shs.1200 per month, **calculate**

(a) The managers total deductions per month

(b) Total tax per month

(c) The manager's annual gross salary

(d) The manager's monthly basic salary if her monthly allowance and medical allowances are 10000 and 2000 shillings

16. The table below shows the income tax for a certain year;

Monthly taxable income (Kshs.)	Tax rates (%)
1- 9680	10%
9681- 18800	15%
18801 – 27920	20%
27921 – 37040	25%
37940 and above	30%

In that year, Odero paid a net tax of Kshs.5,512 per month. His total monthly taxable allowances amounted to Kshs.15,220 and he was entitled to a monthly personal relief of kshs.1,162. Every month the following deductions were made;

N.H.I.F Kshs.320

Union dues Kshs.200

Co-operative shares Kshs.7,500

(a) Calculate Odero's monthly basic salary in Kshs

(b) Calculate his monthly salary

17. (a) A car is worth shs.800,000 when new. During the first year it depreciates by 20% of its value and in the second it deprecates by 5% of its value at the start of the year. During the third, fourth and fifth year, depreciation rate is 10%. How much less will it cost at the end of the fifth year?

(b) Find by how much the compound interest will exceed simple interest on shs.3,000 for two years at 15% per year

18. The table below shows the income tax rates:

Income per month (K£)	**Rate in Kshs per £**
1 - 325	2
326 – 975	3
976 - 1300	5
1301 – 1625	6

Over 1625	7.50

Mr. Misoi is a public servant who lives in a government house and pays a nominal rent of Kshs.1,220 per month. He earns a basic salary of Kshs. 24,800 and a house allowance of Kshs.12,000 per month. He is entitled to a monthly relief of kshs.1620.

(a) Calculate his monthly;

(i) Taxable income in K£

(ii) Tax payable without relief

(iii) Tax after relief

(b) Apart from the income tax. The following monthly deductions are made from his earnings

-HELB loan repayment Kshs.2400

- Health insurance fund Kshs.1200

- 2% of Basic salary union fee

Calculate:- (i) the total monthly deduction made on Mr. Misoi's income

(ii) Mr. Misoi's net income per month

19. Joseph bought a camera on hire purchase (H.P) term by paying a deposit of shs.7200 and cleared the balance in 24 equal monthly installments each of 1250.
(a) find the hire purchase price of the camera
(b) the hire purchase price of the camera is 24% higher than the cash price. Find the cash price of the camera
(c) Kangara took a loan from a financial institution and bought the camera with cash. He repaid the loan at 18% p.a compound interest at the end of the two years. Find the total interest paid by Kangara.

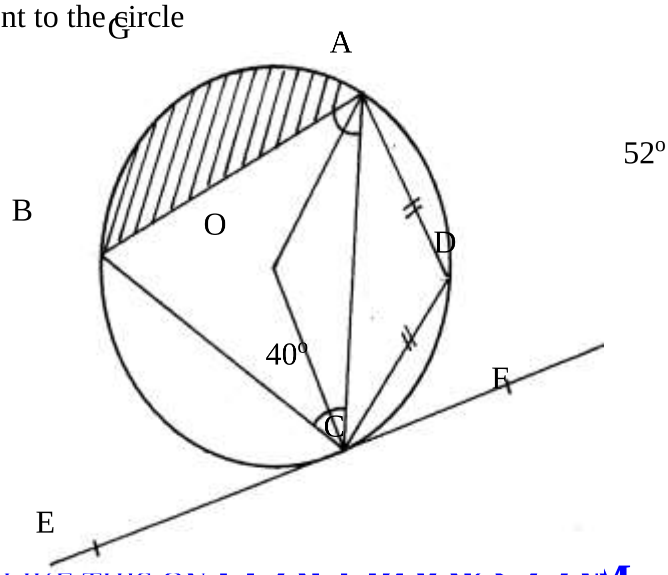
20. Income tax for all the income earned was charged at the rates shown.

Total Income p.a (K.£)	Rate in sh per K£
1 – 1980	2
1981 – 3960	3
3961 – 6440	5
6441 – 7920	7
7921 – 9900	9
Excess of 9900	10

(a) Wanyonyi earned a salary of Kshs.10,500 per month. In addition he was given a house allowance of Kshs. 6500 per month. He got tax relief of Kshs. 300 per month.
Find ; (i) His taxable income p.a
(ii) Income tax he pays per month.
(b) A part from income tax the following deductions are made per month. NHIF of Kshs.320, widow and pension scheme of 2% of his gross salary. Calculate his net monthly pay.

46.Circles –chords and tangents

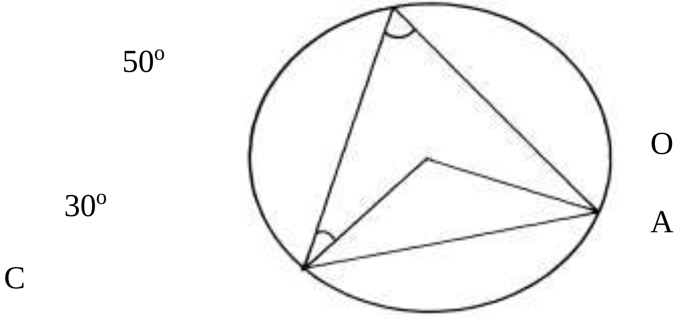
1. In the figure below angle BAC =52°, angle ACB = 40° and AD = DC. The radius of the circle is 7cm. EF is a tangent to the circle



(a) Find; giving reasons

(i) angle DCF
(ii) angle AOB (obtuse)
(b) Calculate the area of the shaded segment AGB

2. In the figure below, O is the centre of the circle. Angle CBA = 50° and angle BCO = 30°. Find the size of the angle BAC



3. In the given figure, O is the centre of the circle and AOBP is a straight line. PT is a tangent to the circle. If PT = 12cm and BP = 4cm. find the radius of the circle

4. In the figure below AOD is a diameter of the circle centre O. BC is a chord parallel to AD. FE is a tangent to the circle. OF bisects angle COD. Angle BCE = angle COE = 20° BC cuts OE at X

Calculate;
(a) angle BOE
(b) angle BEC
(c) angle CEF

(d) angle OXC
(e) angle OFE

5. The figure below shows two pulleys of radii 6cm and 4cm with centres **A** and B respectively. **AB** = 8cm. The pulleys are connected by a string PQXRSY

P
Q
Y A B X
8cm
R
S

Calculate:
(a) Length PQ
(b) ∠PAS reflex
(c) Length of arc PYS and QXR
(d) The total length of the string PQXRSY

6. a) Two pipes **A** and **B** can fill a tank in 3hrs and 4 hrs respectively. Pipe **C** can empty the full tank in 6 hrs.
   i) How long would it take pipes **A** and **B** to fill the tank if pipe **C** is closed?
   ii) Starting with an empty tank, how long would it take to fill the tank with all pipes running?
   b) The high quality Kencoffee is a mixture of pure Arabica coffee and pure Robusta coffee in the ratio 1 : 3 by mass. Pure Arabica coffee costs shs. 180 per kg and pure Robusta coffee costs sh 120 per kg. Calculate the percentage profit when the coffee is sold at sh 162 per kg.

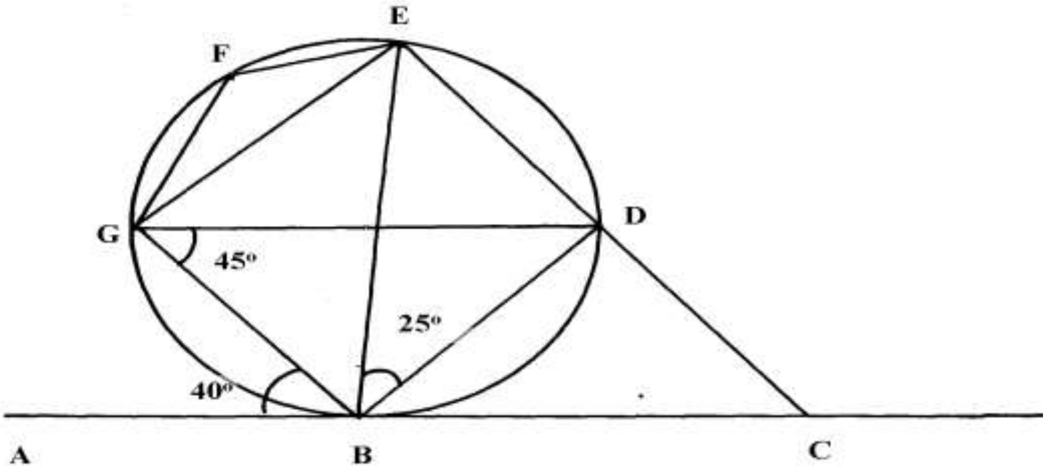
7. In the figure below, ABCD is a cyclic quadrilateral and BD is a diagonal. EADF is a straight line, ∠CDF = 68°, ∠ BDC = 45° and ∠ BAE = 98°.

Calculate the size of:
a) ∠ ABD.
b) ∠ CBD

8. The figure below shows a circle centre O. AB and PQ are chords intersecting externally at a point C. AB = 9cm, PQ = 5cm and QC = 4cm. Find the value of **x**

9. The chords AB and PQ intersects internally at O. Given that the length of OP=8cm, OA= 4.5cm and OQ=6cm. Calculate the length of OB

10. In the figure below ABC is a tangent to the circle at B. given that <ABG=40°, <BGD=45°, and <DBE=25° as shown below.



Find the sizes of the following angles giving reasons in each case:
a) ∠BDG
b)∠DGE

c)∠EFG
d)∠CBD
e)∠BCD

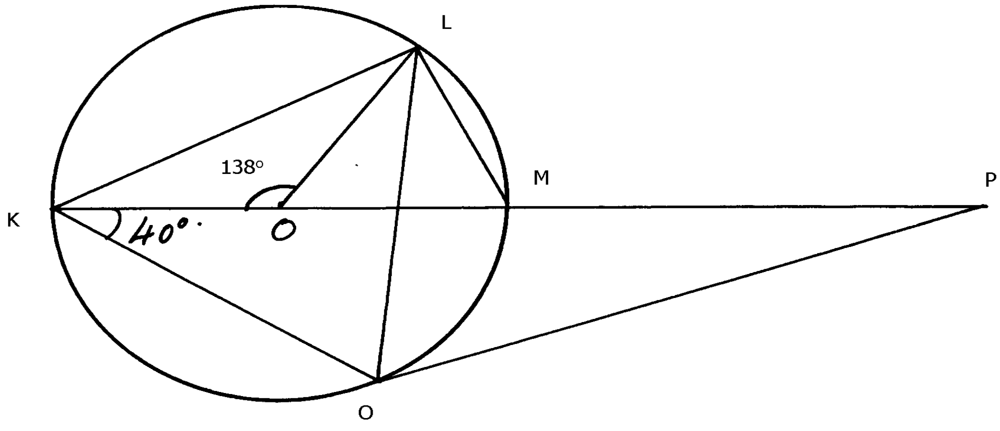
11. The figure below shows two intersecting circles radii 8 cm and 6 cm respectively. The common chord AB = 9cm ad **P** and **Q** are the centres as shown:

(a) Calculate the size of angles:-
  (i) ∠APB
  (ii) ∠AQB
(b) Calculate the area of the shaded region

12. The figure O and P are centres of two intersecting circles. ABE is tangent to circle BCD at B angle BCD is 42°

(a) Giving reasons for your answer, find:-
  (i) CBD
  (ii) DOB
  (iii) DAB
  (iv) CDA
b) Show that ΔADB is isosceles

13.



N

In the figure above K, M & P are points on a straight line. PN is a tangent of the circle centre O. Angle KOL = 130^o and angle MKN = 40^o. Find, giving reasons, the values of angles.

(i) $\angle$MLN
(ii) $\angle$OLN
(iii) $\angle$LNP
(iv) $\angle$MPN
(v) $\angle$LMO

14. In the diagram below, O is the centre of the circle of radius 8cm. BA and BC are tangents to the circle at A and C respectively. PD is the diameter and AC is a chord of length 8cm. Angle ADC = 120^o. ARC is an arc of the circle, Centre B and radius 4.6cm

Calculate correct to 2 decimal places

(a) Angle ABR
(b) Area of sectors ABCR and OAPC
(c) Area of the shaded part

15. In the figure below, ATX is a tangent to the circle at point T, ABC is a straight line, angle ABT = 100^{o}, angle XTD = 58^{o} and line AB = line BT. C and D lie on the circle

Find by giving reasons, the value of angle:

(a) TDC
(b) TCB
(c) TCD
(d) BTC
(e) DTC

16. In the figure below, B, D, E, F and G are on the circumference of the circle centre O. A, B and C form a tangent to the circle at point B. GD is the diameter of the circle. Given that FG = DE, reflex angle GOB = 252°, angles DBC = 36° and FEG = 20°

Giving reasons in each case find the angles:

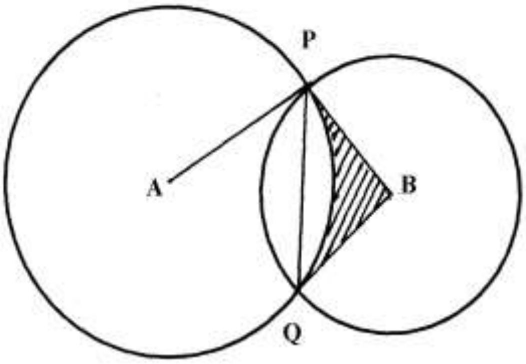
a) GEB
b) BED
c) OBE
d) BGE
e) GFE

17. XYZ is a triangle in which x = 13.4cm, Z= 5cm and $\angle XYZ = 57.7^{o}$. Find:

(i) Length of XZ
(ii) The circum radius of the triangle

18. In the figure shown below, the centers of the two circles are A and B. PQ is a

common chord to the two circles. AP = 6cm, BP=4cm and PQ =5cm



Calculate the area of the shaded region (take π as 3.142)

19. In the figure below NR is a diameter of the circle centre O. Angle PNR = 750^0 ∠ NRM = 50^0 and ∠RPQ = 35^0. MRS and PQS are straight lines.

Giving reasons for every statement you write, find the following angles

(a) ∠ PQR *

(b) ∠QSR

(c) Reflex ∠POR

(d) ∠ MQR

(e) ∠ PON

20. In the diagram below, ATX is a tangent to the circle at point T, ABC is a straight line, ∠ABT= 100^o , ∠XTD = 58^o and the line AB = BT

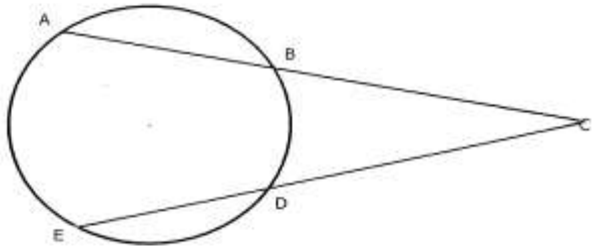
Find giving reasons the value of :

(a) ∠TDC

(b) ∠TCB

(c) ∠TCD
(d) ∠BTC
(e) ∠DTC

21.

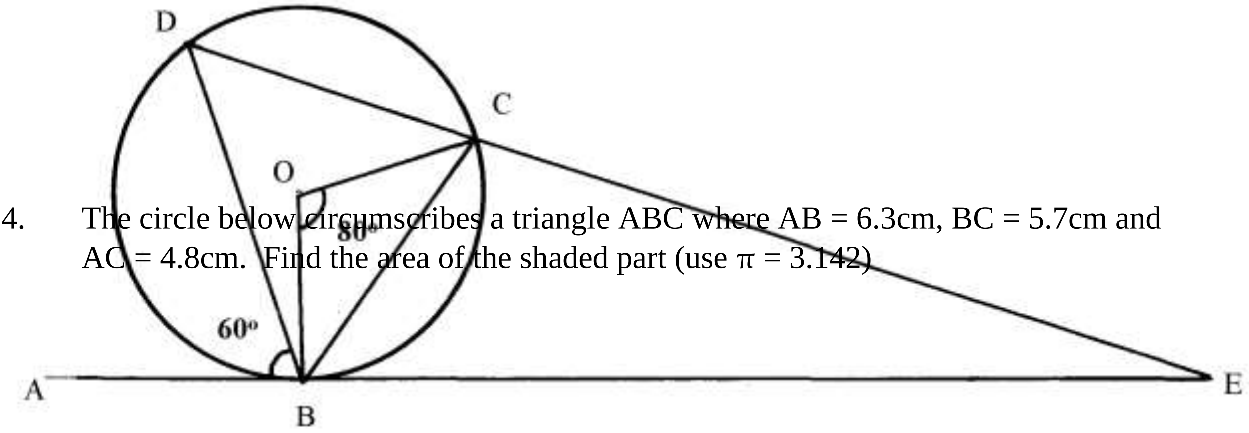


In the figure above AB = 6 cm, BC = 4 cm DC = 5 cm. Find the length DE.

22. The eleventh term of an AP is four times the second term. If the sum of the first seven terms of the AP is 175, find the first term and the common difference

23. In the diagram below ABE is a tangent to a circle at B and DCE is a straight line.

If ABD = 60^o, BOC = 80^o and O is the centre of the circle, find with reasons ∠BEC



24. The circle below circumscribes a triangle ABC where AB = 6.3cm, BC = 5.7cm and AC = 4.8cm. Find the area of the shaded part (use π = 3.142)

25.

(a) O is the centre of the circle and QOTS is a diameter. P, Q, R and S are points on the circumference of the circle. Angle PQS = 38^o and angle QTR = 56^o.

Calculate the size of ;

(i) ∠PRQ

(ii) ∠RSQ

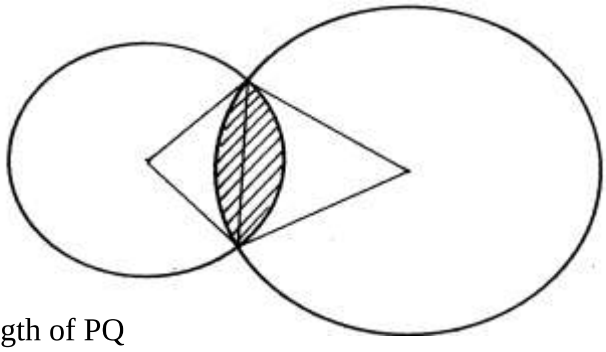
(b) Given that A varies directly as B and inversely as the cube of C and that;

A = 12 when B = 3 and C = 2. Find B when A = 10 and C = 1.5

(c) A quantity y is partly constant and partly varies inversely as the square of x.

The quantity y=7 when x=10 and y=5½ when x=20. Find the value of y when x=18

26. The figure below shows two intersecting circles with centres P and Q and radius 5cm and 6cm respectively. AB is a common chord of length 8cm. Calculate;



:

(a) the length of PQ
(b) the size of;
    (i) angle APB
    (ii) angle AQB
(c) the area of the shaded region

27. Triangle ABC is inscribed in the circle. AB= 7.8cm, AC 6.6cm and BC= 5.9cm. Find:

(a) The radius of the circle correct to one decimal place
(b) The area of the shaded region

28. The figure below shows two circles centres A and B and radii 6 cm and 8 cm respectively. The circles intersect at P and Q. Angle PAB = 42^0 and angle ABQ = 30^0.

(a) Find the size of ∠PAQ and PBQ.

(b) Calculate, to one decimal place the area of:
    (i) Sector APQ and PBQ.

(ii) Triangle APQ and PBQ.
(iii) The shaded area (take π 22)

29. The minute hand of a clock is 6.5 cm long. Calculate the distance in cm moved by its tip between 10.30 am. and 10. 45 a.m. to 2 dpl.

47. Matrices

1. Given that A is $\begin{matrix} 3 & 2 \\ 4 & -1 \end{matrix}$ and A $\begin{matrix} \frac{1}{11} & \frac{2}{11} \\ \frac{4}{11} & \frac{-3}{11} \end{matrix}$

Find the value of a and b in the expression: (3 mks)

$\begin{matrix} 3 & 2 \\ 4 & -1 \end{matrix} \quad \begin{matrix} a \\ b \end{matrix} = \begin{matrix} 12 \\ 5 \end{matrix}$

2. Solve for the unknowns given that the following is a singular matrix.

$\begin{matrix} 1 & 2 \\ x & x-3 \end{matrix}$

3. Given that A = and B = and that C = AB, find C^{-1}

4. $\underset{\sim}{B}$ is a matrix $\begin{matrix} 3 & 2 \\ 2 & 2 \end{matrix}$ and $\underset{\sim}{C}$ is the matrix $\begin{matrix} 9 & -3 \\ 2 & 1 \end{matrix}$

. If $\underset{\sim}{A}$ is a 2 x 2 matrix and A x $\underset{\sim}{B}$ = $\underset{\sim}{C}$, determine the matrix $\underset{\sim}{A}$.

5. An object of area 20 cm^2 undergoes a transformation given by the matrix $\begin{matrix} -1 & -2 \\ 4 & 3 \end{matrix}$ followed by $\begin{matrix} 2 & 3 \\ -1 & 2 \end{matrix}$ find the area of the final image.

6. Find the matrix B such that AB = I and A = $\begin{matrix} \mathbf{3} & \mathbf{2} \\ \mathbf{-1} & \mathbf{3} \end{matrix}$ **.** Hence find the point of intersection of the lines **3x + 2y = 10** and **3y – 4 = x.**

7. Given that **P** = $\begin{matrix} 2 & 3 \\ 1 & 2 \end{matrix}$ and **Q** = $\begin{matrix} 2 & -3 \\ -1 & 2 \end{matrix}$ find ;the matrix product PQ. Hence solve the simultaneous equations below:-

$2x – 3y = 5$
$- x + 2y = – 3$

8. Solve for *x* and *y* in the following matrix equation using elimination method

$\begin{matrix} \frac{1}{2} & -\frac{1}{4} \\ \frac{2}{5} & \frac{1}{6} \end{matrix} \quad \begin{matrix} x \\ y \end{matrix} \quad \begin{matrix} 2 \\ 6 \end{matrix}$

9. A triangle XYZ , X (-1, -1) , Y (-2, -4) Z (-6 , -9) is reflected in the line X axis followed by a reflection in line X= Y. Find the image of the final image

10. Triangle ABC is the image of triangle PQR under a transformation **M** = $\begin{matrix} 2 & 4 \\ 0 & 2 \end{matrix}$ where P, Q, R map onto A, B, C respectively.
Given the points P (5, -1) Q (6, -1) and R(4, - 0.5) draw the triangle ABC on the grid provided.

b) Triangle ABC in (a) above is to be enlarged by scale factor 2 with centre at (11, - 6) to map onto A^1B^1 and C^1. Construct and label triangle A^1B^1 and C^1 on the same grid.

c) By construction, find the coordinates of the centre and the angle of rotation which can be used to rotate triangle $A^IB^IC^I$ onto triangle $A^{II}B^{II}C^{II}$ whose coordinates are (-3, -2) , (-3, -6) and (-1, -2) respectively.

11. Triangle ABC with an area of 15 cm^2 is mapped onto triangle $A^IB^IC^I$ using matrix $M = \begin{matrix} 2 & -3 \\ 1 & 1 \end{matrix}$. Find the area of triangle $A^IB^IC^I$.

12. **T** is a transformation represented by the matrix under **T** a square whose area is $10cm^2$ is mapped onto a square of area $110cm^2$. Find the possible values of **X**

13. Triangle $A^1B^1C^1$ is the image of Δ ABC under a transformation represented by the matrix $M = \begin{matrix} 3 & 2 \\ 9 & 5 \end{matrix}$
If the area of triangle $A^1B^1C^1$ is $54cm^2$. Determine the area of triangle ABC

14. Find the matrix B such that AB = I and $A = \begin{matrix} \mathbf{3} & \mathbf{2} \\ \mathbf{-1} & \mathbf{3} \end{matrix}$ **.** Hence find the point of intersection of the lines **3x + 2y = 10** and **3y – 4 = x.**

48. Formulae and variation

1. P varies as the square of R. R. varies as the square of T. When P = 18, R = 3 and T = 5. Express P in terms of T hence find P when T = 10.

2. Make r the subject of the formula.

$$v = \begin{matrix} r \\ r + c \end{matrix}$$

3. X varies as the cube of Y and inversely as square root of Z, X = 6 when Y = 3 and Z= 25.
   (a) Find;
      (i) An expression connecting X,Y,Z
      (ii) X when Y = 7 and Z = 9
      (iii) Y when X = 8 and Z = 16
   b) If Y is increased by 20% and Z is decreased by 36%, find the percentage increase in X

4. Make **b** the subject of the formula;

$$K = \frac{a\,b}{b - a}$$

5. Find a quadratic equation whose roots are 2.5 + 3 and 2.5 – 3, expressing it in the form $ax^2 + bx + c = 0$ Where a, b and c are integers

6. A quantity **Z** varies directly as the square of x and inversely as the square root of y. If **x** increases by 20% and **y** decreases by 36%, find the percentage change in **Z**

7. The fourth terms of a G.P is 48 and the seventh term is 384. Find the common ratio and hence calculate the sum of the first six terms

8. A quantity **P** varies directly as the square of **Q** and inversely as quantity **R**. If **P** = 2 when **Q** = 4 and **R**=6, find **P** when **Q** = 8 and **R**= 4

9. **B** varies partly as the square of **M** and partly as the inverse of **N**. **B,M** and **N** are such that when **M**=2, **N**= ½ , **B**=96 while when **M**= 3 , **N**=2, **B** = 46. Write an expression for **B** in terms of **M** and **N**.

10. Solve for **x** and **y.**

$$\frac{3x}{y - 1} = 1$$

$$(2x + 2) : (y - 5) = 1 : 2$$

11. Make **x** the subject of the formula.. $P = \frac{x - 1}{x + 2}$

12. Make **d** the subject of the formula given that:-

13. **Z** varies jointly as the square of **x** and inversely as the square of **y**. When **x** = 10 and **y** = 4 then **z** = 15

(a) Find **z** in terms of **x** and **y**

(b) Find the value of **x** when **z** = 8 and **y** = 12

14. A quantity **R** partly varies as **n** and partly as the square root of **n**. When **n** = 9 **R** = 42 and when **n** = 25 **R** = 100. Find **R** when **n** = 16.

15. Make **b** the subject of the formula.

$$a = \frac{bd}{b^2 + d}$$

16. **P** varies party as **Q** and partly as the square root of **Q**. When **Q** = 4, **P** = 22 and when **Q** = 9, **P** = 42. Find the value of **P** when **Q** = 25.

18. Make **C** the subject of the formula
b = k-aC
hence find the value of **C** when **K**= 1, **a** = 4 and **b** = 2

18. The velocity of water flowing through a pipe is inversely proportional to the square of the radius of the pipe. If the velocity of the water is 30cm/s when the radius of the pipe is 2cm. Find the velocity of water when the radius of the pipe is 4cm

19. Make x the subject of the formula

$$\frac{xy}{z+x} \qquad P = 3$$

20. Three quantities **x**, **y** and z are such that **x** varies partly as y and partly as the inverse of the square of Z . When **x** = 6, **y** = 3 and z= 2. When x = 8, y = 5 and z= 1. Find the value of x when y = 10 and z= 8

21. The eleventh term of an AP is four times the second term. If the sum of the first seven terms of the AP is 175, find the first term and the common difference

22. The resistance of an electrical conductor is partly constant and partly varies as the temperature. When the temperature is 20°C, the resistance is 55 ohms. When the temperature is 28°C, the resistance is 58 ohms. Find the resistance when the temperature is 60°C

23. Expand $1 - \underline{1}\ ^{5}$
$(2x)^{-1}$ up to the term in x^3. Hence or otherwise evaluate $(0.98)^5$ to 4 d.p

49. Sequence and series

1. The area covered by Mau forest is 40,000 km^2 at present. If the human encroachment rate is estimated to be 2 % every 10 years. Calculate the area of the forest encroached in 30 years.

2. Three consecutive terms of geometric progression are 3^{2x+1}, 9^x and 81 respectively. Calculate:
(a) The value of x
(b) Find the common ratio
(c) Calculate the sum of the first 10 terms of this series
(d) Given that the fifth and the seventh terms of this G.P forms the first two consecutive terms of arithmetic sequence, calculate the sum of the first 20 terms of this sequence

3. How many terms of the sequence -12 + -10 + -8 .....should be added to give a sum of 338?

4. An arithmetic progression whose first term is 2 and whose nth term is 32 has the sum of its n terms equal to 357. Find **n**

5.

O

In the figure OACB is parallelogram in which M is the mid- point of AC and OM produced meets BC also produced at X.
Given OA = a and OB = b
a) Express OC in terms of a and b
b) Find the values of r and s such that OX = rOM and CX = sBC
c) Hence determine the ratio BC:BX

6. For the series **29 + 23 +..... + (-91),** find;
(a) The number of terms in the above series
(b) The sum of the series

7. (a) Given **that 5, a, b,** and **7** are in arithmetical progression, find the value of **a** and **b**
(b) If **5, P, Q ,** $^{135}/_{8}$ are in geometrical progression. Find the value of **P** and **Q**
(c) Prove that the sum of the first 12 terms of the first series in **(a)** is approximately equal to the sum of the first 6 terms of the second series **(b)** above

8. An aeroplane flew East for 640km then turned and flew on a bearing of 050°. After 2.5hrs flying at 324km/hr, it was necessary to fly to the original point because of technical hitch. How much shorter is it going to cover flying straight to the starting point than retracing its former route?

9. A ball falls vertically from a height of 15m. Each time it bounces back to 50% of the height achieved on the previous bounce. Find the distance covered after 6 such bounces

10. Find the sum of the first 51 terms of the series:-
-22, -19, -16..................................

11. Olunga saves shs.100 on his son's first birthday. He saves shs.200 on the second birthday and Shs.400 on the third birthday and so on doubling the amount on every birthday. How much will he be saving on the boy's 10th birthday.

12. A self-help group intended to purchase a dry cleaning machine worth shs.720,000.
The members were required to contribute equal amounts to pay for the machine.
The group recruited 20 more members consequently, each member paid shs.3000 less that what he would have contributed.

(a) find the original number of members
(b) find the amount required from each member to contribute after the recruitment

13. Find the number of terms in the following sequence
8, 4, 2, ½ …….., $^1/_{512}$

14. An arithmetic progression has the first term a and the common difference d
a) Write down the third, ninth and twenty fifth terms of the progression in terms of **a** and **d**
b) The arithmetic progression above is increasing and that the third, ninth and twenty fifth terms form the first three consecutive terms of a geometric progression. The sum of the seventh and twice the sixth terms of the arithmetic progression is 78.
Calculate:
i) The first term and common difference of the arithmetic progression
ii) The sum of the first nine terms of the arithmetic progression

15. The difference between the fourth and the seventh terms of an increasing arithmetic progression

50.Vectors 2

1.

A

M

$\underset{\sim}{a}$

T

O

$\underset{\sim}{b}$

B

N

In the figure alongside OA = $\underset{\sim}{a}$, OB = $\underset{\sim}{b}$. T lies on AN such that AN : TN = 13:6. M lies on AB such that AM:MB=1:3 and N lies on OB such that OB:BN = 7:-5.
(a) Express in terms of $\underset{\sim}{a}$ and $\underset{\sim}{b}$ in the simplest form
(i) AN
(ii) AT
(iii) AM
(b) Show that O, T and M are collinear and state the ratio of OT: TM

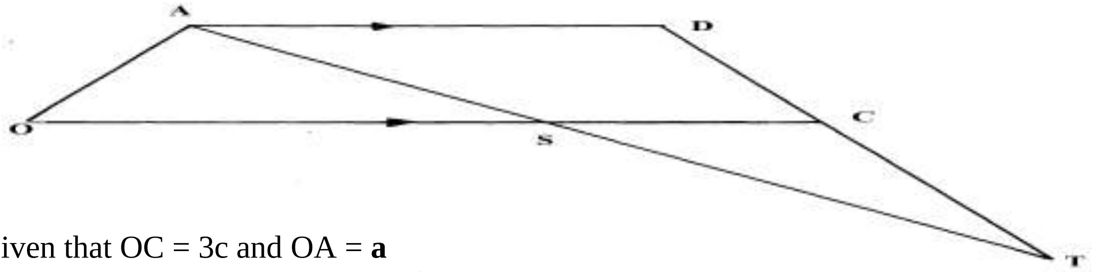
2. A point (-3, 4) divides **AB** internally in the ratio 3:5. Find the coordinates of point **A** given that point **B** is (6, -5)

3. Given that O is the origin, OA = $3\underset{\sim}{i} + 2\underset{\sim}{j} - 4\underset{\sim}{k}$ and OB = $6\underset{\sim}{i} + 11\underset{\sim}{j} + 2\underset{\sim}{k}$. If **x** divides AB in the ratio1:2, find the modulus of OX to 2d.p

4. a) Expand $(2 - {}^1/_5x)^5$
b) Hence use the expansion to find the value of $(1.96)^5$ correct to 3 decimal places

5. In the figure OABC is a trapezium in which 3 AB = 2OC. S divides OC in the ratio 2:1 and AS produced meets BC produced at T

B



Given that OC = 3c and OA = **a**

(a) Express AS and BC in terms of **a** and **c**

(b) Given further that AT = hAS and BT = KBC where h and k are constants

(i) Express AT in two ways in terms a, c , h and k

(c) The obtuse angle between the lines PQ

(d) Hence find the ratio BT: BC

6.

In the figure above, OPQ is a triangle in which OS = ¾ OP and PR: RQ = 2 : 1. Lines OR and SQ meet at T.

(a) Given that OP = P and OQ = q, express the following vectors in term of p and q

(i) PQ

(ii) OR

(iii) SQ

(b) You area further given that ST = m SQ and OT = n OR. Determine the values of m and n

51.Binominial expansion

1. (a) Expand 1 – 3x ^{5}

(b) use your expansion to estimate the value of 0.997 ^{5} Correct to 4 d.p.

2. (i) Expand 5 + $\frac{X}{2}$ upto the term in X^3

(ii) Use your expansion to estimate the value of correct to one decimal place

3. (a) Expand **(3 + 2x)^{6}** up to the fourth term

(b) Use your expansion to estimate:- **(3 3)^{6}**

4. Two dice are thrown once and their sum noted. Find the probability that the sum is odd

5. Find the length PR in a triangle PQR having PQ = 12cm, QR = 8.4cm angle QPR = 35° and angle PRQ = 75° leaving your answer correct to decimal places
$\frac{5x}{x}$ $\frac{2}{-3}$

6. (a) Use binomial expansion to evaluate $(2+\frac{3}{x})^5$ up to the fifth term

(b) By expressing 9.5 in the form $(2 + \frac{3}{x})$, use the expansion in (a) above to calculate $(9.5)^5$ correct to 3 d.p

7. Use the expansion of $(x – 0.2)^5$ to find the exact value of 9.8^5

8. Solve for **x** in the equation;
log (x + 24) = 2 log 3 + log (9 – 2x).

9. Expand $1 + \frac{x}{12}$ in ascending powers of **x** upto the fourth term.
Use the four terms to evaluate ${}^{5}/_{4}\,{}^{6}$ to 4 decimal places.

10. (a) Expand and simplify the binominal expression $(1 + \frac{1}{2} x)^8$
(b) Use the expansion up to the fourth term to evaluate $(1.05)^8$ to 2 decimal places

11. Expand $(3 + x)^4$ in ascending powers of x. Use the first three terms of the expansion to evaluate $(3.02)^4$, correct to 3 decimal places

52. Probability

1. A bag contains 3 black balls and 6 white ones. If two balls are drawn from the bag one at a time,find;
   (a) The probability of drawing a black ball and a white ball.
      (i) Without replacement.
      (ii) With replacement.
   (b) Drawing two white balls.
      (i) Without replacement.
      (ii) With replacement.
2. A cupboard has 7 white cups and 5brown cups all identical in size and shape. There is a blackout in the town and Mrs. Bett has to select three cups one after another without replacing the previous ones.
   (a) Draw a tree diagram for the information
   (b) Calculate the probability that she chooses;
      (i) Two white cups and one brown cup
      (ii) Two brown cups and one white cup
      (iii) At least one white cup
      (iv) three cups of the same colour
3. A two digit number is formed from the first four prime numbers.
   a) Draw the table to show the possible outcomes, if each number can be used only once.
   b) Calculate the probability that a number chosen from the digit numbers is an even number

4. The probability that a boy goes to school by bus is $^{1}/_{3}$ and by matatu is ½. If he uses a bus, the probability that he is late to school is $^{1}/_{5}$ and if he uses a matatu, the probability of being late is $^{3}/_{10}$. If he uses other means of transport, the probability of being late is $^{1}/_{20}$

(a) Draw a probability tree diagram to represent this information

(b) What is the probability that he will be late for school

(c) What is the probability that he be late for school if he does not use a matatu

(d) What is the probability that he is not late for school

5. One day during inspection in a certain secondary school, it was discovered that there was a probability of $^{2}/_{5}$ that a students had shaggy hair, if a student had shaggy hair, there was a probability of ½ that he had torn uniform. But if he had properly combed hair, there was a probability of ¼ that he had a torn uniform. If a student had torn uniform there was a probability of $^{4}/_{5}$ that he had unpolished shoes. Otherwise there was a probability of $^{3}/_{5}$ that he had polished shoes.

a) Represent this information in a probability tree diagram

b) Find the probability that:-

i) a student had all the three faults

ii) a students had exactly two faults

iii) a students had no faults at all

6. A shop is stocked with plates which are from two suppliers **A** and **B**. They are brought in the ratio of 3:5 respectively. 10% of plates from **A** are defective and 6% of plates from **B** are de

7. In a science class $^{2}/_{3}$ of the class are boys and the rest are girls. 80% of the boys and 90% of the girls are right handed and the rest are left handed. The probability that a right handed student will break a test-tube in any session is $^{1}/_{10}$ and the corresponding for the left handed student is $^{3}/_{10}$, their probability being independent of the student sex .

a) Complete the probability tree diagram given below

b) Using the tree diagram, find the probability that :

i) A student chosen from the class is left handed

ii) A test-tube is broken by a left handed student

iii) A test-tube is broken by a right handed student

iv) A test-tube is not broken in any session

8. Students who performed well in an examination are to be given an outing. A student has to throw two dice. If he gets a sum greater than 8, he gets a two-days outing, otherwise he gets a one day outing.

(a) Find the probability that a student gets a two-day outing

(b) A student who qualifies for a two-day outing throws a die and a coin to decide whether he gets pocket money for the two days or for only one day. If he gets a head and a multiple of 3 he gets pocket money for two days. Find the probability that he is given a two-day outing but given pocket money for only one day

(c) If a student gets a one-day outing, he throws a die to decide if he gets pocket money or not. If he gets a number greater than 4 he gets the pocket money. Find the probability that:-

(i) A student gets pocket money for two days

(ii) A student gets pocket money

9. A bag contains **6** red beads and **4** white ones. Two beads are selected from the bag at random without replacement.

(a) Draw a tree diagram to represent the above information.

(b) Calculate the probability that:

(i) Both beads are white.

(ii) Both beads are of the same colour.

(iii) At least a red bead is picked.

(iv) The two beads are of different colours.

10. A bag contains blue, green and red pens of the same type in the ratio 8:2:5respectively. A pen is picked at random without replacement and its colour noted.

a) Determine the probability that the first pen picked is;

(i) blue

(ii) either green or red.

b) Using a tree diagram, determine the probability that;

(i) the first two pens picked are both green.

(ii) Only one of the first two pens picked is red.

c) (i) Draw the probability space for the possible outcomes when a coin is tossed and a die thrown simultaneously

(ii) Determine the probability of getting a head and an even number.

11. A box contains five red balls and four black balls all identical. Three balls are drawn without replacement from the box at random;

(a) Draw a tree diagram to show the situation

(b) use the tree diagram to find the probability that;

(i) the balls picked are of the same colour

(ii) more red balls were picked

(iii) at least a black ball was picked

(iv) atmost 1 red ball was picked

12. A bag contains 10balls of which 3 are red, 5 are white and 2 are green. Another bag contains 12balls of which 4 are red, 3 are white and 5 are green. A bag is chosen at random and then a ball chosen at random from the bag. Find the probability that the ball so chosen is red

13. In a certain science class $^2/_3$ of the class are boys and the rest girls. $^4/_5$ of the boys and $^9/_{10}$ of the girls are right handed, and the rest are left handed. The probability that a right handed student will break a test-tube in any session is $^1/_{10}$ and the corresponding probability for a left handed student is $^3/_{10}$, these probabilities being independent of the student's sex.
(a) Represent this information on a tree diagram
(b) Using the diagram above;
  (i) determine the probability that a student chosen at random form the class is left handed
  (ii) determine the probability that a student chosen at random from the class is right handed and will break a test tube in any session
(c) determine the probability that a test tube is broken in any session

14. A box contains 5 red biro pens, 4 black biro pens and 6 green biro pens. If three pens are picked once at random, find the probability that:
(i) all the biro pens are red
(ii) the biro pens are of the same colour
(iii) the biro pens are one of each colour
(iv) none of the biro pens is red

15. The probability that Chebet goes to bed on time ¾ . If she goes to bed on time, the probability that she wakes up on time is $^5/_6$, otherwise her probability of waking up on time is $^1/_3$.
(a) (i) Find the probability of Chebet getting to bed on time and waking up on time by use of diagram
  (ii) Waking up late
(b) If Chebet wakes up late, her probability of getting to class on time is $^1/_5$ otherwise, her probability of getting to class on time is $^3/_5$.
  (i) Find the probability of Chebet getting to bed on time and gets to class late
  (ii) Getting to bed late and get to class on time

53. Compound proportions, mixtures and rates of work

1. Three business partners Georgina, Gilbert and Akumu decided to buy a plot worth shs.510,000. They contributed shs.30000; as a deposit in the ratio 2:3:5 respectively. They paid the balance in two months by contributing equal amounts. After one year, they sold the plot for a profit of 20% and invested the initial capital in another business. The profit was shared in the ratio 1:2:3; respectively. Find how much each partner
(a) contributed towards the deposit
(b) paid to clear the balance
(c) received as a profit

2. Twelve men take 20days to complete a piece of work. How long would 16 men take to do the same piece of work?

3. Mr. Kitur bought grades of tea ; Grade A costs shs.109 per kg and a kg of Grade B costs shs.81.50. In what ratio must he mix the two grades in order to make a profit of 20% by selling the mixture at Kshs.112.80per kg?

4 Mogutu and Onacha working together can do a piece of work in 6days. Mogutu working alone takes 5days longer than Onacha. How many days does it take Onacha to do the work alone?

5 Given the curve $\mathbf{y = 2}x^3 + \frac{1}{2}x^2 - 4x + 1$, find the equation of the normal to the curve at (1, -½)

6 **A** and **B** are connected by the equation **B = KA + M** where **K** and **M** are constants. The table below shows the values of **A** and corresponding values of **B**

A	1.5	3.0	4.5	6.0	7.5
B	8	11	14	17	20

a) Draw a suitable straight line on the grid provided
b) State the values of K and M, hence express B in terms of A

7 The latitude and longitude of two stations **P** and **Q** are (47°N, 25°W) and (47°N, 70°W) respectively. Calculate the distance in nautical miles between **P** and **Q** along the latitude 47°N

8 A coffee blender mixes 6 parts of types **A** with 4 parts of type **B**. If type A costs Kshs. 72 and type **B** costs him Ksh.66 per kg respectively at what price should he sell the mixture in order to make a profit of 5%. Give your answer to the nearest ten cent.

9 (a) (i) Paint **A** costs shs.150 per litre while **B** costs shs.160 per litre. In what proportion must **A** be mixed with **B** to produce a mixture costing shs.156 per litre
(ii) What must be the selling price of the mixture if a profit of 12% is to be realized?
(b) A cylindrical water tank can be filled to a depth of 2.1m by a pipe **P** in 2 hours. Pipe **Q** takes 7 hours to fill the tank to the same level. Pipe **R** can empty this amount of water in 6hours. Initially, the tank is empty. Pipes **P** and **Q** are turned on at 8.45a.m and pipe R at 9.45a.m. Find the depth of water in the tank at 11.45a.m

10 Two grades of tea leaves one costing sh.420 per kilogram and the other costing sh. 470 per kilogram are to be mixed in order to produce a blend worth sh.455 per kilogram. In what proportion should they be mixed?

11. The internal radius of a pipe is 0.35m. Water flows through the pipe at the rate of 45cm per second. Calculate the amount of water that passes through the pipe in 2 ¼ hours in litres

12 In 2000 the total cost of manufacturing an item was ksh1250 and this was divided among the costs of material, labour and transport in the ratio of 8:14:13. In 2003 the cost of material was doubled, labour cost increased by30% and transport costs increased by 20%
a) Calculate the cost of manufacturing this item in 2003
b) In 2004 the cost of manufacturing the same item was ksh1981 as a result of increase in labour costs only. Find the percentage increase in labour costs of 2004

13. Brand **A** tea costing Kshs.80 per kg is mixed with Brand **B** tea costing Kshs.100 per kg such that the mixture is sold at Kshs.114 making a profit of 20%. Find the ratio of **A:B**

14. In what proportion must teas of Kshs.76 and Kshs.84 per kg be mixed to produce a tea costing Kshs.81 per kg

15. Onyango bought 3 brands of tea **P, Q** and **R**. the cost price of the three brands were shs.25, shs.30 and shs.45 per kilogram respectively. He mixed the three brands in the ratio 5:2:1 respectively After selling the mixture, he made a profit of 20%
(a) How much, profit did he make per kilogram of the mixture?
(b) After one year, the cost price each brand was increased by 12%.
(i) For how much did he sell one kilogram of the mixture to maintain 20% profit. Give your answers to the nearest 5cts.
(ii) What would have been his percentage profit if he sold one kilogram of the mixture at shs.40.25?

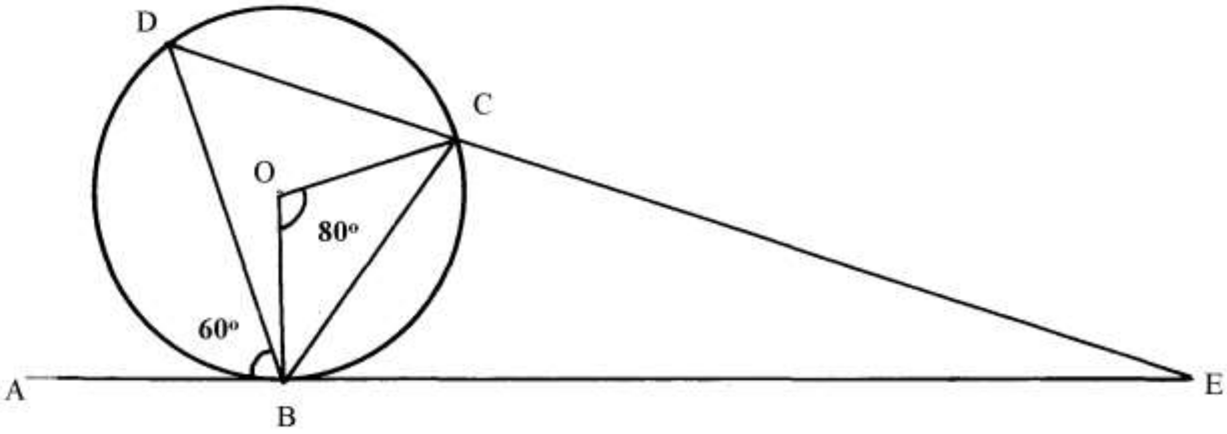
16. A mixture contains two powders X and Y with masses in the ratio 3:11. If the mixtures Cost Shs.6.70 per kg and powder x costs Shs.5.60 per kg. Find the cost of 1kg of powder Y

54. Graphical Methods

1. The equation of a circle is given by $x^2 + 4x + y^2 – 5 = 0$. Find the centre of the circle and its radius.

2 The equation of a circle is $x^2 + y^2 + 6x – 10y – 2 = 0$. Determine the co-ordinates of the centre of the circle and state its radius

3. In the diagram below ABE is a tangent to a circle at B and DCE is a straight line.
If ABD = 60°, BOC = 80° and O is the centre of the circle, find with reasons ∠BEC



4. Obtain the centre and the radius of the circle represented by the equation:
$x^2 + y^2 - 10y + 16 = 0$

5. Complete the table below, for the function $y = x^3 + 6x^2 + 8x$

x	-5	-4	-3	-2	-1	0	1
x^3	-125		-27	-8		0	1
$6x^2$		96	54		6	0	6
8x	-40		-24			0	8
y			3	0		0	15

(a) Draw a graph of the function $y = x^3 + 6x^2 + 8x$ for $-5 \leq x \leq 1$ and use the graph to estimate the roots of the equation $x^3 + 6x^2 + 8x = 0$

(b) Find which values of **x** satisfy the inequality $x^3 + 6x^2 + 8x - 1 > 0$

6. Sketch the curve of the function $y = x^3 - 3x + 2$ showing clearly minimum and maximum points and the y – intercept.

7. Show that $4y^2 + 4x^2 = 12x - 12y + 7$ is the equation of a circle, hence find the co-ordinates of the centre and the radius

8. Two variables R and P are connected by a function $R = KP^n$ where K and n are constants. The table below shows data involving the two variables

P	3	3.5	4	4.5	5
R	36	49	64	81	100

(a) Express $\mathbf{R = KP^n}$ in a linear form
(b) Draw a line graph to represent the information above
(c) Find the values of constants **K** and **n**
(d) Write down the law connecting **R** and **P**
(e) Find the value of **P** when **R** = **900**

9. A circle of radius 3cm has the centre at (-2, 3) . Find the equation of the circle in the form of $x^2 + y^2 + Px + qy + c = 0$

10. In an experiment, the values of two quantities V and T were observed and the results recorded as shown below.

V	0	2	4	6	8	10
T	0.49	0.30	0.24	0.20	0.16	0.137

It is known that **T** and **V** are related by a law of the form $T = \frac{a}{b + V}$
where **a** and **b** are constants.

a) Draw the graph of $\frac{I}{T}$ against V

b) Use your graph to find;

i) The values of **a** and **b**.
ii) **V** when **T** = 0.38
iii) **T** when **V** = 4.5

11. Find the equation of the tangent to the curve $y = 2x^3 + x^2 + 3x - 1$ at the point (1, -5) expressing you answer in the form $y = mx + c$

12. Given that :- $243 = (81)^{-1}$ x $({}^1/_{27})^x$ determine the value of x

13. Show that $3x^2 + 3y^2 + 6x - 12y - 12 = 0$ is an equation of a circle hence state the radius and centre of the circle

14. (a) Fill in the table below for the function $\mathbf{y = -6 + x + 4x^2 + x^3}$ **for** $\mathbf{-4 \leq x \leq 2}$

x	-4	-3	-2	-1	0	1	2
-6	-6	-6	-6	-6	-6	-6	-6
x	-4	-3	-2	-1	0	1	2
$4x^2$			16			4	
x^3							
y							

(b) Using the grid provided draw the graph for $\mathbf{y = -6 + x + 4x^2 + x^3}$ **for** $\mathbf{-4 \leq x \leq 2}$

(c) (i) Use the graph to solve the equations:-
(i) $x^3 + 4x^2 + x - 4 = 0$
(ii) $-6 + x + 4x^2 + x^3 = 0$
(iii) $-2 + 4x^2 + x^3 = 0$

15. The table below shows the results obtained from an experiment to determine the relationship between the length of a given side of a plane figure and its perimeter

Length of side ι (cm)	1	2	3	4	5
Perimeter P(cm)	6.28	12.57	18.86	21.14	31.43

(a) On the grid provided, draw a graph of perimeter **P**, against ι
(b) Using your graph determine;
(i) the perimeter of a similar figure of side 2.5cm
(ii) the length of a similar figure whose perimeter is 9.43cm
(iii) the law connecting perimeter p and the length ι
(c) If the law is of the **form P = 2kι + c** where **k** and **c** are constants, find the value of **k**

16. In an experiment with tungsten filament lamp, the reading below of voltage (V) current (I), power (P) and resistance (R)were obtained. It was established that **P** was related to **R** by a law $P = aR^n - 0.6$. Where **a** and **n** are constants.

V	1.30	2.00	2.80	4.40	5.70
I	1.50	1.80	2.10	2.50	2.90
P	0.73	2.05	3.28	7.44	10.62

R	0.89	1.13	1.33	1.78	1.99

Plot a suitable line graph and hence use it to determine the value of **a** and **n**

17. Find the gradient of a line joining the centre of a circle whose equation is $\mathbf{x^2 + y^2 – 6x = 3 – 4y}$ and a point P(6,7) outside the circle..

18. a) Complete the table below for the function $\mathbf{y = -x^3 + 2x^2 – 4x + 2}$.

x	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**
$-x^3$	27	8		0		-8		
$2x^2$	18	8	2	0				
-4x		8		0				-16
2	2	2	2	2	2	2	2	2
y		26		2		-6		-46

b) On the grid provided below draw the graph of $\mathbf{-x^3 + 2x^2 – 4x + 2}$ for $\mathbf{- 3 \leq x \leq 4}$.

c) Use the graph to solve the equation $\mathbf{-x^3 + 2x^2 – 4x + 2 = 0}$.

d) By drawing a suitable line on the graph solve the equation. $\mathbf{–x^3 + 2x^2 – 5x + 3 = 0.}$

19. Determine the turning point of the curve $y = 4x^3 - 12x + 1$. State whether the turning point is a maximum or a minimum point.

20. (a) Complete the table below for the equation of the curve given by $\mathbf{y = 2x^3 – 3x^2 + 1}$

X	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3
$\mathbf{2x^3}$	-16		-2		0		2		16		
$\mathbf{-3x^2}$	-12			0.75	0	-0.75					-27
1	1				1						
y	-27	-12.5			1						13.5

(b) Use the table to draw the graph of the function $\mathbf{y = 2x^3 – 3x^2 + 1}$

c) Use your graph to find the values of x for :-

(i) $y > 0$

(ii) The roots of the equation $2x^3 – 3x^2 + 1 = 0$

(iii) $2x^3 – 3x^2 = 9$

21. Find the radius and the centre of a circle whose equation is :
$2x^2 + 2y^2 – 6x + 10y + 9 = 0$

55.Matrices and Transformations

1. Given triangle ABC with vertices A (-6, 5), B(-4, 1) and C(3, 2) and that A(-6, 5) is mapped onto $A^1(-6, -4)$ by a shear with y-axis in variant. On the grid provided below;
   (i) draw triangle ABC
   (ii) draw triangle $A^1B^1C^1$, the image of triangle ABC, under the shear
   (iii) determine the matrix representing the shear

(b) Triangle $A^1B^1C^1$ is mapped onto $A^{11}B^{11}C^{11}$ by a transformation defined by the matrix
(i) Draw triangle $A^{11}B^{11}C^{11}$ on the same grid as ABC and $A^1B^1C^1$

(ii) Describe fully a single transformation that maps A^{11} $B^{11}C^{11}$

2. (a) Under a certain rotation A(2,0) is mapped onto $A^1(-4, 2)$ and B(0,5) is mapped onto $B^1(-9, o)$
   (i) On the grid provided plot the lines AB and A^1B^1 on the same axes
   (ii) Hence determine by construction the co-ordinates of the centre and angle of rotation
   (b) Under a quarter positive turn about the origin O, A^1 is mapped onto A^{11} and B^1 is mapped onto B^{11}. Determine the co-ordinates of A^{11} and B^{11}
   (c) Describe fully a single transformation which would map A to A^{11} and B to B^{11}

3. A transformation **T** is represented by the matrix $\begin{pmatrix} \mathbf{0} & \mathbf{-1} \\ \mathbf{-1} & \mathbf{0} \end{pmatrix}$ and transformation **U** $\begin{pmatrix} \mathbf{0} & \mathbf{-1} \\ \mathbf{-1} & \mathbf{0} \end{pmatrix}$ by the matrix. Given that a rectangle has co-ordinates at A (1,2) B(6, 2), C(6, 4) and D (1, 4) and that under **T** the image of ABCD is $A_1B_1C_1D$ and under **U** the image of $A_1B_1C_1D$ is $A_2B_2C_2D_2$:
   (a) Find the co-ordinates of $A_1B_1C_1D_1$ and $A_2B_2C_2D_2$
   (b) On the grid provided, plot ABCD, $A_1B_1C_1D_1$ and $A_2B_2C_2D_2$
   (c) Describe the transformation represented by:-
      (i) U
      (ii) UT
   (d) If $A_2B_2C_2D_2$ were to be transformed by a transformation represented by the matrix to map onto $A_3B_3C_3D_3$. What would be the area of $A_3B_3C_3D_3$

4. The vertices of a quadrilateral are A(2,2) B(8,2) , C (8,6) and D(6,4) under a rotation the images of vertices A and D are A(0,8) and D1(-2, 12).
   (a) On the grid provided and using the same axes draw the quadrilateral ABCD and the points A^1 and D^1
   (b) Determine the centre and angle of rotation
   (c)Locate the points B^1 and C^1 under the rotation and complete the quadrilateral

5. A translation maps the point P(5, -3) onto $P^1(2, -5)$
   (a) Determine the translation vector T
   (b) A Point R^1 is the image of R(-2, -3) under the same translation in (a) above, find the magnitude of P^1R^1
6. Triangle ABC has vertices at A(0, -1), B(4, 3)and C(2,2).
   (a) Find the coordinates of image triangle $A^1B^1C^1$ of triangle ABC under translation vector $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$
   (b) Given that triangle $A^{11}B^{11}C^{11}$ is the image of triangle $A^1B^1C^1$ under an enlargement scale factor 3, centre O(0,0) , find the coordinates of A^{11}, $B^{11}$and C^{11}
   (c) If the area of triangle $A^1B^1C^1$ is 24 cm^2, calculate the area of triangle $A^{11}B^{11}C^{11}$
   (d) Find the matrix that maps triangle $A^{11}B^{11}C^{11}$ onto triangle ABC

7. a) The triangle ABC where A (2,-1) B (1, 2) and C (4, 4) is reflected in the line X = 4 to give triangle $A_1B_1C_1$. Draw the two triangles on the graph provided and state the co-ordinates of $A_1B_1C_1$
   b) Draw the triangle A_2 (5,6), B_2 (2,7) and C_2 (0,4). Given that triangle $A_2B_2C_2$ is the image of triangle $A_1B_1C_1$ under rotation, determine the centre and angle of this rotation

c) Show the image of triangle $A_2B_2C_2$, under an enlargement centre (0, 6) scale factor -1

8. (a) Find the co-ordinates for the image of point **P(6, -2)** under the transformation defined by :-

$x^1 = x - 3y$

$y^1 = 2x$

(b) (i) A quadrilateral ABCD has vertices A(4, -3), B(2, -3), C(4, -1) and D(5, -4). On the grid provided, draw the quadrilateral ABCD

(ii) $A^1B^1C^1D^1$ is the image of ABCD under a rotation through +90° about the origin. On the same axes, draw $A^1B^1C^1D^1$under the transformation

` (c) $A^2B^2C^2D^2$is the image of under $A^1B^1C^1D^1$ under another transformation by the matrix

(i) Determine the co-ordinates of $A^2B^2C^2D^2$ and plot it on the same axes

(ii) Describe the transformation that maps $A^1B^1C^1D^1$onto $A^2B^2C^2D^2$

(d) Find a single matrix of transformation that would map $A^2B^2C^2D^2$onto ABCD

9. (a) Triangle **XYZ** has vertices **X**(2, -1) **Y**(4, -1) and **Z** (4,2). Triangle XYZ maps onto triangle $X^1Y^1Z^1$ under transformation T_1 = . Draw triangles XYZ and its image $X^1Y^1Z^1$ on the grid provided

(b) Another triangle $X^{11}Y^{11}Z^{11}$ is the image of $X^1Y^1Z^1$ after transformation $\mathbf{T_2}$ = . Draw triangle $X^{11}Y^{11}Z^{11}$on the same set of axes

(c) Find the single transformation matrix **T** that maps triangle XYZ on to the final image $X^{11}Y^{11}Z^{11}$

(d) Given that the area of triangle XYZ is 15cm^2, find the area of the triangle $X^{11}Y^{11}Z^{11}$

10. The quadrilateral A (2,1), B (4,1), C (4,4) and D (2,4) is mapped onto A'B' C'D' by a matrix M_1 such that A^1 (8,7), B^1 (14,7), C^1 (14,16) and D^1 (8,16) .

a) Draw both ABCD and A^1B^1 C^1D^1 on the same plane

b) Find the matrix of transformation that mapped ABCD onto A'B' C'D' and describe it fully

c) A^1B^1 C^1D^1 underwent another matrix transformation at N which is a translation that gave the image A^{11} B^{11} C^{11} D^{11}, Where A^{11} (7,9), B^{11} (13,9), C^{11} (13,18) and D^{11} (7,18). The transformation N is a translation . Find the translation

d) Draw A^{11} B^{11} C^{11} D^{11} on the same axes where ABCD and A^1B^1 C^1D^1 were drawn

11. a) On the grid provided. Plot the points A(2, -1) B (0, -3) C(2, -4) and D (4, -2) and join them to form a quadrilateral ABCD. What is the name of this quadrilateral?

b) The points A^1 (1, 2) B^1 (3, 0) C^1 (4, 2) and D^1 (2, 4) are the images of ABC and D under a certain transformation T_1. On the same grid draw quadrilateral $A^1B^1C^1D^1$ and describe transformation T_1 fully.

c) The points A^{11}(-2, -4) B^{11}(-6, 0) C^{11}(-8, -4) and D^{11}(-4, -8) are the images of $A^1B^1C^1D^1$ under transformation T_2. On the same grid draw quadrilateral $A^{11}B^{11}C^{11}D^{11}$ and describe the transformation T_2 fully.

d) On the same grid draw quadrilateral A^{111} B^{111} C^{111} D^{111}, the image of A^{11} B^{11} C^{11} D^{11} under a reflection in the x-axis. State the co-ordinates of A^{111} B^{111} C^{111} D^{111}.

12. The Points A^1B^1 and C^1 are the images of A(4, 1), B(0, -2) and C(-2, 4) respectively under a transformation represented by the matrix;

$$M = \begin{matrix} -1 & 1 \\ 2 & -3 \end{matrix}$$

(a) Write down the coordinates of A^1 B^1 and C^1

(b) A^{11} B^{11} and C^{11} are the images of A^1 B^1 and C^1 under another transformation whose Matrix is:

$$N = \begin{matrix} 2 & -1 \\ 1 & 2 \end{matrix}$$

Write down the coordinates of A^{11} B^{11} and C^{11}

(c) Transformation **M** followed by **N** can be represented by a single transformation **P**. Determine the matrix for **P**

(d) A matrix **P** is given by $\begin{matrix} 8 & 7 \\ 4 & 5 \end{matrix}$

Find P^{-1}

13. Triangle $A^1B^1C^1$ is the image of triangle ABC under a transformation represented by matrix T = If the area of triangle $A^1B^1C^1$ is 25.6cm^2, find the area of the object

14. A point P(2, -4) is mapped into P^1(4, 0) under a translation. Determine the image of point Q(-1, 2) under the same translation

15. The points A (2, 6), B (1, 1), C (2, 3) and D (4,0) are the vertices of quadrilateral ABCD.

(a) On graph paper plot the points A, B, C, and D and join them to form quadrilateral ABCD.

(b) The points A, B, C and D are the images of A^1, B^1, C^1 and D^1 respectively under an enlargement centre the origin and scale factor -2. On the same grid draw the image quadrilateral A^1 B^1 C^1 D^1.

(c) The points A^{11} B^{11} C^{11} and D^{11} are the images of ABCD respectively under reflection in the x – axis. On the same grid, locate the pints A^{11} B^{11} C^{11} and D^{11} and draw the second image quadrilateral A^{11} B^{11} C^{11} D^{11}.

(d) Quadrilateral A^{111} B^{111} C^{111} D^{111} is the image of ABCD under a certain transformation T. Describe transformation T fully.

16. T is a transformation represented by the matrix . Under T, a square of area 10cm^2 is mapped onto a square 110cm^2. Find the values of *x*

56. Statistics II

1. The table below shows the masses to the nearest kg of a number of people.

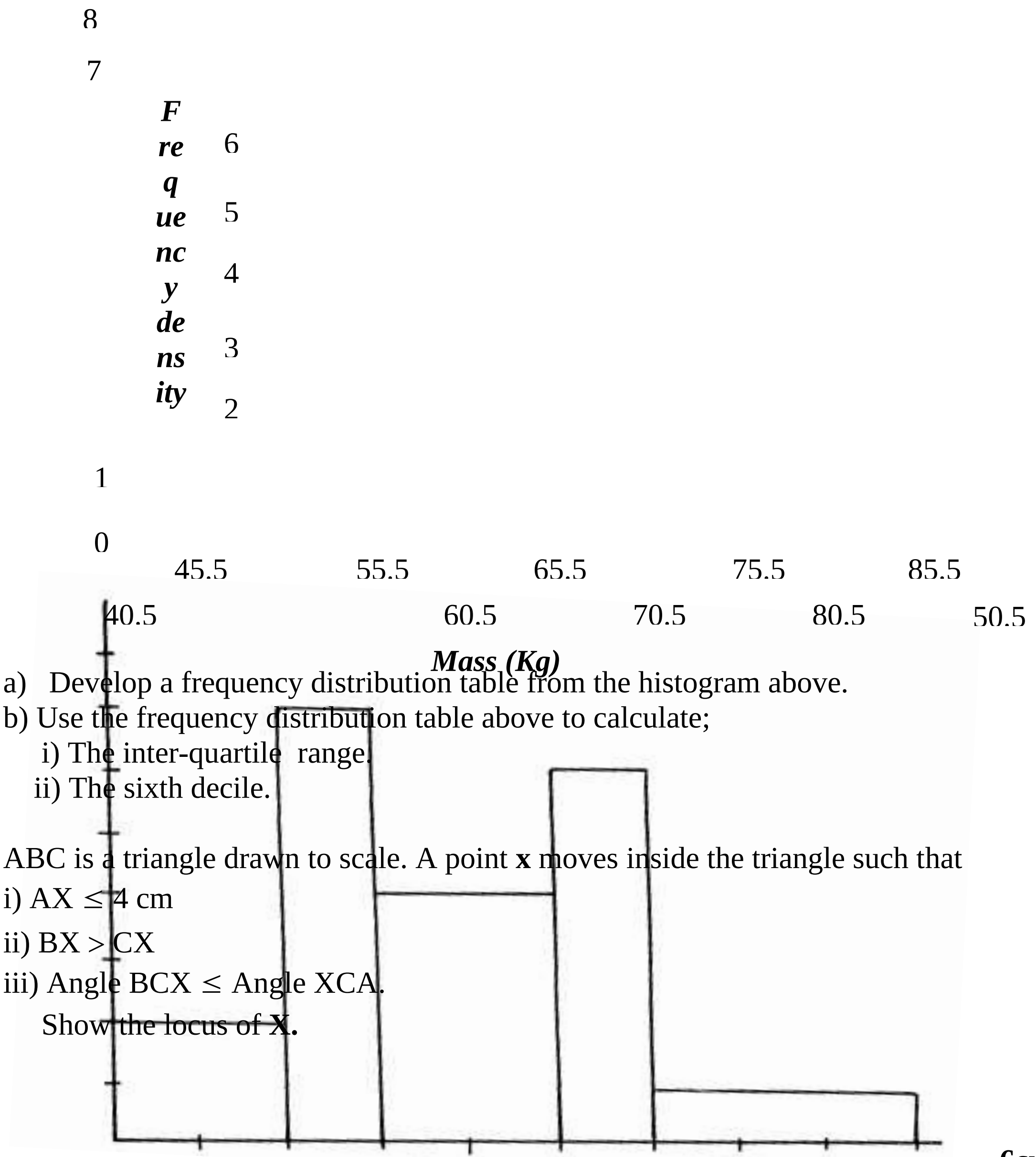
Mass (kg) Frequency	50 – 54 19	55 – 59 23	60 – 64 40	65 – 69 28	70 – 74 17	75 – 79 9	80 – 84 4

a)Using an assumed mean of 67.0, calculate to one decimal place the mean mass.

(b) Calculate to one decimal place the standard deviation of the distribution.

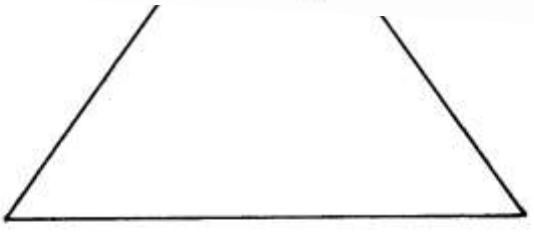
2. Use only a ruler and pair of compasses in this question;
(a) construct triangle ABC in which AB = 7cm, BC = 6cm and AC = 5cm
(b) On the same diagram construct the circumcircle of triangle ABC and measure its radius
(c) Construct the tangent to the circle at C and the internal bisector of angle BAC. If these lines meet at D, measure the length of AD

3. Below is a histogram drawn by a student of Got Osimbo Girls Secondary School.



a) Develop a frequency distribution table from the histogram above.
b) Use the frequency distribution table above to calculate;
i) The inter-quartile range.
ii) The sixth decile.

4. ABC is a triangle drawn to scale. A point **x** moves inside the triangle such that
i) AX ≤ 4 cm
ii) BX > CX
iii) Angle BCX ≤ Angle XCA.
Show the locus of **X.**



55º

7cm

5. The following able shows the distribution of marks of 80 students

Marks	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Frequency	1	6	10	20	15	5	14	5	3	1

(a) Calculate the mean mark
(b) Calculate the semi-interquartile range
(c) Workout the standard deviation for the distribution

6. The table below shows the marks of 90 students in a mathematical test

Marks	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No. of students	2	13	31	23	14	**X**	1

a) Find **X**

b) State the modal class

(c) Using a working mean of 22, calculate the; i) Mean mark

ii) Standard deviation

7. (a) Using a ruler and a pair of compasses only construct triangle PQR in which PQ = 5cm, PR = 4cm and $\angle PQR = 30^o$

(b) Measure; (i) RQ

(ii) $\angle PQR$

(c) Construct a circle, centre O such that the circle passes through vertices P, Q, and R

(d) Calculate the area of the circle

8. The ages of 100 people who attended a wedding were recorded in the distribution table below

Age	0-19	20-39	40-59	60-79	80-99
Frequency	7	21	38	27	7

a) Draw the cumulative frequency

b) From the curve determine: i) Median

ii) Inter quartile range

iii) 7th Decile

iv) 60th Percentile

9. The marks obtained by 10 students in a maths test were:-

25, 24, 22, 23, ***x,*** 26, 21, 23, 22 and 27

The sum of the squares of the marks, $\Sigma x^2 = 5154$

(a) Calculate the: (i) value of x

(ii) Standard deviation

(b) If each mark is increased by 3, write down the:-

(i) New mean

(ii) New standard deviation

10. 40 form four students sat for a mathematics test and their marks were distributed as follows:-

Marks	1 – 10	11-20	21- 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 - 100
No. of students	1	3	4	7	12	9	2	1	0	1

a) Using 45.6 as the working mean, calculate;

i) The actual mean.

ii) The standard deviation.

b) When ranked from first to last, what mark was scored by the 30th student? (Give your answer correct to 3 s.f.)

11. The table below shows the distribution of marks scored by pupils in a maths test at Nyabisawa Girls.

Marks	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90
Frequency	2	5	6	10	14	11	9	3

a)Using an Assumed mean 45.5, calculate the mean score.
b) Calculate the median mark.
c) Calculate the standard deviation.
d) State the modal class.

12. The table below shows the marks scored in a mathematics test by a form four class;

Marks	20-29	30-39	40-49	50-59	60-69	70-79	80-89
No. of students	4	26	72	53	25	9	11

(a) Using an assumed mean of 54.5, calculate:-
  (i) The mean
  (ii) The standard deviation
(b) Calculate the inter quartile range

57. Loci

1. (a) Using a ruler, a pair of compasses only construct triangle XYZ such that XY = 6cm, YZ = 8cm and $\angle XYZ = 75^\circ$
(b) Measure line XZ and $\angle XZY$
(c) Draw a circle that passes through X, Y and Z
(d) A point M moves such that it is always equidistant from Y and Z. construct the locus of M and define the locus

2. (a) (i) Construct a triangle ABC in which AB=6cm, BC = 7cm and angle ABC = 75°
Measure:-
  (i) Length of AC
  (ii) Angle ACB
(b) Locus of P is such that BP = PC. Construct P
(c) Construct the locus of Q such that Q is on one side of BC, opposite A and angle BQC = 30°
(d) (i) Locus of P and locus of Q meet at X. Mark ***x***
  (ii) Construct locus R in which angle BRC 120°
  (iii) Show the locus S inside triangle ABC such that $XS \geq SR$

3 . *Use a ruler and compasses only for all constructions in this question.*
a) i) Construct a triangle ABC in which AB=8cm, and BC=7.5cm and $\angle ABC = 112\frac{1}{2}^\circ$

ii) Measure the length of AC

b) By shading the unwanted regions show the locus of P within the triangle ABC such that

i) AP ≤ BP

ii) AP >3cm

Mark the required region as **P**

c) Construct a normal from C to meet AB produced at D

d) Locate the locus of **R** in the same diagram such that the area of triangle ARB is ¾ the area of the triangle ABC.

4. On a line AB which is 10 cm long and on the same side of the line, use a ruler and a pair of compasses only to construct the following.

a) Triangle ABC whose area is 20 cm^2 and angle ACB = 90°

b) (i) The locus of a point P such that angle APB = 45°.

(ii) Locate the position of P such that triangle APB has a maximum area and calculate this area.

5. A garden in the shape of a polygon with vertices A, B, C, D and E. AB = 2.5m, AE = 10m, ED = 5.2M and DC=6.9m. The bearing of **B** from **A** is 030° and **A** is due to east of **E** while **D** is due north of E, angle EDC = 110°,

a) Using a scale of 1cm to represent 1m construct an accurate plan of the garden

b) A foundation is to be placed near to CD than CB and no more than 6m from A,

i) Construct the locus of points equidistant from CB and CD.

ii) Construct the locus of points 6m from **A**

c) i) shade and label **R** ,the region within which the foundation could be placed in the garden

ii) Construct the locus of points in the garden 3.4m from AE.

iii) Is it possible for the foundation to be 3.4m from AE and in the region?

6. a) Using a ruler and compasses **only** construct triangle PQR in which QR= 5cm, PR = 7cm and angle PRQ = 135°

b) Determine < PQR

c) At P drop a perpendicular to meet QR produced at T

d) Measure PT

e) Locate a point **A** on **TP** produced such that the area of triangle AQR is equal to one- and – a - half times the area of triangle PQR

f) Complete triangle AQR and measure angle AQR

7. Use ruler and a pair of compasses only in this question.

(a) Construct triangle ABC in which AB = 7 cm, BC = 8 cm and ∠ABC = 60^0.

(b) Measure (i) side AC (ii) ∠ ACB

(c) Construct a circle passing through the three points A, B and C. Measure the radius of the circle.

(d) Construct Δ PBC such that P is on the same side of BC as point A and ∠ PCB = ½ ∠ ACB, ∠ BPC = ∠ BAC measure ∠ PBC.

8. Without using a set square or a protractor:-

(a) Construct triangle **ABC** in which **BC** is 6.7cm, angle **ABC** is 60° and ∠**BAC** is 90°.

(b) Mark point **D** on line **BA** produced such that line **AD** =3.5cm

(c) Construct:-

(i) A circle that touches lines **AC** and **AD**

(ii) A tangent to this circle parallel to line **AD**

. Use a pair of compasses and ruler only in this question;

(a) Draw acute angled triangle **ABC** in which angle **CAB** = 37½ °, **AB** = 8cm and **CB** = 5.4cm. Measure the length of side **AC** (**hint 37½ ° = ½ x 75°**)

(b) On the triangle **ABC** below:

(i) On the same side of **AC** as **B,** draw the locus of a point **X** so that angle **Ax C** = 52½ °

(ii) Also draw the locus of another point **Y**, which is 6.8cm away from **AC** and on the same side as **X**

(c) Show by shading the region **P** outside the triangle such that angle **APC ≥ 52 ½°** and **P** is not less than 6.8cm away from **AC**

58.Trigometric ratios 3

1. The table below gives some values of y = sin 2x and y = 2 cox is the range given.

(a) Complete

X^{o}	-225	-180	-135	-90	-45	0	45	90	135	180	225
y – sin 2x^{3}	-1.0		1.0			0			-1.0		1.0
y = 2cos x^{3}	-1.4		-1.4			2.0			-1.4		-1.4

(b) On the same axes, draw the graphs of y = sin 2x and y = 2 cos x.
(c) Use your graph to find in values of x for which sin 2x – 2 cos x = 0.
(d) From your graph
 (i) Find the highest point of graph y = sin 2x.
 (ii) The lowest point of graph y = 2 cos x.

2. (a) Copy and complete the table below for y =2sin (x +15)^{o} and y =cos(2x -30)^{o} for 0^{o} $\leq$ x $\leq$ 360^{o}

x	0	30	60	90	120	150	180	210	240	270	300
y =2sin(x+15)											
y= cos(2x-30)											

(b) On the same axis draw the graphs:
 y = 2sin (x + 15) and y = cos(2x -30) for 0^{o} $\leq$ x $\leq$ 360^{o}
(c) Use your graph to:
 (i) State the amplitudes of the functions y = 2sin (x +15) and y= cos (2x -30)
 (ii) Solve the equation 2sin (x+15) – cos (2x -30) = 0

3. The diagram below shows a frustum of a square based pyramid. The base ABCD is a square of side 10cm. The top A^{1}B^{1}C^{1}D^{1} is a square of side 4cm and each of the slant edges of the frustum is 5cm

Determine the:
i) Altitude of the frustrum

ii) Angle between AC1 and the base ABCD
iii) Calculate the volume of the frustrum

4 (a) Compete the table below:

$y = 3\sin(2x + 15)^o$

x	-180	-150	-120	-90	-60	-30	0	30	60	90	120
y	0.8			-0.8			0.8		21		

(b) Use the table to draw the curve **$y = 3\sin(2x + 15)$** for the values – **$180^o \leq \theta \leq 120^o$**
(c) Use the graph to find:
  (i) The amplitude
  (ii) The period
  (iii) The solution to the equation:-
    $\sin(2x + 15)^o = {}^1/_3$

5. Make **q** the subject of the formula in $\frac{A}{B}$ =

6. a) Complete the table below for the functions $y = \cos(2x + 45)^o$ and $y = -\sin(x + 30^o)$for $-180^o \leq x \leq 180^o$.

	-180	-150	-120	-90	-60	-30	0	30	60	90	120	150	180
y=Cos(2x + 45°)	0.71		-0.97	-0.71			0.71		-0.97			0.97	
y = -sin(x + 30°)	0.5	0.87			0.5			-0.87		-0.87			0.5

b) On the same axis, draw the graphs of $y = \cos(2x + 45)^o$ and $y = -\sin(x + 30)^o$
c) Use the graphs drawn in (b) above to solve the equation.

$$\cos(2x + 45)^o + \sin(x + 30)^o = 0$$

7. Without using tables or calculators evaluate $\frac{\sin 60^o \cos 60^o}{\tan 30^o \sin 45^o}$ leaving your answer in surd form.

8. (a) Complete the table below for the functions $y = 3\sin x$ and $y = 2\cos x$

X	0	30	60	90	120	150	180	210	240	270	300	330	360
3sin x			2.6	3			0	-1.5	-2.6	-3		-1.5	
2cosx		1.7	1.0			-1.7	-2	-1.0			1.0	1.7	2

(b) Using a scale of 2cm to represent 1 unit on the y- axis and 1cm to present 30^o on the x-axis ,draw the graphs of $y = 3\sin x$ and $y = 2\cos x$ on the same axes on the grid provided
(c) From your graphs:
  (i) State the amplitude of $y = 3\sin x$
  (ii) Find the values of x for which $3\sin x - 2\cos x = 0$
  (iii) Find the range of values of **x** for which $3\sin x \geq 2\cos x$

9. (a) Fill in the following table of the given function:-

x	0	90	180	270	360	450	540	630	720	810
sin ½*x*	0			0.71					0	
3Sin (½*x* + 60)					-2.6					2.6

(b) On the grid provided draw the graph of the function **y = sin ½*x*** and **y = 3Sin (½*x* + 60)** on the same set of axes

(c) What transformation would map the function **y = sin ½ *x*** onto **y = 3 Sin (½ *x* + 60)**

(d) (i) State the period and amplitude of function : **y = 3 Sin (½*x* + 60**

(ii) Use your graph to solve the equation: **3Sin (½*x* + 60) – Sin ½*x* = 0**

10. a) Complete the table below giving your answer to 2 decimal places

x°	0°	30°	60°	90°	120°	150°	180°
2sinx°	0	1		2			
1 – Cos x°			0.50	1			2

b) On the grid provided, using the same axis and scale draw the graphs of :-
y = 2sinx°, and y =1-cosx for
0°≤ x ≤ 180° , take the scale of
2cm for 30° on the x-axis
2cm for 1 unit on the y-axis

c) use the graph in **(b)**above too solve the equation 2sinx + cosx° = 1 and determine the range of values of for which 2 sinx° =1-cosx°

11. Solve the equation **2 sin (x + 30) = 1 for 0 ≤ x ≤ 360.**

12. (a) Complete the table below, giving your values correct to 1 decimal place

x	**0°**	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**90°**	**100°**	**110°**	**120°**	**130°**	**140°**	**150°**	**160°**	**170°**	**180°**
10 sin x	**0**	**-**	**3.4**	**5.0**		**7.7**		**9.4**	**9.8**	**10**	**9.8**	**9.4**		**7.7**		**5.0**	**3.4**		**0**

(b) Draw a graph of y = 10 sin x for values of x from 0° to 180°. Take the scale 2cm represents 20° on the x-axis and 1cm represents 1 unit on the y axis

(c) By drawing a suitable straight line on the same axis, solve the equation: -
500 sin x = -x + 250

12. Complete the table below for the functions y = cosx and y =2 cos (x 300) for θ≤x ≤ 3600

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
Cos *x*	1	0.87	0.5		-0.5	-0.87	-1.0		0.5	0		0.87	1
2 cos (*x* + 30°)	1.73		0	-1.0		-2.0	-1.73	-1.0		1	1.73	2.00	1.73

(a) On the same axis, draw the graphs of y cos x and y 2cos(x - 30) for O<x < 360°.
(b) (i) State the amplitude of the graph y = cos x^o.
(ii) State the period of the graph y = 2 cos (x + 30°).
c) Use your graph to solve
Cos x = 2cos(x+30°)

13. Solve the equation sin(2θ +10) = -0.5
for $0 \leq \theta \leq 2\pi^c$

14. Solve the equation
$4 \sin 2x = 5 – 4 \cos^2 x$ for $0° \leq x \leq 360°$

15. (a) Complete the table given below by filling in the blank spaces

X	0	15	30	45	60	75	90	105	120	135	150	165	870
4cos 2x	4.00		2.00	0	-2.00	-3.46	-4.00	-3.46	-2.00	0	2.00		4.00
2 sin (2x +30°)	1.00	1.73	2.00	1.73		0	-1.00	-1.73	-2.00	-1.73		0	1.00

(b) On the grid provided; draw on the same axes, the graphs of **y = 4cos 2x and y =2sin(2x +30°) for 0°≤ x≤180°**. Take the scale: 1cm for 15° on the **x-axis** and 2cm for 1unit on the y-axis
(c) From your graph:-
(i) State the amplitude of **y = cos 2x**
(ii) Find the period of **y = 2sin (2x + 30°)**
(d) Use your graph to solve:-
4cos2x – 2sin (2x +30) = 0

59. Three dimensional geometry

1. The figure below represents a plan of a roof with a rectangular base ABCD. AB = 20cm and BC=12cm. the ridge PQ = 8cm is centrally placed. The faces ADP and BCQ are equilateral triangles. **N** is the mid-point of BC

Calculate:

(a) QN
(b) The altitude of **P** above the base
(c)The angle between the planes ABQP and ABCD
(d) (i) Locus P and locus Q meet at X. Mark X
  (ii) Construct locus R in which angle BRC is 120^o
  (iii) Show that locus inside triangle ABC such that XS ≥ R

2.

The diagram alongside shows a right pyramid whose base is a regular pentagon of side 10cm.VA=B=VC=VD=VE=18.2cm and O is the centre of the pyramid. Calculate;

(a) height of the pyramid
(b) area of the pentagon
(c) angle between the face VAB and the base of the pyramid
(d) The pyramid is a container filled with orange juice.
  Calculate the amount of juice in it.
(e) find the surface area of the face VCD

3. The diagram below shows a right pyramid on a rectangular base ABCD measuring 7.5cm by 4.2cm.

4.2cm

If the volume of the pyramid is $52.5cm^3$, **find**:-
(i) The height of the pyramid
(ii) The length of a slanting edge correct to 1decimal place
(iii) The angle between AV and CV
(iv) The obtuse angle between the edges AB and VD

4. The figure below is cuboid ABCDEFGH. AB = 12cm, BC=5cm, CF = 6.5cm

E
F
M
6.5cm
G

H

D C

5cm

A

12cm B

Calculate:

(a) the length BD

(b) the angle AF makes with the base ABCD

(c) the angle DHGC makes with the base ABCD

(d) **M** is the mid-point of HE. Calculate the length of line MC and the angle line MC makes with the base ABCD

5. The figure below is a right pyramid with a rectangular base ABCD and vertex V.

O is the centre of the base and M is a point on OV such that OM = $^{1}/_{3}$ OV, AB = 8 cm, BC = 6 cm and VA = VB=VD = VC = 15 cm. Find ;

i) The height OV of the pyramid.

ii) The angle between the plane BMC and base ABCD.

6. The figure below represents a right pyramid with vertex V and a rectangular base PQRS, VP=VQ=VR=VS=18cm, PQ=16cm and QR=12cm. M and O are the midpoints of QR and PR respectively.

Find: a) the length of the projection of the line VP on the plane PQRS
b)the size of the angle between line VP and the plane PQRS
c) the size of the angle between plane VQR and PQRS

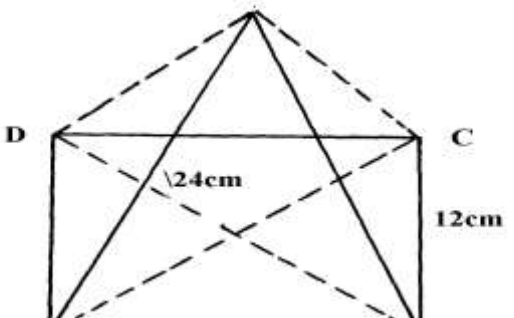
7. Mayoni Municipal Council wishes to construct a monument on the grounds. The monument is designed to be in the shape of a frustrum of a right pyramid. The base of the frustrum is a square of side 5.5meters while the top of the frustrum is a square of side 2.1cm

If the perpendicular distance between faces ABCD and EFGH is 7cm;
(a) find the surface area of the monument frustrum
(b) The monument is to be painted on all surface excluding the base. Paint is sold in 4 litre tins each costing Kshs.640/=. It is estimated that an area 10m^2 is painted by ½ litre of paint, find the cost of painting the monument.

8. The figure below is a pyramid of a rectangular base PQRS of length 12cm and width 9cm. The slanting edge has a length of 19.5cm

(a) Determine the height of the pyramid
(b) The angle PO makes with base PQRS
(c) The angle POS makes with QOR
(d) The volume of the pyramid

9. The diagram below shows a right solid pyramid on a square base ABCD of side 12cm and slanting height of 24cm



Calculate;
a) To two decimal place the height (VO) of the pyramid
b) the volume of the pyramid
c) the total surface area of the pyramid

10. The base of a pyramid consists of a regular pentagon **ABCDE, 4.5cm** a side. The vertex of the pyramid is **V** and **VA = VB = VC = VD = VE = 6.4cm.**
 (a) Sketch the general view of the pyramid
 (b) Calculate:
  (i) The angle between **VA** and the base
  (ii) The angle between face **VCD** and the base

11. The positions o two towns A and B on earths surface are (60°N, 139°E) and (60°N, 41°W) respectively
 a) Find the difference in longitude between A and B
 b) Given that the radius of the earth is 6370km, calculate the distance between A and B in KM
 c) Another town C is 420km East of town B and on the same latitude A and B find the longitude of town C

60. Longitudes and latitudes

1. The latitude and longitude of two stations **P** and **Q** are (47^oN, 25^oW) and (47^oN, 70^oW) respectively. Calculate the distance in nautical miles between **P** and **Q** along the latitude 47^oN

2. A pane leaves an airport **P** (10^oS, 60^oE) and flies due north at 800km/hr. By taking radius of the earth to be 6370-km and 1 nautical mile to be 1.853km,
 (a) Find its position after 2hrs
 (b) The plane turns and flies at the same speed due West to reach **Q** longitude 12^oW. Find the distance it has traveled due in West nautical miles
 (c) Find the time it has taken
 (d) If the local time at **P** was 1300hrs when it reached **Q**. Find the local time at **Q** when it landed at **Q**

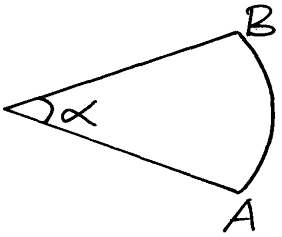
3. Bot juice company has two types of machines, A and B, for juice production
 Type A machine can produce 800 litres per day while type B machine produces 1600 litres per day.
 Type A machine needs 4 operators and type B machine needs 7 operators
 At least 8000 litres must be produced daily and the total number of operators should not exceed

41. There should be 2 or more machines of each type. Let x be the number of machines of type A and y the number of machines for type B,
a) Form all inequalities in x and y to represent the above information
b) On the grid provided below, draw the inequalities and shade the wanted regions
c) Use the grid in (b) to determine the least number of operators required for the maximum possible production

4. Points **R** and **S** are two points on the surface on a latitude 48°S. The two points lie on longitudes 30°W and 150°E respectively. By taking the earth's radius to be 6370km, calculate:
(a) The distance from **R** to **S** along a parallel of latitude.
(b) An aeroplane flies at an average speed of 2 80km/h from R to S along a great circle through the South Pole. Calculate the total time taken.
(c) The local time of R when the local time of R is 2.15m.
(d)Another point Q is 600Nm North of R .Find the location of Q

5. A jet flies from 34^{o}N, 12^{o}E to (34^{o}E , 24^{o}E) in 1 ½ hrs. Find its average speed in knots
P and **Q** are two points on a geographical globe of diameter 50 cm. They both lie on a parallel latitude 50^{o} North. **P** has longitude 90^{o} West and Q has longitude 90^{o} East. A string **AB** has one end at point **P** and another at point **Q** when it is stretched over the North pole. Taking $\pi = 3.142$;
(i) Calculate the length of the string.
(ii) If instead the string is laid along the parallel of latitude 50^{o}N with **A** at point **P**, calculate the longitude of point **B**
(iii) State the position of **B** if the string is stretched along a great circle of **P** towards the South pole if point **A** is static at **P**.

7. Two points **A**(70^{o}, 15^{o}E) and **B** lie on the same circle of latitude on the earths surface. Given that the shortest distance between the two points along the circle of latitude is 2133.6km. Giving coordinates to the nearest degree, find the location of **B**.
(Take $\pi = \frac{22}{7}$ and radius of earth = 6380km)



8. The position of two towns **A** and **B** on the earth's surface are (36^{o}N, 49^{o}E) and (36^{o}N, 131^{o}W) respectively (Earth's radius =6370km and $\pi = {}^{22}/_{7}$):-
(a) Find the longitudinal difference between the two towns
(b) Calculate the distance between the towns:-
  (i) Along a circle of latitude (in km)
  (ii) Along the great circle in km and nautical miles
(c) Another town **C**, is 840km due East to town **B**. Locate the position of town **C**

9. **P, Q** and **R** are points on the surface of the earth such that **P** (60^{o}N, 20^{o}W), **Q** (60^{o}S, 20^{o}W) and **R**(60^{o}N, 80^{o}E) find:
a) The shortest distance between **P** and **Q** on the surface of the earth in kilometres and nautical miles(**nm**)

b) The length of latitude 60°N and hence the length of the minor arc **PR** in kilometres
c) The distance from **P** to the North Pole

10. A jet flies from town **X** (50°S, 20°E) directly to **Y**(50°S, 28°W) and then due South for 1200m to **Z**
(a) (i) Find the latitude of **Z**
(ii) Calculate the distance XY along a parallel of latitude 50°S in km
(b) (i) Given that the average speed of the jet is 400 knots, calculate the time taken to reach **Z** from **X** to the nearest 0.1hour
(ii) Find the time of arrival at **Z** given that the plane left **X** at 7.40a.m. Take $\pi = {}^{22}/_{7}$ and radius of the earth to be 6370km

11. A jet on a rescue mission left town A(35°S, 15°E) to town B(45°N, 15°E) and then to town C(45°N, 45°W). If 1o subtends 60nm and the radius of the earth is 6370km. Find;
(a) the distance in nautical miles from A to C via B correct to 4 s.f
(b) the distance in kilometers from A to B to the nearest km
(c) the jet flew at 840km/h from A to C. If the jet left town A at 8.15a.m, what time will it arrive at town C in local time

61. Linear programming

1. A man bakes two types of cakes, queen cakes and marble cakes. Each week he bakes **x** queen cakes and **y** marble cakes. The number of cakes baked are subject to the following conditions; $30x + 20y \leq 4800$, $30x + 40y \geq 3600$ and $10x > 30y$
He makes a profit of shs.10 on each queen cake and shs.12 on each marble cake.
(i) Draw a graph to represent the above information on the grid provided
(ii) From the graph, determine how many cakes of each type he should make to maximize his weekly profit
(iii) Calculate the maximum profit
(iv) If he is to make a weekly profit of at least shs.600, find the least number of marble cakes he should bake

2. A company produces shirts and jerseys using two types of machines. Every shirt made requires 2 hours on machine **A** and 2 hours on machine **B**. Every Jersey made requires 3hours on machine **A** and I hour on machine **B**. In one day the time limit on machine **A** is 24hours but that on machine **B** is 12hrs. The number of Jerseys produced must not be more than the shirts produced in one day. The company makes a profit of shs.200 on each shirt and shs.200 on each Jersey. The company produces **x** shirts and **y** jerseys per day
(a) Write down four inequalities which must be satisfied by **x** and **y** and represent these inequalities on a grid
(b) Find the values of **x** and **y** which will give the company maximum daily profit and also state the maximum profit

3. A trader makes two types of chair, ordinary and special chairs. The cost of each ordinary chair is shs.300 while each special chair costs shs.700. He is prepared to spend not more than shs.21,000. It is not viable for hi m to make less than 20 chairs. Ordinary chairs must be less than twice the special chairs but more than 15. By taking the number of ordinary chairs as **x**

and special chairs as **y**:

(a) Write down all the inequalities in **x** and **y**

(b) Draw the inequalities on the grid provided

(c) He sells a special chair at a profit of shs.140 while ordinary chairs at a profit of shs.120; Determine the maximum possible profit

4. A school has to take 384 people for a tour. There are two types of buses available. Type X and type Y. Type X can carry 64 passengers and type Y can carry 48 passengers. They have to use at least 7 buses.

a) Form all linear inequalities which will represent the above information .

b) On the grid provided, draw the inequalities and shade the un-wanted region.

b) The charges for hiring the buses are ;

Type X: shs.25,000
Type Y: shs.20,000

Use your graph to determine the number of buses of each type that should be hired to minimize the cost.

5. A shoe maker makes two types of shoes **A** and **B**. He takes 3 hours to make one pair of type **A** and **4** hours to make one pair of type **B**. He works for a maximum of 120 hours to make **x** pairs of type **A** and **y** pairs of type **B**. It costs him Kshs. 400 to make a pair of type **A** and Kshs.150 to make a pair of type **B**. His total cost does not exceed kshs.9000. He must make at least 8 pairs of type **A** and **12** pairs of type **B**.

(a) Write down four inequalities representing the information above

(b) On the grid provided represent the inequalities and shade the unwanted regions

(c) The shoe maker makes a profit of kshs.40 on each pair of type **A** and kshs.70 on each pair

6. A theatre has a seating capacity of 250 people. The charges are shs.100 for an ordinary seat and shs.160 for a special seat. It costs shs.16,000 to stage a show and the threatre must make a profit. There is never more than 200 ordinary seats and for a show to take place at least 50 ordinary chairs must be occupied. The number of special seats is always less than twice the number of ordinary seats.

a) taking **x** to be the number of ordinary seats and **y** the number of special seats , write down all the inequalities representing the information above.

b) On the grid provided, draw the graph to show the inequalities in **(a)** above

c) Determine the number of seats of each type that should be booked in order to maximize the profit.

7. A man sells two types of ice creams in cups and sticks. He can store less than ten packets in his cooling box. He sells more cups than sticks but less than 3 items as many cups as sticks. He also knows that he will sell more than 3 packets of sticks. His profit is shs.3.00 on a packet of cups and shs.2.00 on a packet of sticks.

(a) Form inequalities to represent the above information:

(Let x – packets of cups and
y – packets of sticks)

(b) On the grid provided graph the inequalities to satisfy the required condition

(c) How many packets of cups and sticks should the man put in his box to give him the highest profit?

8. A shopkeeper bought 50 pangas and 30 jembes :-

(a) From a wholesalers for shs.4,260. He had bought half as many jembes and 5 pangas less, he would have paid shs.1290 less. Had the shopkeeper bought form wholesaler **B**, he would have paid 10% more a panga and 15% less for a jembe. How much would he have saved if he had bought the 50pangas and 30 jembes from wholesalers **B**

(b) The price of a suit if marked at shs.5000. A discount

9. The games master whishes to hire two matatus for a trip. The operators have a Toyota which carries 10passengers and a Kombi which carries 20 passengers. Altogether 120 people have to travel. The operators have only 20litres of fuel and the Toyota consumes 4 litres on each round trip and the Kombi 1 litre on each round trip. If the Toyota makes **x** round trips and the kombi **y** round trips;

(a) write down four inequalities in x and y which must be satisfied

b) represent the inequalities graphically on the grid provided

x-axis

(c) The operators charge shs.100 for each round trip in the Toyota and shs.300 for each round trip in the kombi;

(i) determine the number of trips made by each vehicle so as to make the total cost a Minimum

(ii) find the minimum cost

10. The velocity of a particle Vm/s moving in a straight line after t seconds is given by $\mathbf{V = 3t^2 - 3t - 6}$. Find the distance covered by the particle between **t = 1** and **t =** 4seconds

62. Differentiation

1. A particle moves in a straight line from a fixed point. Its velocity Vm/s after t seconds is given by $V = 9t^2 - 6t + 2$ calculate the distance traveled by the particle during the 2nd second. (4 mks)

1. A particle moves such that **t** seconds after passing a given point **O**, its distance **S** metres from **O** is given by **S= t (t-2) (t-1)**
   (a) Find its velocity when **t** = 2 seconds
   (b) Find its minimum velocity
   (c)Find the time when the particle is momentarily at rest
   (d) Find its acceleration when **t** = 3seconds

2. The table below gives the values of x and y for the curve $y=x^2 +1$

X	0	1	2	3	4	5	6	7	8	9	10
y	1	2		10	17		37	50		82	

a) Complete the table
b) Use the mid- ordinate rule to estimate the area enclosed by the curve $y = x^2 + 1$.
   Use five coordinates
c) Using integration, calculate the actual area in (a) above
d) Calculate the percentage error in the estimated area

3. The gradient function of a curve is given by the expression **2x + 1**. If the curve passes through the point **(-4, 6);** find the equation of the curve

4. A particle **P** moves in a straight line so that its velocity, Vm/s at time t seconds where $t \geq 0$ is given by $v = 28 + t – 2t^2$
   Find;
   (a) the time when **P** is instantaneously at rest
   (b) the speed of **P** at the instant when the acceleration of **P** is zero
   (c) Find the acceleration of **P** when the article is instantaneously at rest
   (d) Find the distance covered by the particle during the 3rd second, when at t = 0 D = 5M

5. A particle **K** moves a long a straight line 50 cm long. At time **t** = 0, **k** is at **A** and **t** seconds later its velocity **vcm/s** is given by $\mathbf{v = 15 + 4t - 3t^2}$**.**
   a) Write down the expression for;
      i) The acceleration of **K** at time **t** seconds.
      ii) The distance of **K** from **A** at time **t** seconds.
   b) i) Find **t** when **K** is instantaneously at rest.
      ii) How far is **K** from **A** at this time?
   c) Find the period of time during which the acceleration of **P** is positive.

6. The diagram below shows the sketch of the curve $\mathbf{y = x^2}$ and $\mathbf{y = -x^2 + 8}$ intersecting at **A** and **B**:-

(a) Find the value of **a** and **b** hence find the coordinates of A and B
(b) Find the area enclosed by **x = a,** x **= b**, the axis and:-
    (i) the curve $y = x^2$
    (ii) the curve $y = -x + 8$

7. The distance from a fixed point of a particle in motion at any time **t** seconds is given by :-
$S = t^3 - {}^5/_2 t^2 + 2t + 5$ metres
Find its:
(a) Acceleration after **t** seconds
(b) Velocity when acceleration is zero

8 A particle moves in a straight line. It passes through point **O** at **t = 0** with a velocity **v** = 5 m/s. The acceleration **a** m/s^2 of the particle at time **t** seconds after passing through **O** is given by
$a = 6t + 4$
(a) Express the velocity v of the particle at time t seconds in terms of t.
(b) Calculate the velocity of the particle when **t = 4.**
(c) (i) Express the displacement **s** by the particle after **t** seconds in terms of **t**.
    (ii) Calculate the distance covered by the particle between **t = 1** and **t = 4.**

9 . The displacement **S** metres of a particle moving along a straight line after **t** seconds is given by.

$$S = 3t + \frac{3t^2}{2} - 2t^3$$

a) Find its initial acceleration

b) Calculate:

i) The time when the particle was momentarily at rest

ii) Its displacement by the time it came to rest momentarily

c) Calculate the maximum speed attained

10. Find the equation to the tangent to the curve:-
$y = 4x^3 - 2x^2 - 3x + 5$ at the point (2, 23)

11. A farmer wanted to make a trough for cows to drink water. He had a metal sheet measuring 240cm by 120cm and 1cm thick. The density of the metal is 2.5g/cm^3. A square of sides 30cm is removed from each corner of the rectangle and the remaining part folded to form an open cuboid.

(a) Sketch the sheet after removing the squares for the four corners, showing all the dimensions

(b) Calculate:-

    (i) The area of the metal which forms the cuboid

(ii) The mass of the empty cuboid in Kilograms

(b) The cuboid is filled with water whose density is 1g/cm^3. Calculate the mass of the cuboid when full of water

12. A rectangular sheet of cardboard is 8cm long and 5cm wide. Equal squares are cut away at each corner and the remainder is folded so as to form an open box. Find the maximum volume

13. (a) Find the equation of the normal to the curve :- $y = x^3 – 2x – 1$ at (1, -2)

(b) Determine the nature of the turning points to the curve $y = x^3 – 3x + 2$; Hence in the space provided below, sketch the curve

14. A particle moves in a straight line so that its velocity, v/m/s at time t seconds where $\mathbf{t \geq 0}$ is given by $\mathbf{v = 28 + t – 2t^2}$

Find:-

(a) The time when **P** is instantaneously at rest

(b) The speed of **P** at the instant when the acceleration of **P** is zero

(c) Given that **P** passes through the point **O** of the line when t = 0;

(i) Find the distance of **P** from **O** when **P** is instantaneously at rest

15. A particle moves such that **t** seconds after passing a given point **O**, its distance **S** metres from **O** is given by $\mathbf{S= t (t-2) (t-1)}$

(a) Find its velocity when **t** = 2 seconds

(b) Find its minimum velocity

(c)Find the time when the particle is momentarily at rest

(d) Find its acceleration when **t** = 3seconds

63.Approximation of area

1 Use trapezoidal rule to estimate the area bounded by the curve **$y = 8 + 2x - x^2$ for $-1 \le x \le 3$** using 5 ordinates

2\. (a) Using trapezoidal rule, estimate the area under the curve $y = \frac{1}{2}x^2 - 2$ between $x = 2$ and $x = 8$ and x-axis. Use six strips

(b) (i) Use integration to evaluate the exact area under the curve

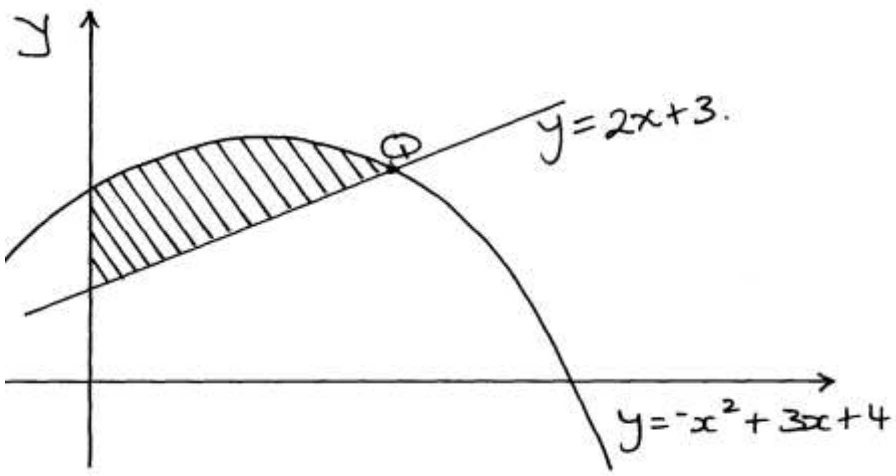
(ii) Find the percentage error in calculating the area using trapezoidal rule

3 (a) Using trapezoidal rule, estimate the area under the curve $y = \frac{1}{2}x^2 - 2$ between $x = 2$ and $x = 8$ and x-axis. Use six strips

(b) (i) Use integration to evaluate the exact area under the curve

(ii) Find the percentage error in calculating the area using trapezoidal rule

4 The figure below shows the graphs of $y = 2x + 3$ and $y = -2x^2 + 3x + 4$



Q

(a) determine the co-ordinates of Q, the intersection of the two graphs

(b) Find the exact area of the shaded region

5\. The table below shows some values of the function; $y = x^2 + 2x - 3$ for $-6 \le x \le -3$

x	-6	-5.75	-5.5	-5.25	-5	-4.75	-4.5	-4.25	-4.0	-3.75	-3.5	-3.25	-3
y	21	18.56		14.06		10.06	8.25		5		2.25	1.06	0

(a) complete the table

(b) using the completed table and the mid-ordinate rule with six ordinates, estimate the area of the region bounded by the curve; $y = x^2 + 2x - 3$ and the lines $y = 0$, $x = -6$ and $x = -3$

(c) (i) by integration find the actual are of the region in **(b)** above

(ii) Calculate the percentage error arising from the estimate in **(b)**

6 Complete the table below for $y = 5x^2 - 2x + 2$. Estimate the area bounded by the curve, the x – axis, the lines $x = 2$ and $x = 7$ using the trapezoidal rule with strips of unit length.

x	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7

y	18			56.25	74		117			200.25	

6. Integration

1. Evaluate:- $\frac{x^2 - 3x + 2}{x - 2}\, dx$

2. Find the values of **a** which satisfy the integral
$\int_o^a (x^2 + 1)\, dx = 2a$

Answers section I & II

1. L.C.M

1.

2	*20,*	*24,*	*26,*	*28*
2	*10*	*12*	*13*	*14*
2	*5*	*6*	*13*	*7*
3	*2*	*3*	*13*	*7*
5	*5*	*1*	*13*	*7*
7	*1*	*1*	*13*	*7*
13	*1*	*1*	*13*	*1*
1	*1*	*1*	*1*	

Size of the land = (2^3 x 3 x 5 x 7 x 13) + 7) aces
= 10920 + 7 = 10,927 aces

2.

2	*30*	*45*	*54*
3	*15*	*45*	*27*
3	*5*	*15*	*9*
3	*5*	*5*	*3*
5	*5*	*5*	*1*
	1	*1*	*1*

Least volume of x = 2 X 33 x 5 + 21
= 270 + 21 = 291

3. *L.C.M. of 30, 36 and 45*

2	*30*	*36*	*45*
2	*15*	*18*	*45*
3	*15*	*9*	*45*
3	*5*	*3*	*15*
5	*5*	*1*	*5*
	1		*1*

L.C.M. = $2^2 \times 3^2 \times 5 = 180$
The number m = 180 + 7 = 187

4. $x^2 + x = x(x + 1)$
$x^2 - 1 = (x + 1)(x - 1)$
$x^2 - x = x(x - 1)$
$x(x+1)(x - 1)$
$x^3 - x$

2. Integers

1. $X > -1$
$X \geq 3$

2. $2x\ 2^3 \times 8^x x\ 8^2 = 128$
$2x \div 2^3 \times 2^3 x \times 8^2 = 128$
Let 2^x be y
${}^{y}/_{8} \times y^3 \times 64 = 128$
${}^{8y}/_{8} = 128/8$
$y^4 = 16$ M1
$y^4 = 24$ M1
$\therefore y = 2$ A1

$-5 \times 6 \div 2 + (-5)$

3. $-12 - 3 = 4$
$4 \times 4 + 15$
Numerator 16 + 15 = 31
Denominator $-5 \times 3 + -5 = 31$
$-15 + -5$
$-15 + -5$
$= -20$
$\frac{31}{-20}$
$= -1\,{}^{11}/_{20}$

4. $= \frac{(-8) - (-4)}{-9 + 15} + \frac{(-16) + (-6)}{46 - 13}$
$= \frac{-12}{6} + \frac{-22}{33}$
$= -2 - \frac{2}{3}$
$= -2\frac{2}{3}$

5
$P^{-1} =$

$\frac{-1}{5}$

$P^{-1} R = \qquad =$

$= \begin{matrix} ^4/_5 & ^{-6}/_5 \\ ^1/_5 & ^1/_5 \end{matrix}$

6. $\frac{-8 \div 2 + 12 \times 9 - 4 \times 6}{56 \div 7 \times 2}$

$= \frac{-4 + 108 - 24}{16}$

$\frac{80}{16} \qquad = 5$

3. Fractions

1. $\frac{1}{2} \times \frac{7}{2} = \frac{3}{2} \times 1\frac{5}{6} \qquad \frac{3}{4} \times \frac{5}{2} \times X$

$\frac{7}{4} + \frac{3}{2} \times \frac{11}{2} \qquad = \frac{15}{4}$

$\frac{7}{4} + \frac{11}{4} = \frac{18}{4}$ B1

$\therefore \frac{18}{4} \div \frac{15}{4}$

$\frac{18}{4} \times \frac{4}{15} = \frac{6}{5} = 1\frac{1}{5}$ A1

2. $^2/_5 \div \frac{1}{2}\ 0f\ ^4/_9 - 1^1/_{10}$

$= ^2/_5 \div \frac{1}{2}\ X\ ^4/_9 - ^{11}/_{10}$

$= ^2/_5\ x\ ^9/_2 - ^{11}/_{10}$

$= ^9/_5 - ^{11}/_{10} = ^{18-11}/_{10} = ^7/_{10}$

$^1/_8 - ^1/_6\ X\ ^3/_8 = ^1/_8 - ^1/_{16}$

$= ^{2-1}/_{16} = ^1/_{16}$

$\frac{^2/_5 \div \frac{1}{2}\ 0f\ ^4/_9 - 1^1/_{10}}{^1/_8 - ^1/_6\ of\ ^3/_8} = \frac{^7/_{10}}{^1/_{16}}$

$= ^7/_{10}\ X\ ^{16}/_1$

$= ^{56}/_5 \quad = 11^1/_5$

3. BODMAS

$^3/_7\ X\ ^7/_3 = 1$

$^9/7\ X\ 1 = 9/7$

$^{3}/_{4} + {}^{9}/_{7} = 21 + 36 = 57$ M1
28 28
$^{9}/_{7} - {}^{3}/_{8} = 72 - 21 = 51 \times {}^{2}/_{3} = {}^{17}/_{28}$ M1
$^{57}/_{28} \times {}^{28}/_{17} = 3\,{}^{6}/_{17}$ A1

4. $\frac{2}{5} \times \frac{9}{2} - \frac{11}{10}$
$\frac{1}{8} - \frac{1}{16}$
$= \frac{7}{10} \times \frac{16}{1}$

$= \frac{56}{5} = 11\,\frac{1}{5}$

5. $^{3}/_{8}\,({}^{38}/_{5} - {}^{55}/_{36} \times {}^{12}/_{5})$

$^{3}/_{8} \times {}^{59}/_{15} = {}^{59}/_{40} = 1{}^{19}/_{40}$

6. Numerator
$\underline{({}^{9}/_{5} \times {}^{25}/_{18}) \div {}^{5}/_{2} \times 24}$
$^{7}/_{3} - (\,^{1}/_{4} \times 12\,) \div {}^{5}/_{3}$

$^{9}/_{5} \times {}^{25}/_{18} = {}^{5}/_{2} \div {}^{5}/_{3} \times 24$

$^{5}/_{2} \times {}^{3}/_{5} \times 24 = 36$

$7/3 - {}^{1}/_{4} \times 12 \div 5/3$
$7/3 - 3 \times 3/5$
$\therefore \underline{36} = 67.50$
$^{8}/_{15} = 67\,\frac{1}{2}$
$^{7}/_{3} - 3 \times {}^{3}/_{5}$

6. Let X be money raised
Teachers house = $^{1}/_{7}\,x$
Classrooms = $^{2}/_{3} \times {}^{6}/_{7} = {}^{4}/_{7}x$
Remainder = $^{1}/_{3} \times {}^{6}/_{7} = {}^{2}/_{7}x$
$^{2}/_{7}\,x = 300000$
x = Shs.1050000

4. Decimals

1. a) 471331.512

b) 7.273352

c) 40.16649692

2. Let r = 5.722222………………..
10r = 57.22222……………….
100r = 572.22222…………..
100r = 572.2222……………
10r = 57.222 ………….
90r = 515

3. $\frac{38 \times 23 \times 27 \times 100 \times 100000}{114 \times 575}$
= 36 For elimination of decimals For correct answer only

4. $\frac{84 \times 132 \quad \times 35}{287 \times 560}$
41 4 16

$= \frac{99}{41}$ 1

5. $\frac{12 \times 0.25 - 12.4 \div 0.4 \times 3}{⅛ \text{ of } 2.56 + 8.68}$
$\frac{3 - 31 \times 3}{0.32 + 8.68}$
$\frac{-90}{9}$
= -10

5. Squares and square roots

1. (a) (i) 24.78
(ii) 0.0316
(b) 24.78 – 0.0316 = 24.75 M1 A1

2. $3 \times \frac{1}{1.36 \times 10^{-2}} - 2x \frac{1}{13.84}$

3 x 8.575 – 2 x 0.07224
= 25.725 - 0.14448
= 25.58052
= 25.58

3. $\frac{153 \times 1.8}{0.68 \times 0.32}$

$\frac{158 \times 1.8 \times 10000}{0.68 \times 0.32 \times 10000}$

$\frac{158 \times 18000}{68 \times 32} = \frac{9 \times 9000}{4 \times 16}$

$\frac{9 \times 9 \times 10^3}{4 \times 16} = \frac{9 \times 10^{3/2}}{8}$

$1.125 \times 10^{3/2}$

6. Algebraic expressions

1. Let the daughter's age 5yrs ago be x
Mother 4x
come;
Daughter = x + 9
Mother = 4x+ 9
$4x + 9 = \frac{5}{2}(x + 9)$
$4x + 9 = 2.5x + 22.5$
$1.5x = 13.5$
$x = 9$
Mother = 41yrs
14 + 41 =55

2. B.P = 160 x 50 = 24000
$S.P = (\frac{(160 \times 8) - (20 + 12)}{8}) \times 180$
$= 28080$
Profit = 28080 – 24000 = Shs.4080

3. a) $6a + 7a - 2b - 4b + 2$
$= 13a - 6b + 2$

b) $\frac{2x-2}{2x} - \frac{3x+2}{4x} = \frac{2(2x-2) - (3x+2)}{4x}$
$= \frac{4x - 3x - 4 - 2}{4x}$
$= \frac{x - 6}{4x}$

4. $6u^2y^2 + 13uy - 5 = (2uy + 5)(3xy - 1)$

$3u^2y^2 – 13uy + X = (uy – 4) (3xy – 1)$

$$\frac{(2xy +5) \quad (3xy – 1)}{(uy – 4) \quad (3xy -1)}$$

$$= \frac{2xy + 5}{Uy – 4}$$

5. a) From $x + y$ and $x^2 = y^2 = 34$

$X = 8 – y$

Substituting for x in $x^2 – y^2 = 34$

$(8 – y) (8 – y) + y^2 = 34$

$64 – 8y – 8y + y^2 + y^2 = 34$

$64 – 16y + 2y^2 = 34$

$2y^2 – 16y + 64 – 34 = 0$

$2y^2 – 16y + 30 = 0$

$y^2 = 8y + 15 = 0$

$y (y – 3) – 5 (y-3) = 0 \quad (y-5) (y – 3)$

y is either 5 or 3

but $x – y = 8$

x is either 5 0r 3

$\therefore x^2 + 2xy + y^2 = 32 + 2 x 3 x 5 + 25$

$= 9 + 30 + 25 = 64$

b) $2xy = 2 x 3 x 5 = 30$

c) $x^2 – 2xy + y^2 = 9 – 2 x 3 x 5 + 25 = 4$

d) $x = y = 8$ and $x^2 + y^2 = 34$

$x = 8 – y$

$(8 – y)^2 + y^2 = 34$

$y^2 – 8y + 15 = 0$

$y^2 – 3y – 5y + 15 = 0$

$y(y -3) – 5(y – 3)$

$(y-3) = o \quad y = 3$

$(y-5) = 0 \quad y = 5$

$x + 3 = 8, x = 5$ or $x + 5 = 8$

$x = 3$

$\therefore$ x is either 3 or 5

y is either 3 0r 5

6. $$\frac{6x^2 + 35x – 6}{2x^2 – 72}$$

$$= \frac{6x(x -+ 6) -1(x + 6)}{2(x^2 – 36)}$$

$$= \underline{(6x – 1) (x + 6)}$$

$2(x-6)(x+6)$

$= \frac{6x-1}{2(x-6)}$

7. $\frac{2}{5}(3x-2) - \frac{3}{4}(2x-2)$

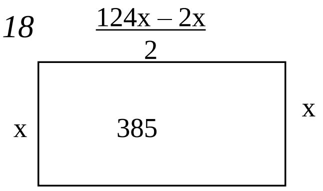
$= \frac{8(3x-2)-9(2x-2)}{12}$

$= 24x - 16 - 18x + 18$

$= \frac{6x+2}{12}$

$= \frac{2(3x+1)}{12}$

$= \frac{3x+1}{6}$



8. Numerator:

$4y^2 - x^2 = (2y+x)(2y-x)$

Denominator :

$2x^2 + 4yx + 3yx - 6y^2$

$= (2x^2 - 4yx) + (3yx - 6y2)$

$= 2x(x-2y) + 3y(x-2y)$

$= (2xx+3y)(x-2y)$

Combining : $\frac{(2y+x)(2y-x)}{(2x+3y)(x-2y)}$

$-\frac{2x+3y}{2y+x}$ or $\frac{-2x-3y}{2y+x}$

9. $\frac{3(x+y)-(x-y)}{X^2 - y^2}$

$= \frac{3x+3y-x+y}{x^2 - y^2}$

$= \frac{2(x+2y)}{x^2 - y^2}$

10. $x^2 + 2x - 5 = 3x + 1$

$x^2 - x - 6 - 6 = 0$

$(x+2)(x-3) = 0$

$x = -2$ or $x = 3$

When $x = -2$, $y = 3x - 2 + 1 = -5$ Point $(-2, -5)$

When $x = 3$, $y = 3 \times 3 + 1 = 10$ Point $(3, 10)$

11. (a) $\frac{y(y+2)}{y(y^2 - y - 60}$

$\frac{y(y+2)}{y(y^2 - y - 6)} = \frac{y+2}{(y+2)(y-3)}$

(b) $y + 2 \quad = \frac{1}{4}$

$(y + 2)(y-3)$

$4y + 8 = y^2 – y – 6$

$y^2 – 5y – 14 = 0$

$(y-7)(y+2)= 0$

$y=7$

$y=-2$

12. $\frac{104.6}{2.4} = 44 \times 2$

$\frac{63.9}{2.4} = 26 \times 2$

$= 88 + 54= 142$

13. $3 (25 x^2 – 9y^2)$

$3 (5x + 3y) (5x – 3y)$

14. i) $d = 8.4$ $r = ½$

6^{th} jump $= 8(½)^{6-1}$

$^{8.4}/_{32}$

$= 0.2625 = 0.26cm$

ii) $56 = \frac{9.4 (1 – (½) 6}{1 – ½}$

$= \frac{8.4 \times 63 \times 2}{64}$

$= 16.54$ cm

15. Factorizing the numerator

$= p(p^2 – q^2) + q(p^2-q)$

$= (p+q) (p^2-q^2)$

$= (p+q) (p+q) n(p-q)$

Factorising the denominator

$(p+q) (p+q)$

$\frac{\text{Numerator}}{\text{Denominator}} = p - q$

16. $\frac{(3x + 2y) (3x - 2y)}{(3x + 2y) (3x - 2y)}$

$\frac{3x + 2y}{4x + 3y}$

17. $(x – 3) (AX^2 +BX + C) = x^3 – 7x – 6$

$AX^3 + BX^2 +CX – 3AX^2 – 3BX – 3c = x^3 – 7x – 6$

$A = 1$

$B – 3A = 0$

$B - 3 \times 1 = 0$
$B = 3$
$-3c = -6$
$c = 2$

18. a) $8(2^2)^y = 6 \times 2^y - 1$
$\text{let } t = 2^y$
$8t^2 = 6t - 1$
$8t^2 - 4t - 2t + 1 = 0$
$(4t - 1)(2t - 1) = 0$
$t = ¼ \text{ or } ½$
$\therefore t = 2^y = ¼ = 2^{-2}$
$\therefore y = -2$
0r $t = 2^y = ½ = 2^{-1}$
$\therefore y = -1$
$\therefore y = -2 \text{ 0r } -1$

b) Numerator $= 2x^2 - 98$
$= 2(x^2 - 49)$
$= 2(x + 7)(x - 7)$
Denominator $= 3x^2 - 16x - 35$
$= 3x^2 - 21x + 5x - 35$
$= 3x(x - 7) + 5(x - 7)$
$= (x - 7)(3x + 5)$

$$\therefore \frac{2x^2 - 98}{3x^2 - 16x - 3} \div \frac{x + 7}{3x + 5} = \frac{2(x + 7)(x - 7)}{(3x + 5)(x - 7)} \text{ x } \frac{(3x + 5)}{(x + 7)}$$

$$= 2$$

19. $\frac{(2x - y)\ (2x + y)}{(x - 3y)(2x - y)}$ ✓ ✓

$\frac{2x + y}{x - 3y}$ ✓

20. $P^2 - 2pq + q^2 = (p - q)^2$
$P^3 - pq^2 + p^2q - q^3$
$= p(p^2 - q^2) + q(p^2 - q^2)$

$$= (p+q)(p^2-q^2)$$

$$\frac{(p-q)^2}{(p+q)(P^2-q^2)} = \frac{(p-q)^2}{(p+q)^2(p-q)} \checkmark$$

$$= \frac{p-q^1}{(p+q)^2}$$

21. Let the numbers be a and b

$a + b = 15 - x3$

$5a - 3b = 19 \text{ x } 1$

$3a + 3b = 45$

$5a - 3b = 19$

$8a = 64$

$a = 8$

$b = 7$

22.

$$\begin{array}{l} \quad\quad 4 \quad\quad 3 \quad\quad 2 \\ \frac{3(2x-5) - 4(1-x) - 6(x-4)}{12} \end{array}$$

$$\frac{6x - 15 - 4 + 4x - 6x + 24}{12}$$

$$\frac{4x - 5}{12}$$

23.

$$\frac{3a^2 + 4ab + b^2}{4a^2 + 3ab - b^2} = \frac{3a^2 + 3ab + ab + b^2}{4a^2 + 4ab - ab - b^2}$$

$$= \frac{3a(a+b) + b(a+b)}{4a(a+b) - b(a+b)}$$

$$= \frac{(3a+b)(a+b)}{(a+b)(4a-b)}$$

$$= \frac{3a + b}{4a - b}$$

7. Rates Ratio and percentages

1.

Men	cottages	days
5	2	21
x	6	21

$$x = \frac{6}{2} \text{ x } \frac{21}{21} \text{ x } 5 = 15$$

more men = 15 – 5 = 10

3. a) i) In 1 hr; Tap A fills $^{1}/_{3}$

2. Max Perimeter = 2(18.5 + 12.5)

= 62 cm

Working Perimeter = 2(18 +12)

= 60 cm

% error = $\frac{2}{60} \text{ X } 100 = 3.33\%$

B - $\frac{1}{4}$

Capacity filled in 1 hr = $^{1}/_{3} + \frac{1}{4}$

$= {}^{7}/_{12}$

$^{7}/_{12} = 1$ hr

$1 = 1 \text{ x } 1 \text{ x } {}^{12}/_{7}$

$= 1\,{}^{5}/_{7}$ hrs.

ii) $^{1}/_{3} + \frac{1}{4} - {}^{1}/_{6} = {}^{5}/_{12}$ ⇒ in one hr

$^{5}/_{12} = 1$hr

$1 = 1 \text{ x } 1 \text{ x } {}^{12}/_{5}$

$= 2\,{}^{2}/_{5}$ hrs

4. (a) $\frac{144000}{n-5} - \frac{144000}{R}$

$= \frac{720,000}{n(n-5)}$

(b) $\frac{720,000}{n(n-5)} = 2400$

$300 = n(n-5)$

$n^2 - 5n - 300 = 0$

$(n-20)(n+15) = 0$

Either n = 20, n = -15 m = 20

(c) contributed = $\frac{144000}{20}$ = 7200

(d) % increase = $\frac{2400}{7200} \text{ x } 100 = 33.33\%$

5. (a) In 1 hour $\frac{1}{40} + \frac{1}{15} + \frac{1}{20}$ of the tank will be filled

$= \frac{17}{120}$

In 5 hours = $\frac{17}{120} \text{ x } 5$

$= \frac{17}{24}$

(b) In two hours taps x and y

$\frac{1}{40} + \frac{1}{15}$ x 2 of the tank to be filled

$= \frac{11}{60}$

In 7 hours = $\frac{11}{60} + \frac{17}{24}$

$= \frac{107}{120}$

(c) Remaining fraction = $1 - \frac{107}{120}$

$= \frac{13}{40}$

In $\frac{1}{40}$ hour proportion, time taken

$= \frac{13}{120} \times 40h$

$= 4\,{}^{1}/_{3}$

Time taken = $7 + 4\,{}^{1}/_{3}$ = 11 hrs 20 min.

Tank will be full at 8.00 + 11hrs 20 min

1920 hrs or 7.30 p.m

6. Let Philip take x days to finish the job alone.

$$\frac{1}{x} + \frac{1}{x + 5} = \frac{1}{6}$$

$6 (x + 5) 6x = x(x + 5)$ ✓

$6x + 30 + 6x = x^2 + 5$

$x^2 - 7x - 30 = 0$

$(x - 10) (x + 3) = 0$ ✓

$x = 10$ and $x = -3$

7.

16	9	14
X	7	12

$X = 16 \times \frac{9}{7} \times \frac{14}{12}$

= 24men

Extra men = 24 -6

= 8men

8. a) Let the original no. of people be x

Originally each would contribute

$\frac{180000}{X}$

New contribution per person

$\frac{180000}{X - 3}$

$\frac{180000}{X - 3} - \frac{180000}{x} = 3000$

$180000x - 180000x + 540000 = 30000 - 9000$

$30x^2 - 90x - 5400 = 0$

$3x^2 - 9x - 540 = 0$

$X^2 - 3x - 180 = 0$

$(x- 15) \ (x + 12) = 0$

$X = 15$ or -12

Original number of people 15

b) $\frac{180000}{15} = \frac{180000}{15}$

c) Original contribution per person

Shs.12000

New contribution per person

$= \frac{180000}{12} \qquad = 15000$

% increase

$\frac{15000 - 12000}{12000} \times 100\%$

$\frac{3000}{12000} \times 100\%$

$= 25\%$

9. a) cost of running the business

$\frac{20}{100} \times 43200$

$= $ Shs.8640

b) 15% of profit

$\frac{15}{100} \times 43200 \quad =$ Shs. 6480

Rest of the profit

$= 43200 - (8640 + 6480) = 28080$

Ratio of contribution

40000 : 64000

5 : 8

Mue received

$\frac{1}{2}$ X 6480 = Shs.3240
$^{8}/_{13}$ X 28080 = Shs. 17280
= Shs.20320

c) Konie received
Shs.3240 + 10800 = 14040

$\frac{14040}{1800}$ = 7.8
= 7 cows

10. (7x – 3y) : 2x + 3y
x= 2 y= 1
14 – 9 : 4+ 9
5 : 13

11. a) B ___ bulls
G ___ Goats
5B + 30G = Kshs.117000 ……… Equation (i)
4B + 25G = Kshs.(117000 – 22250)
4B + 225G = Kshs.94750 ………… Equation (ii)

From equation (i) 5B + 30G = Kshs.117000 (dividing through by 5)
= (B + 6G = 23400) x 4
= 4B + 24G = 93600 ………….(iii)

Equation (ii) – q(iii) = 4B + 24G = 94750 -
$\underline{4B + 24G = 93600}$
G = 1150
∴ 1 goat costs Kshs.1150
Substituting in (i)
5B + 30 (1150) = 117000
5B + 34500 = 117000
5B = 825000
B = Kshs.16500

b) Abduls selling price
Bull $^{140}/_{100}$ x 16500 = 23100 x 5 = Kshs.115,500

Goat $^{130}/_{100}$ x 1150 = 1495 x 30 = Kshs.44850

Total 44850 + 115500 = Kshs.160350
= Kshs.160350
Ali's selling price
Bulls $^{150}/_{100}$ x 16500= 24750 x 4 = Shs.99000

Goats $^{140}/_{100}$ x 1150 = 1610 x 25 = Shs.40250

Total 99000 + 40250 = Kshs.139,250

Profit made
Abdul ________ Kshs. (160350 – 117000) = Kshs.43350

Ali __________ Kshs. (139250 – 94750) = Kshs.44500

Ali made more profit by Kshs.1150/=

12. Original costs
$T = {}^{8}/_{24}\,x = {}^{x}/_{3}$
$L = {}^{4}/_{24}x = {}^{x}/_{6}$
$R = {}^{12}/_{24}x = {}^{x}/_{2}$

New $T = {}^{x}/_{3}$ x 1.12 = 0.3733x
$L = {}^{x}/_{6}$ x 1.18 = 0.1967x
$R = {}^{x}/_{2}$ x 1.4 = 0.7x
Therefore % change

$$\frac{(0.3733x + 0.967x + 0.7x) - x}{X} \times 100$$

= 0.27 x 100
= 27%

13. Let Mary's yrs be x
Mothers age = 2 ½ x
4yrs ago Mary was x – 4
4yrs ago mother was 2 ½ x – 4

$$\frac{2\frac{1}{2}x - 4}{x - 4} = \frac{3}{1}$$

$^{5}/_{2}$ x – 3x = -12
- ½ x = -12
x = 24yrs
mother's age is $=({}^{5}/_{2}$ x 24)
= 60yrs

14. $$\frac{16 \times 9 \times 14}{7 \times 12}$$

= 24
Extra men = 24 – 16
B1= 8more men

15.. Ratio K : B = 3 : 4

a) Kongo got $\frac{3}{7} \times \frac{35}{100} \times 181300 = 27195/=$

Beatrice got $\frac{4}{7} \times \frac{35}{100} \times 181300 = 36260/=$

b) Kongo got $\frac{3}{7} \times \frac{60}{100} \times 181300 + 9000$

$= 136,620/=$

Beatrice got $\frac{4}{7} \times \frac{60}{100} \times 181300 + 120000$

$= \underline{182,160/=}$

16. Let no. be mn
$M + n = 9 \ldots (i)$
$10m + n$, reversed $10n + m$
$10n + m - 10m + n = 27$
$1n - 9m$

17. $V1 = \pi r^2$
h
$R = 130r = 1.3r$
$H = \frac{80h}{100} = 0.8h$
$V_2 = \pi R^2 h = (1.3r)^2 \times 0.8h$
$= 1.352V_1$
% change $= \frac{V_2 - V_1}{V_1} \times 100$
$= \frac{(1.352 - 1) V_1}{V_1} \times 100$
$0.352 \times 100 = 35.2\%$

18. In 1hr both fills = 1 + 1 -10 = 23
Tina to fill = 120 = 5 5/23
5hrs 13min

19.

16	9	14
X	7	12

$X = 16 \times \frac{9}{7} \times \frac{14}{12}$
= 24men
Extra men = 24 -6
= 8men

20. a) Expenses $= \frac{30}{100} \times 600,000$
= sh. 180,000
Business $= \underline{15} \times 420,000$

100
= sh. 63,000
Rest of profit = 357,000
Ratio 160 : 200 : 240
4 : 5 : 6

(i) Langat received = sh $\frac{4}{15}$ x 357,000
= sh 95,200
(ii) Korir received = sh $\frac{5}{15}$ x 357,000
= sh119,000

(iii) Koech received = sh $\frac{6}{15}$ x 357,000
= 142,800

(b) % = $\frac{119,000}{600,000}$ x 100
= 19.83

21. a) 125 :100 = 5:4

b) $^5/_4$ x 400 = 500

22. Alcohol A = $^{25}/_{120}$
= 30cm^3
Alcohol in B = $^{20}/_{100}$ x 180
= 36cm^3
Results = $\frac{36 + 30}{120 + 180}$
= $\frac{66}{300}$ x 100 =22%
Remaining = 300-x
Volume of alcohol = (300 –x) x $^{22}/_{100}$ = 66-0.22x
Total volume of alcohol = 66-0.22x + x
= 66 + 0.78x
% alcohol = $\frac{66 + 0.78x \text{ x } 100}{300}$ = 35
= 66 + 0.78x = 105
0.78x=39
x=50

23. Max Perimeter = 2(18.5 + 12.5)
= 62 cm

Working Perimeter = 2(18 +12)
= 60 cm
% error = $\underline{\ 2\ }$ X 100 = 3.33%

24. a :b = 1:2
b : c = 3:4
a:b = 3:6
b:c = 6:8
∴ a:b:c = 3:6:8

8. Length

1. $\frac{3x + 2y)\ (5x - 3y)}{(5x - 3y)\ (x-y)}$

$= \frac{3x + 2y}{x - y}$

2. 3N + ½ (R-M)

$$= 3 \begin{matrix} {}^{2}/_{3} & 1 \\ 2 & 4 \end{matrix} + \tfrac{1}{2} \begin{matrix} -1 & - & 2 \\ 0 & & 0 \end{matrix} \qquad \begin{matrix} 3 & 0 \\ -1 & 4 \end{matrix}$$

$$= \begin{matrix} 2 & 3 \\ 6 & 12 \end{matrix} + \tfrac{1}{2} \begin{matrix} -4 & 2 \\ 1 & 4 \end{matrix}$$

$$= \qquad + \begin{matrix} -2 & 1 \\ 0.5 & -2 \end{matrix} = \begin{matrix} 2 & 3 \\ 6 & 12 \end{matrix} \quad \begin{matrix} 0 & 4 \\ 6.5 & 10 \end{matrix}$$

9. Area

1. M x m value $= \frac{2.655 + 6.415}{6.405 - 2.655}$

$= \frac{9.07}{3.75}$

= 2.4187

2. (a) Number of tiles to cover the room $= \frac{10.5 \text{ x } 6}{0.3 \text{ x } 0.3}$

= 700 tiles

(b) (i) 15 x 700 tiles

$\frac{15 \text{ x } 700}{20}$ cartons

Cost $= \frac{15 \text{ x } 700}{20}$ x 800

Cost = Kshs. 420,000

(ii) Other expenses = 2000 + 600 = 2600/=
Total expenses = Kshs. 420,000 + 2600
= Kshs. 422600

Selling price = $\frac{112.5}{100} \times 422600$
= Kshs. 475, 425

Selling price per tile = $\frac{475,425}{525 \times 20}$
= 45.27
= Kshs. 45.00

3. $\frac{AC}{\text{Sin } 60^o} = 10 = AC = 8.66$
$\angle A70^o$, $\frac{BC}{\text{Sin } 70^o} = 10 = BC = 8.91$
Area = ½ x 8.66 x 8.91 sin 50°
= 27.28

4. S = ½ (170 + 190 + 210)
S = 285
Area = 285 (285 – 170) (285 – 190) (285 – 210)

= 2865 x 115 x 95 x75
= $\frac{15281m^2}{10,000}$
= 1.528ha

5. LCM of 30, 50 and 35 mins
30 = 2 x 3 x 5
35 = 5x 7 L.C.M = 2 x 3 x 5 = 1050
50 = 2 x 52
Into hrs $\left(\frac{1050}{60}\right)$ hrs = 17.5hrs
Next wail together at 7:18
+ 17:30
24:48
= at 1. 48 a.m on Tuesday

6. Maize – $\frac{1}{4} \times \frac{2}{3} = \frac{1}{6}$
Remainder – $\frac{2}{3} - \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$
Beans – $\frac{4}{5} \times \frac{1}{2} = \frac{2}{5}$
carrots – $\underline{1} \times \underline{1} = \underline{1}$

5   2   10

Let total area of farm be x acres

$\frac{1}{10}x = 0.9$

$x = 0.9 \times 10 = 9$acres

10. Volume and capacity

1. L.s.f. = $\frac{18}{24} = \frac{3}{4}$

A.s.f = $\frac{9}{16}$

v.s.f = $\frac{27}{64}$

$\frac{h}{3.2} = \frac{3}{4} \Rightarrow 4h = 3h + (3 \times 3.2)$

$h = 9.6$

(i) surface area of small cone:

$L = \quad 9^2 + 9.6^2 = 13.16m$

S.A = $(3.142 \times 9 \times 13.6) = 384.581$

Curved area of frustrum

$= \frac{7}{1} \times \frac{3.142 \times 9 \times 13.16}{9}$

$= 289.4$

Top area = $(3.142 \times 9^2) = 254.5cm$

$\therefore$Total area = $543.9m^2$

(ii)Volume of smaller cone = $\frac{3.142 \times 9^2 \times 9.6}{3}$

$= 814.41$

Volume of frustrum = $\frac{(37 \times 814.41)}{27}$

$= 1116.043m^3$

$= 1116043L$

Litres used per day= (15 x 15 x 40) + (116 x 65)= 16540L

No. of days = $\frac{1116043}{16540}$ = 67.5days

2. L.S.F = $\frac{3}{2} = \frac{28 + h}{h}$

$56 + 2h = 3h$

$h = 56cm$

Volume = $1/_3\, r^2H - 1/3r^2h$

$= {}^1/_3 \times {}^{22}/_7 \times 15 \times 15 \times 56 - {}^1/_3 \times {}^{22}/7 \times 10 \times 10 \times 28$

$= 13200 - 29331/_3$

= 10.2667litres

(b) Slant height = 152 + 562 = 3361
= 57.97cm
Curved surface – RL – rl

3. 2.6 x 4.8 x 3.2 = $39.936m^3$
$1m^3$ = 1000litres
$39.936m^3$ = 39.936 x 1000
= 39936 litres

4. The top surface of the frustrum is-2/3 way up the vertical height of the original one.
⇒VX: XY = 1/3h: h = 1:3
Using similar triangle we have
$\frac{R}{R} = \frac{VX}{VY} = \frac{1}{3}$
R:R = 1:3
$\frac{r}{R} = \frac{1}{3}$ ⇒ R = 3r
R = 3x7 = 21cm
(c)height of removed cone is $^1/_3$ height of original cone
h = $^1/_3$ x 45 = 15cm
volume of removed cone = $^1/_3\, r^2h$
$= 1 \times \frac{22}{7} \times 7 \times 7 \times 15$
= $770cm^3$
Now L. S. F = $^1/_3$
V. S. F= $(^1/_3)^3 = {^1/_{27}}$
Hence ratio of volumes = 1:27
Volume of original cone = 27x Vol. of small cone
= 770 x 27= $20790cm^3$
Capacity of frustrum
= vol. of original cone – vol. of removed cone
= 20790 – 770= $20020cm^3$
$\frac{20200}{1000}$ = 20 l

(d) capacity of tank = $\frac{150 \times 120 \times 80}{1000}$ = 1440l
No. of buckets = $\frac{1440}{20}$ = 72buckets

5. Mass of water = 1 x 3000 cm^3 = 3000 g
Mass of alcohol = 0.8 x 1200 = 9600g
Mass of mixture = 12,600g
Volume of mixture = 15,000 cm^3

Density of mixture = $\frac{12600}{15000}$

= $\underline{0.84g/cm^3}$

6. (a) Vol. of tank = 22 x 144 x 1.7 = 5.236

Vol. of milk = $^3/_5$ x 5.236 = 3.146m^3

Vol. in liters = 3.1416 x 1000 = 3141.6litres

(b) (i) Vol. of packet ($^1/_3$ x 10 sin 60) x 13.6

= 26.97 x 13.6

= 3.66.75cm^3

= 367cm^3

(ii) No. packets = $\frac{(3141.6 \text{ x } 1000)}{367}$

(iii) Amount = 8560.2 x 20

= 171204.3597

= Shs.171,204.40

7. Volume of culvert

= $^{22}/_7$ $(76^2 - 64^2)$ x 300 x 10^{-6}

= $^{22}/_7$ x $\frac{1680 \text{ x } 300}{10000000000}$

= 1.584m^3

11. Mass, weight and density

1. Density = $\frac{300 \text{ x } 1,000,000}{20 \text{ x } 1000}$

1

=15,000 kg/m^3

2. $D = \frac{M}{V}$

Mas $= D \times V$

$= \frac{1g}{cm^3} \times 2500cm^3$

$= 2500g$……………………………………(i)

Mass $= 0.8 \times 8000$

$= 6400g$ ………………………………(ii)

total mass $= (2500 + 6400)g$

$= 8900g$

Density of mixture $= \frac{8900g/cm^3}{10500}$

12. Time

1. Time between Monday 0545hr and Friday 1945

= 4x 24 + 14 = 110 hrs

Time lost = 0.5 x 110 = 55 min.

Time in 12 hr system

(1945 – 55 – 1200)

6.50 p.m.

2. Time between Monday 0445h and Friday 1845h

= 4 x 24 + 14 = 110h

Time lost = 0.5 x 110

= 55min

Time shown in 12 hour system

1845 – 55 = 1750 h

= 5.50 p.m

3. (a) 1600h – 830h = 7hrs 30min or 7 ½ hours

(b) Average speed $= \frac{300}{7½}$

= 40km/h

13. Linear

1. The diagram below shows the graphs of

$Y = \frac{3}{10}x - \frac{3}{2}$, $5x + 6y = 30$ and $x = 2$

By shading the unwanted region, determine and label the region R that satisfies the three inequalities;

$Y \geq \frac{3}{10}x - \frac{3}{2}$, $5x + 6y \geq 30$ and $x \geq 2$ (2 mks)

L_1 $y = \frac{3}{10}x - \frac{3}{2}$ at (0, 0)

$0 \geq 2$ *

Picking P(0,0)

$0 \geq -\frac{3}{2}$

L_2 $5x + 6y = 30$

At (0, 0) $5x + 6y \geq 30$

$0 \geq 30$ *

2. $7s + 3t = 2950$ ………………….(i) x 5

$3s + 5t = 2750$ …………………..(ii) x 3

$35s + 15t = 14750$

$\underline{9s + 15t = 8250}$

$26s = 6500$

$s = 250$

$t = \frac{2750 - 3(250)}{5} = 400$

$2t + 2s = 2(400) + 2(250)$

= shs. 1,300

3. Let the cost of a biro be b

Pencil be p

$2b + 5p = 120$ x 3

$3b + 2p = 114$ x 2

$6b + 15p = 360$

$\underline{6b + 4p = 228}$

$11p = 132$

$P = 121$

$2b + 60 = 120$

$2b = 60$

$b = 30$

$\therefore$The cost of 1 biro is 30/=

The cost of 1 pencil is 12/=

4. Let son's present age be n yrs

Father's age is 2n yrs

Ten years ago: son's age $\Rightarrow n - 10$

Father's age $\Rightarrow 2n - 10$

Son's present age = 30yrs

Father's present age = 2x 30 = 60yrs

5. $2x + 21 > 15 - 2x$ $15 - 2x \geq x + 6$

$4x > 0.6$ $-3x \geq -9$

$x > -1\frac{1}{2}$ $x \leq 3$

$\Rightarrow -1\frac{1}{2} < x \leq 3$

Values are -1, 0, 1, 2, 3.

6. $y = -2x + 4$
gradient of h line is ½
Equation $\frac{y + 4}{x + 1} = ½$
$2y + 8 = x + 1$
$2y – x + 7 = 0$

7. $2s + 3t = 1750$
$3s + 2t = 1500$
$4s + 6t = 3500$ $2t = 1500 – 600$
$9s + 6t = 4500$ $t = 450$

$5s = 1000$
$s = 200$
Shirt = sh 200
Trouser = sh 450

8. Let $r = 3.818181…$
$100r = 381.818181$
$99r = \frac{378}{99} = \frac{42}{11}$
$= 3^{9}/_{11}$

9. (a) Let cost of pencils be x and biro pens to be y
$4x + 6y = 66$
$2x + 5y = 51$

$4x + 6y = 66$
$4x + 10y = 102$
$4y = 96$
$y = 24$
Correct substitution
$\therefore x = 3$
Pencils = shs.9
Biro pens = 3

(b) $9p + 3b = 228...(i)$
$b –y = 4$
$b = 4 + r$ ....(ii)
substituting for b in ....(i)
$p^2 + 5p – 288 = 0$

$p = \frac{-5 \pm \ 25 – 4 x 1 x -228}{2 x 1}$
P = 13 (to the nearest whole no.)
$b= 4+ 13 = 17$

10. $3x – 2 (x + 2) = 21$
$X = 25$
Large No = 25 + 2 = 27
∴ product = 25 x 27 = 695

11. $x -20 + 3x = 180^oC$
$4x = 200$
$x = 50^o$

Attempt to get x by using ι+e = 180°
$e = \frac{(2n-4)90}{n}$
number of sides

12. $5x + 4y = 6160$
$\underline{4(3x + y = 2800}$
$-7x = - 5040$
$x = 720$
$y = 640$
$4(720) + 2(640) = 4160$

13. $2x + 3y = 390$
$5x + 2y = 810$
$15x + 6y = 2430$
$\underline{4x + 6y = 780}$
$11x = 1650$
$x = 150$
A pair of trouser =sh150
A shirt = sh30

14. Equations

1. Through A/C in Kenya
1000000 X 76.84 = Shs.7684000
through A/C in UK
$\frac{1000000}{1.53}$ X 115.70 = Shs.7,562,091.15
Through UK less by
768400 – 7562091.85 = 121,908.85

2. 6000 turn ______ 6000 X 84.15
= Kshs.504900
Balance = 504900 – 300000
= 204900
∴ sterling pound = $^{204900}/_{121.47}$
= 1686.8

3. In Rand = $\frac{2800265}{10.0166}$ = 279562.4264
Expenses = (115,700 + 97000 + 53689)
= 266389 Rand

Remainder = 279562.4264
266,389.000
13, 174.4264
Amount in Kshs. = 13174.4264 x 9.9399
= 130,942.50

4. Kshs. (3000 x 1.89) = 5670
Remain = 5670 – 4695 = 75
Francs = $\frac{975}{1.95}$ = 500

5. Amount in dollars = 75 x 40 = 3,000
Amount in Ksh = 3000 x 81.40 = 244,200/=
Less commission 4,000

Total received sh 240,200

6. Hong Kong 8105,000 x 9.74 = ksh.1022700
Amount spent in Kenya = 403879
Balance = 1,022,600 – 403,879 = 618,821
Amount in South Africa = $\frac{618821}{12.11}$= 51100rands

7. 500000 J yen into Kshs.= ($\frac{500000}{100}$ x 66.5)
= Kshs. 330,250
Amount spend in Kenya= Kshs. 16200
Remained with Kshs. (330250 – 16200)
= Kshs. 314,040
Kshs. 314040 into Euros:
= ($\frac{314040}{78.15}$)
= 4,018.554063Euros
He left Kenya with = 4,019 Euros (nearest Euro

8. 1 $ Kshs. 77.43
5600$ = (5600 x 77.43)
= 433608
Spent 201,367
Remainder = (433608 – 201367)
= 232241
1SR shs.9.51
Shs.232241
$\frac{1 \text{ x } 232241}{9.51}$

= shs.24420.715

9. 1UK £ = 125.30
9000 UK £ = 125.30 x 9000
= 1,127,700
Commission = 5/100 x 1,127,700 = 56,385
He got 1,071,315
Expenditure = ¾ of 1,071,315 = 803,486.25
Amt. left = 267,828.75

$$\text{In US \$} = \frac{267,828.75}{63.20}$$

= 4237.7966 ≃ 4237 US $

10. 1 sterling pound = Kshs.120
? = Kshs.100000
$^{100000}/_{120}$ = 833.3 sterling pounds
1 sterling pound = 1.79 U.S dollars
833.3 = ?
= 833.3 x 1.79 = 1491.7 dollars
1 U.S dollar = Kshs.78
1491.7 dollars = Kshs?
1491.7 x 78 = 116350 Kenya shillings

11. Amount received in Kenya shillings

$$= \frac{\Sigma 50,000 \times Shs.120.7131}{\Sigma} = Kshs.6035655$$

Amount received in sterling pound

$$= \frac{1\Sigma \times Kshs.6035655}{120.9294} = \Sigma 49910.568$$

12. Sh(20000 x 147.86) = sh.2957200

$$\text{To US Dollars} = \frac{44700}{74.5} = 6000$$

He received 6000 US Dollars

13. a) $6a + 7a - 2b - 4b + 2$
$= 13a - 6b + 2$

b)
$$\frac{2x-2}{2x} - \frac{3x+2}{4x} = \frac{2(2x-2)-(3x+2)}{4x}$$
$$= \frac{4x-3x-4-2}{4x}$$
$$= \frac{x-6}{4x}$$

1. $2x - 3y + 6 = 0$

   $-3y = -2x - 6$

   $y = \frac{2}{3}x + 2$

   When $y = 0$ $x = -3$

   $x = 0$ $y = 2$

   $\therefore$ Co-ordinate of y – intercept is (0,2)

   ” ” x – intercept is (-3,0)

   $\therefore \angle CAO = \tan^{-1}\frac{2}{3}$

   $= 33.69^o$

   $\therefore \angle\theta = 180 - 33.69^o$

   $= 146.31^o$

2. Point y $\left(\frac{4 + -2}{2}, \frac{7 + -1}{2}\right) = (1, 3)$

   grad AB $= \frac{7 + 1}{4 + 2} = \frac{8}{6}$

   grad xy = - ¾

   grad xy = - ¾

   $\frac{y - 3}{x - 2} = -\frac{3}{4}$

   $y = -\frac{3}{4}x + \frac{15}{4}$

3. $Y = 3x - 1$

   $M = 3$

   $M_1m_2 = -1$

   $M_2 = -\frac{1}{3}$

   $\frac{y - 3}{x - 2} = -\frac{1}{3}$

   $3y - 9 = -x + 2$

   $\frac{3y}{3} = \frac{-x}{3} + \frac{11}{3}$

   $Y = \frac{x}{3} + \frac{11}{3}$

4. Pt T is $\frac{1 + 5}{2}, \frac{4 + 10}{2} = (-2, 7)$

   grad. of grid xy $= \frac{10 - 4}{-5 - 1} = \frac{14}{-6} = \frac{-7}{3}$

   $\therefore$ grad of $L_2 = \frac{3}{7}$

   Take a general pt P(x,y) on L_2

   $\Rightarrow \underline{y - 7} = \underline{3}$

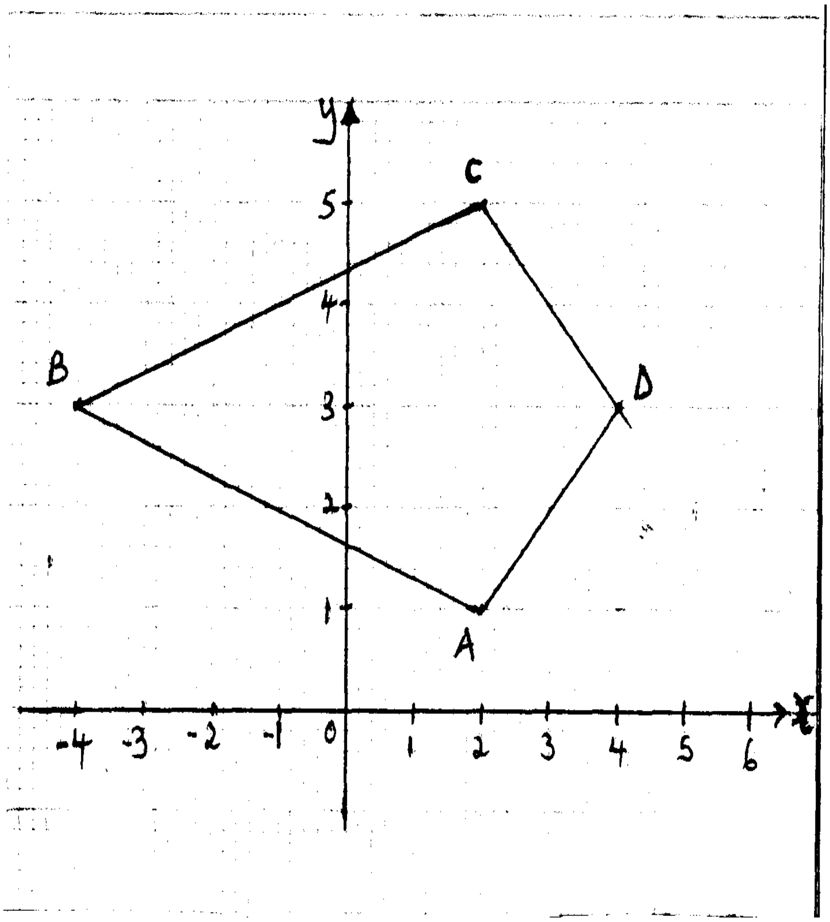
$x - 2 \quad 7$

$\Rightarrow 7y – 49 = 3x + 6$

$7y = 3x + 55$

Or $y = \underline{3x} + \underline{55}$ **Equation of L_2**

5. a, b



(c) Name : a kite

6. (a) Grad of line QP $= \frac{4-2}{1-3} = \frac{2}{-2} = -1$

Grad of line QR = 1

Take a pt Q(1,4) and T(x,y) on line QR

$y- 4 = 1$

$x – 1$

$y – 4 = x -1$

$y = x + 3$ .....equ. of QR

(b) $y= x+3$ …(i) Equ of QR

$y = 3x - 7$ ...(ii) Equ. of Pr
Solving simultaneously ;:
$x + 3 = 3x - 7$
$2x = 10$
$x = 5$
Substituting ; $y = 8$
$\therefore R$ is the pt (5,8)

$$\begin{array}{llllll} \text{(c) } \underset{\sim}{PS} = \underset{\sim}{QR} = & 5 & - & = & 4 & 1 \\ & 8 & & & 4 & 4 \end{array}$$

$$\begin{array}{llllll} \underset{\sim}{OS} = & 3 & + & = & 7 & 4 \\ & 2 & & & 6 & 4 \end{array}$$

S is the point (7,6)

7. a) Gradient OA = Gradient of CB

$$\frac{-1-0}{2-0} = -\tfrac{1}{2}$$

Gradient of CB

$$\frac{y-3}{0-4} = -\tfrac{1}{2}$$

$2y - 6 = 4$
$2y = 10$
$y = 5$

b) i) $AN = ON - OA = \frac{1}{2} OM - OA$
$OM = OA + \frac{1}{2} AB = (2) + \frac{1}{2}(2)$
$= 3$

$$\begin{array}{llll} AN = \tfrac12 & 3 & -2 & = \tfrac12 \;-\; {}^{1}/_{3} \\ \quad = \tfrac12 & 1 & -1 & \end{array}$$

ii) $NC = OC - ON$

$$\begin{array}{llllll} = & 0 & - & {}^{3}/_{2} & = & -{}^{3}/_{2} \\ & 5 & & \tfrac12 & & \tfrac12 \end{array}$$

$$\begin{array}{llllllll} \text{iii) } AC = OC - OA = & 0 & - & 2 & = & 2 & -1 \\ & 5 & & -1 & & & 3 \end{array}$$

c) $AN = \frac{1}{2} - \begin{matrix}1\\3\end{matrix}$

$NC = {}^{3}/_{2} \quad -{}^{1}/_{3}$

$4AN = AC$ And A is a common point hence A, N, C lie on a straight line.

8. a) Δ ABC line AB = 7 cm and BC = 8 cm.

Construction of ∡60^o

(b) AC = 7.6 $\underline{+}$ 0.1 and

∡ ACB = 53 $\underline{+}$ 1^o

(c) 2 sides bisector $\underline{1}$
Circle drawn radius 4.4. $\underline{\pm}$ 0.1

(d) Bisect ∡ ACB

Bisection line to cut the circle to identify P

∡ PBC measure ≡

(a) AB = 7 cm, BC = 8 cm

∡ ABC = 60^o

(b) AC = 7.6 $\underline{+}$ 0.1 cm

∡ ABC = $53^o\underline{\pm}0.1$

(c) Perpendicular bisectors of any two sides.
Circle drawn
Radius = 4.4.$\underline{\pm}$0.1. cm

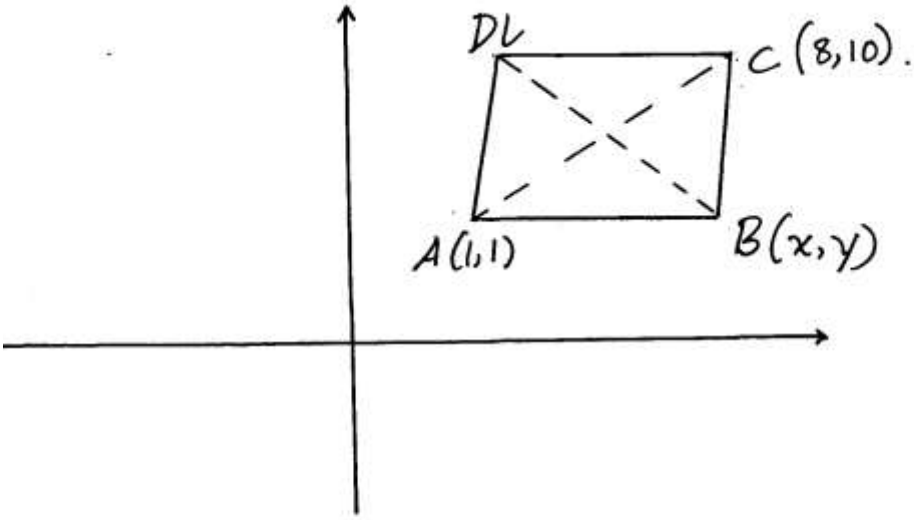
(d) ∡ ACB bisected

Bisection line drawn to cut circle at P

∡BPC = ∡BAC = 67^o

∡ PBC = 88 ± 0.1^o

9.



$M\left(\frac{1+8}{2}, \frac{1+10}{2}\right) = M(4.5, 5.5)$

b) AB: $4x - 5y = -1 \times 2$

BC: $5x - 2y = 20 \times 5$

$8x - 10y = -2$

$\underline{25x - 10y = 100}$

$-17x = -102$

$x = {}^{102}/_{17} = 6.0$

$24 - 5y = -1$

$5y = -25$

$Y = 5$

$\therefore \underline{B(6,5)}$

$\frac{x + 6.0}{2} = 4.5 \qquad x = 3$

$\frac{y + 5}{2} = 5.5 \qquad y = 6$

$\therefore \underline{D\ (3,6)}$

c) $AB = \sqrt{(16 - 1)^2 + (5-1)^2}$

$\sqrt{25 + 16}$

$\sqrt{41} = 6.40$ (units)

10. Mid ordinate

Area = 1.2 (6.2 + 4.3 + 2.6)

= 15.72

16. Coordinates and graphics

1. Let the exterior ∠ be x

$6.5x + x = 180$

$7.5x = 180^0$

$x = 24$

No. of sides = $\frac{360}{24}$

= 15 sides.

2. $\frac{(2n-4)\,90}{(2(n+2)-4)90} = \frac{3}{4}$

$\frac{2n-4}{2n} = \frac{3}{4}$

$8n - 16 = 6n$

$2n = 16$

$n = 8$

$(2(8) - 4)\,90$

$= 12 \times 90 = 1080$

3. $\frac{15}{2}\,\frac{b}{2} = 60$

$15b = 60 \times 4$

b = 16cm (diagonal)

$\Rightarrow \;=\; 8^2 + 7.5^2$

$\therefore per = 4 \quad 8^2 + 7.5^2$

= 43.86cm

4. $x^2 = 7.25^2 - 5.25^2$

$x = \sqrt{7.25^2 - 5.25^2}$

$= 52.5625$

$\underline{27.5625}\;\; -$

$\sqrt{25}$

= 5cm

B

x 7.25

5.25 A X

BC = 15.25 + 5 = 22.25cm

Arc CD = ${}^{90}/_{360}$ X 3.142 X 2 X 22.25

= 34.65475

Perimeter = AB + BC + CD + DE + EA

= 15.25 +7.25 + 22.25 + 34.95 + 5.25

= 84.95cm

5. $AB^2 = 10^2 - 8^2 = 100 - 64$

$AB^2 = 36$

AB = 6cm

$\text{Cos}\,(90^o - x^{o)}\,{}^{8}/_{10} = {}^{4}/_{5}$

Attempt to get x by using ι+e = 180°

e = $\frac{(2n-4)90}{n}$

number of sides

6. $x - 20 + 3x = 180^oC$

$4x = 200$
$x = 50^o$

7. $2x + 40 + x – 25$
$3x + 15 + 9 = 180$
$3x + 15 = 29$
$9 = ½ (3x + 15)$
$3x + \frac{3x}{2} = 180 -15-\frac{15}{2}$
$x = 35^o$
$x = 35 = 10^o$
$½ (10 + 110) = 60^o$

8. $\frac{1260}{90} = 14rt \angle s$
Sum of interior $\angle s$
$(2n -4) rt \angle s$
$2n-4 = 14$
$n = 9$ 9 sided polygon

9. $N = 50 + 40 = 90^o$
Alternative angles

10. $5^{3(y+1)} + 5^{3y} = 630$
Let $x = 5^{3y}$
$5^3 x 5^{3y} + 5^{3y} =630$
$125x + x = 630$
$x = 5$
$5^{3y} = 5^1$
$3y = 1$
$y = {}^1/_3$

11. $\frac{360}{n} + 108 = 180 - \frac{360}{n}$
$360 + 108n = 180n – 360$
$-72n = -720$
$n = 10$

12. Let exterior angle be x
$\frac{4x}{4} = \frac{180^o}{4}$
$x = 45^o$
$n=\frac{360}{\text{Exterior angle}}$
$n = \frac{360}{45}$

$= 8sides$

13\. a) Let $< BDC = ø$

$A^2 = 5^2 + 8^2 – 2 x 5 x 8 \cos ø$

$\cos ø = \frac{89 – 16}{80} = \frac{73}{80}$ $= 0.9125$

$Ø = 24°9$
1 $\boxed{1}$ $^{=}24°8$

b) Area of ABD

$= ½ x 8 x 10 \sin 24°9^1$

$= 40 x 0.4091$

$= 16.36cm^3$ 16.37 16.38

14\. (a) ∠CDF = 100-60=40^o (exterior angle of a Δ)

(b) ∠BDE = 20^o (DE is bisector of BDG)

∴∠ABD = 20^o (alternate angles)

15\. $4x + x – 30 = 180$

$5x = 210°$

$x = 42$

$(x -30)n = 360°$

$12n = 360°$

$n = \frac{360°}{12}$

$n = 30$

16\. $180(n-20) = 1440$

$n- 2 = \frac{1440}{180} = 8$

$n = 10$

Decagon

17\. <PQR =<SRT = x (Alt <SPQ //RS)

∴ 5x + 3x + x = 180° <'s of Δ

$9x = 180°$

$X = 20°$

$∴5 x 20 + y = 180$

$y = 180 – 120 = 60$

18\. Let the interior ∠ be x and exterior be y

$∴ x + y = 180$

$+$

$\underline{x – y = 132}$

$2x = 312$

x = 156
y = 180 – 156 = 24^o

No. of sides (n) = $\frac{360^o}{24}$ = 15

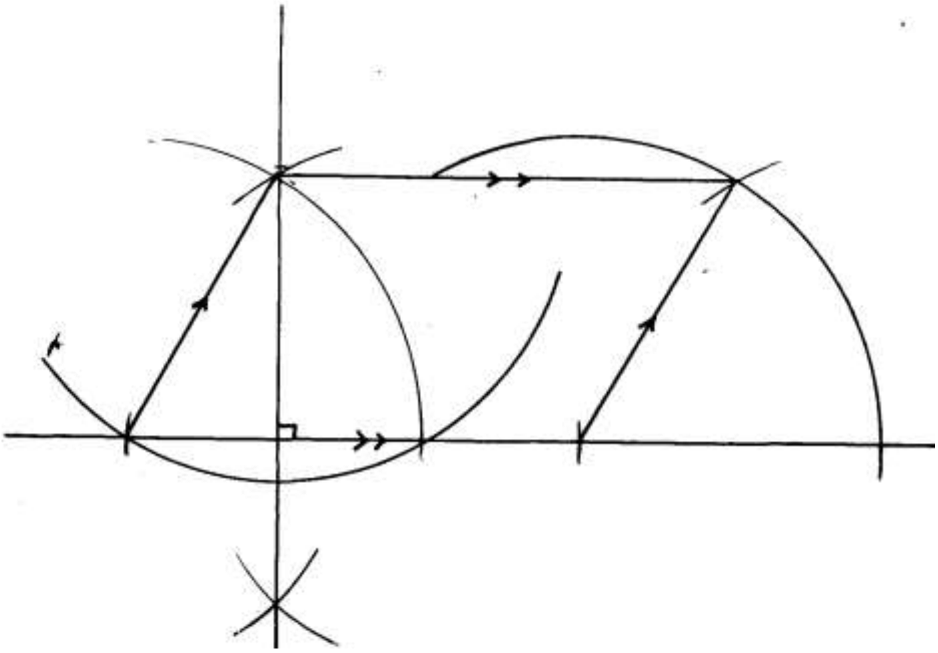
= 15 sides

17. Geometrical constructions

1. A = 120000 (1 + $^8/_{100}$ x ¼)^3

120000 (1.02)^3 = 127344.95

2.



3. BC = 3.5 cm ± 0.1 B_1

B1 construction of ∠CAB.

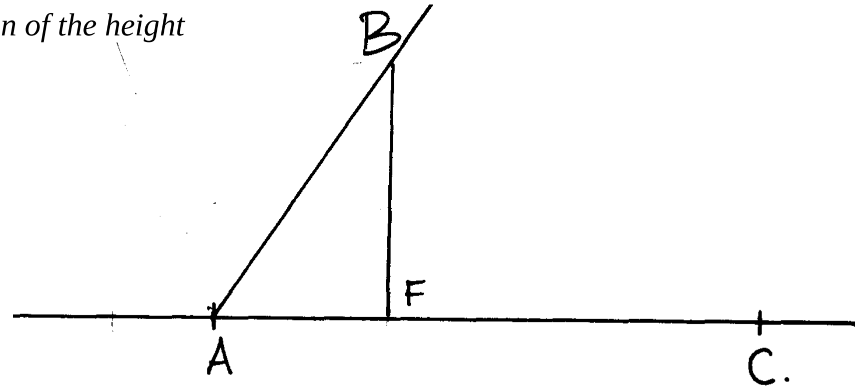
B1 completion of triangle.

N/B/ Arcs should be seen in order to award the above marks.

4. *Height = ± 8.7 1cm*
(½ x 7 x 8.7) 30.45cm^2
2 ±1cm

5. *Give 1m of correct and complete triangle*
Correct angle
Correct construction of the height

6.



7. *Marked price = $\frac{100}{90}$ x 450 = shs.500*
Cost = $\frac{100}{25}$ x 450 = shs.360
Profit = 500 – 360
= shs. 140

18. Scale drawing

1. a) $\frac{YZ}{\sin 28^o} = \frac{13.5}{\sin 100^o}$
Duration of travel = 8:55a.m – 7.35a.m
= $^4/_3$
Speed = $\frac{6.436}{^4/_3}$
= 4.827km/hr

(b) *13.5 = 6.436 + ZQ*

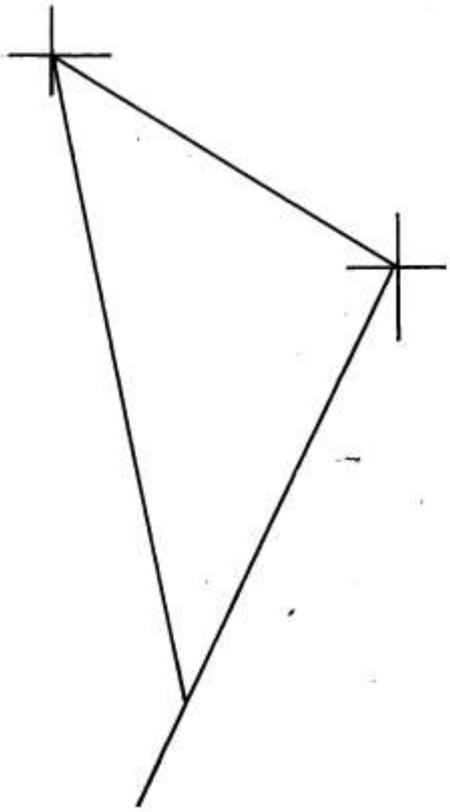
Sin 10^o Sin 118^o

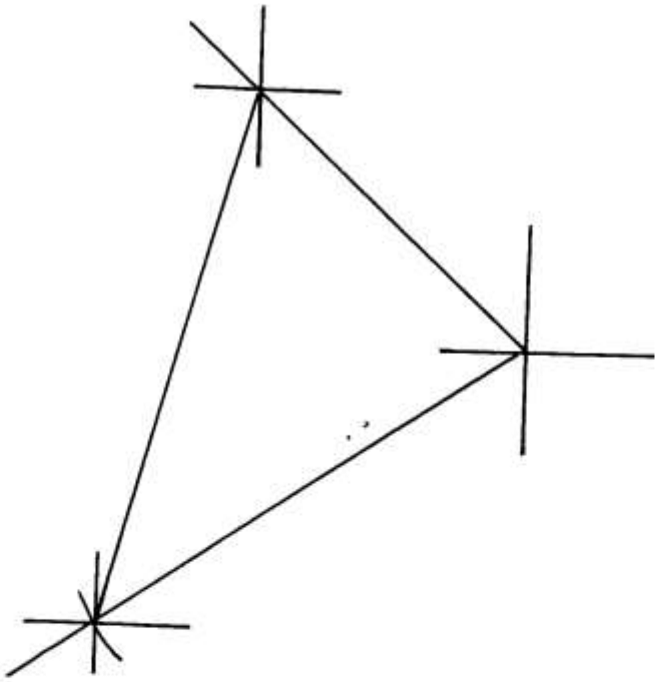
$6.436 + ZQ = 13.5 \times \sin 118^o = 68.659$

$ZQ = 68.659 - 6.436$

$= 62.223$

2. 1cm rep 100km

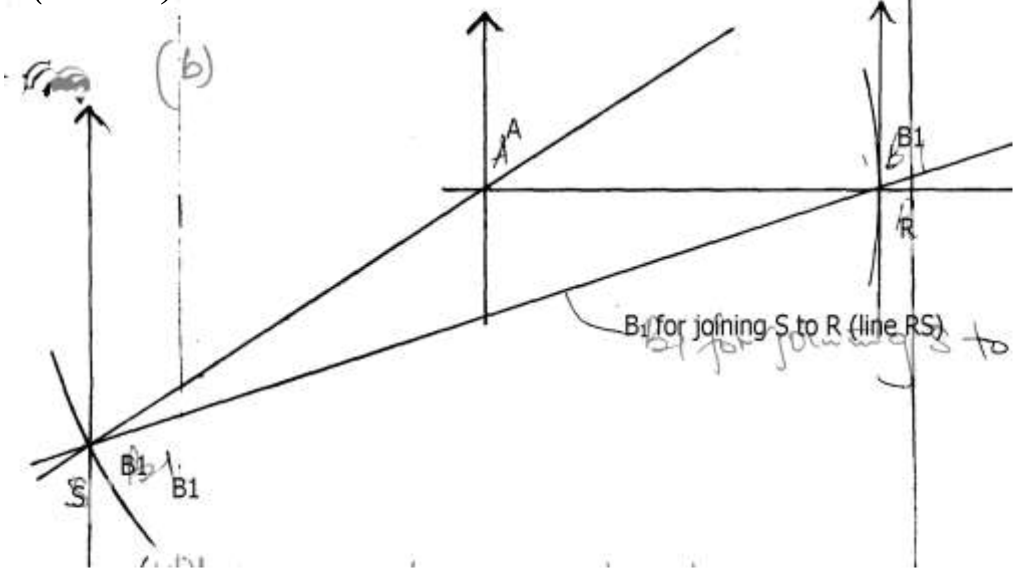




b) i) 049 ± 1
ii) 190 ± 1
c) 6.7 ± 0.1
670 ± 10

3. a) (i) Distance covered by s
= (750 x ½)km = 375 km

Distance covered by R
= (600 x ½) km = 300 km



(b) (i) Distance between the two aeroplanes

= 12.5 x 50 = 625 $\underline{+}$ 5 km

(ii) Speed = $\frac{625}{45}$ x 60 km/hr

= 833 $^1/_3$ km /h

(c) (i) Bearing of S from R = 225^o

(ii) The bearing of R from S = 72^o

4.

Area A: ½ x 25 (33 + 21) = 675
Area B: ½ x 40 (21 x 42) = 1260
Area C: ½ x 30 x 42 = 630
Area D: ½ x 25 x 40 = 500
Area E: ½ x 5 (40 + 25) = 162.5
Area F: ½ X 60 (25 + 36) = 1830
Area G: ½ x 5 x 36 = 90 √
= 5,147.5m^2

5. *A to C = 96 ± 1 km*
Bearing = 300^o

(i) 62 ± 1km
(ii) 97 ± 1 km
a. 304^o
030^o

6. *Graph*

b) i) 80 km
ii) 11.06a.m

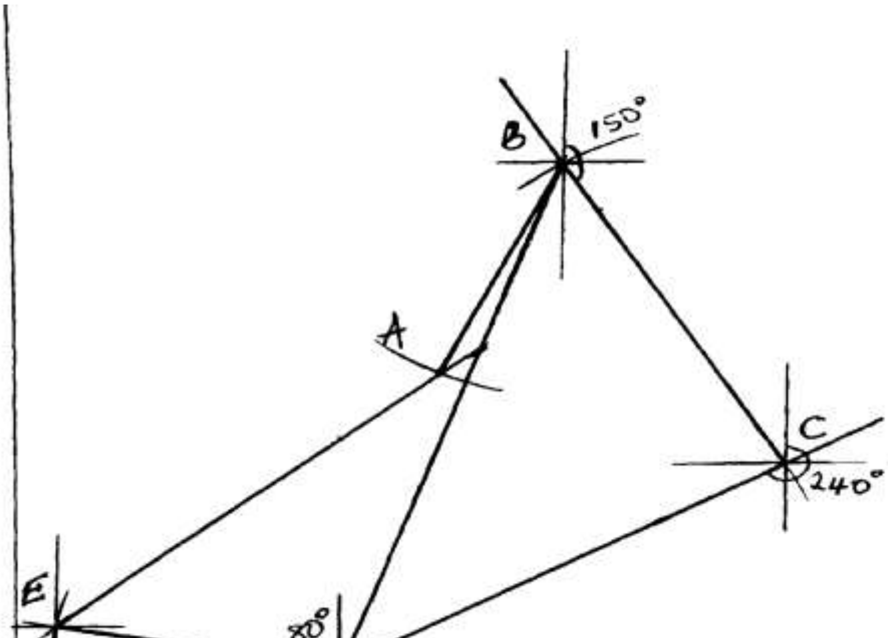
c) Average speed of the 2nd train
Time taken $= 80 \div 1^{11}/_{12} = \frac{80 \times 12}{23}$
$= 41.74$ *km/h*

7. *L.S.F* $= \frac{4}{2000000} = \frac{1}{500000}$
A.S.F $= \left(\frac{1}{5 \times 10^5}\right)^2 = \frac{1}{2.5 \times 10^{11}}$

Area of rectangle $= (2.4 \times 1.5)\ cm^2$
$= 3.6cm^2$
Actual area $= \frac{3.6 \times 2.5 \times 10^{11}}{100 \times 10000}$ *ha*
$= 9 \times 10^5$
= 900,000ha

8. *a) Δ ABD √ly constructed*
Δ ABP
b) i) AD = 4.5 + 0.1cm
Distance A + D
= 4.5 X 10 = 45km
ii) Bearing of (i) from B
= 241 + 1
iii) Bearing P from D
= 123 = 2
iv) Dp = 12.9 + 0.2 am
Distance D + P = 12.9 X 10
= 129 km

9. a)



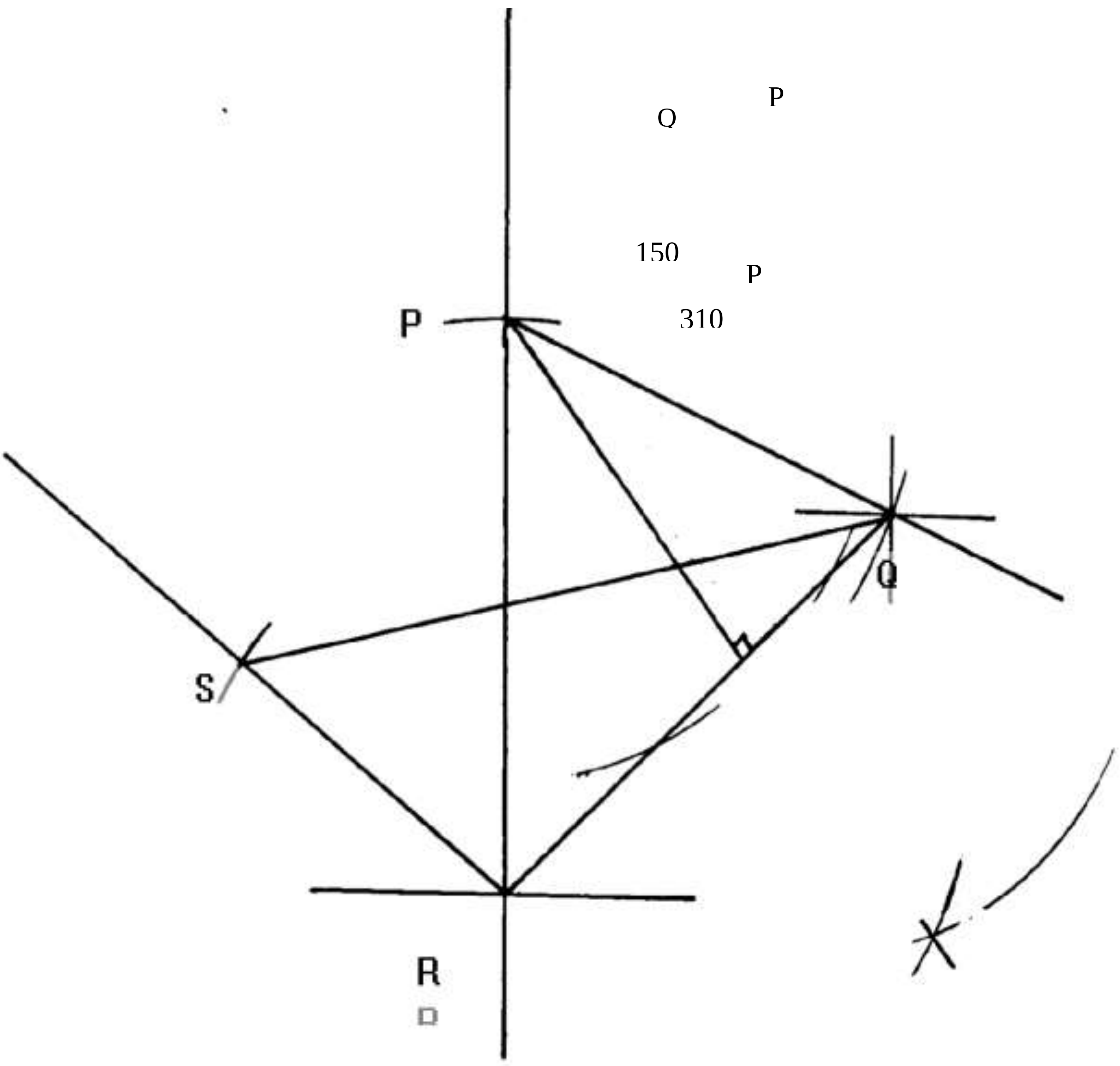
b) i) 6.8 + 0.1cm

Distance Ae = 340 + 5 km

ii) 180 + 18 = 198 + 2

10. a)

P 310



b) (i) *SP = 7.8 x 50 = 390 km ± 5 km*

(ii) *S & Q = 255° ± 1°*

(iii) *4 x 50 = 200 km + 5 km*

11. (a) *Scale = 50km*

Drawing accurately<NCE = 25°

<NCT = 145°

<NTY = 90°

Lines drawn //

(b)By measurement:

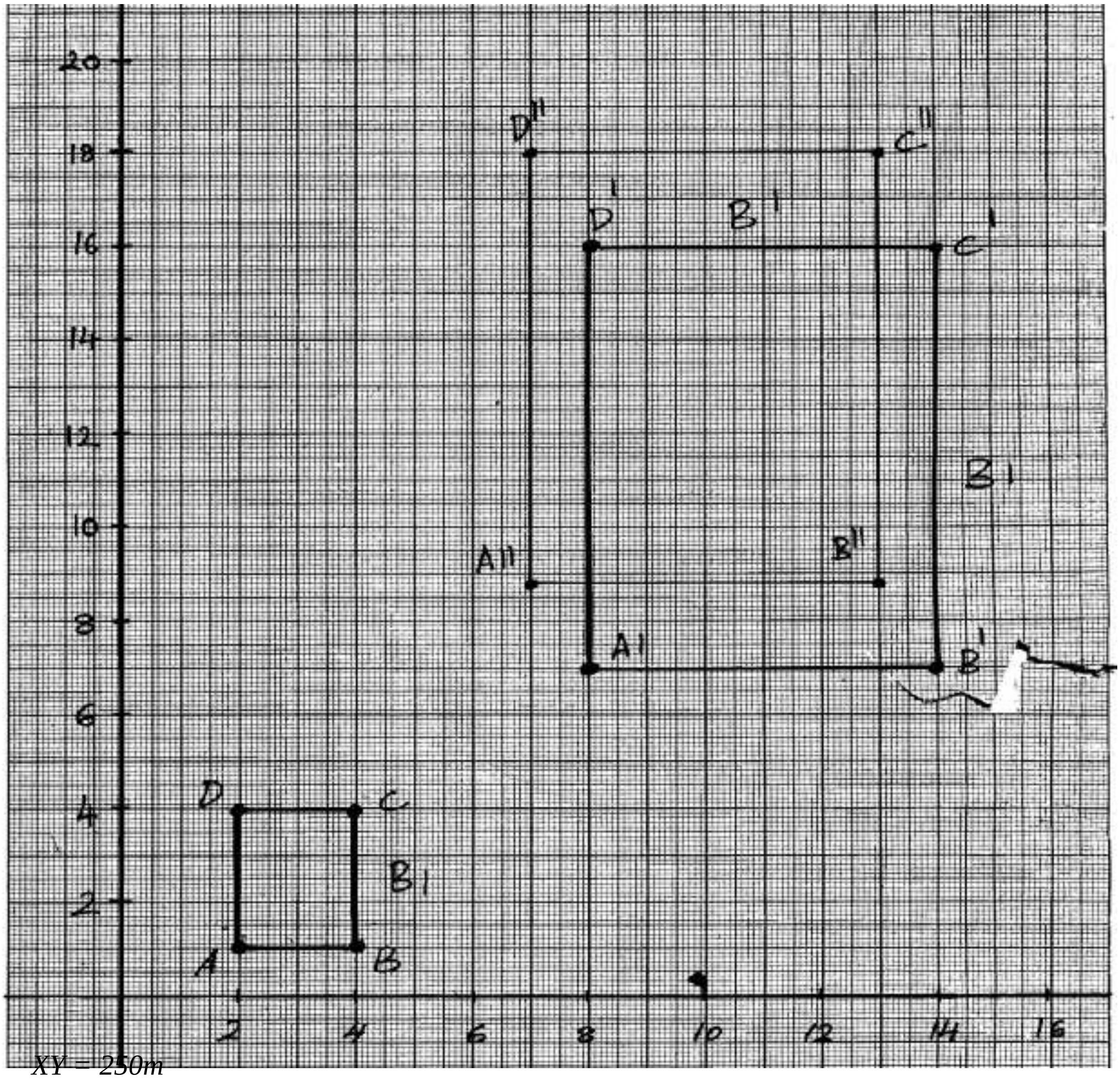
(i) Distance SY = 6.9 x 50 = 345± 5km

Bearing Y For S = 360^o – 114 = 246±1^o

(ii) distance ST = 7.9 x 50 = 39.5 ±5km

(iii) distance YT = 9.8 x 50 = 490 5km

12.



XY = 250m

Area of A = ½ x 50 x 60 = 1500m^2

B = ½ x 70 x 60 = 2100m^2

C = ½ (60 +80) x 120=11050m^2

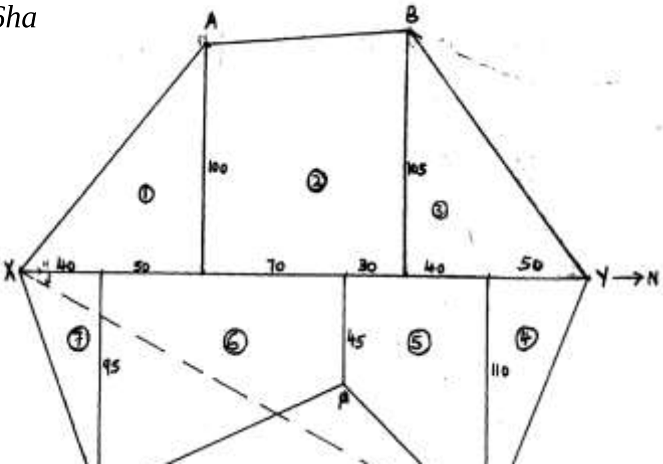
D = ½ x 80 x 80 = 3200m^2

F = ½ x 10 x 70 = 350m^2

Total area = 26600m^2

$Ha = \frac{26600}{10,000} = 2.66ha$

13.



(b) Total area = area (1) + (2) + (3) + (4) +(5) + (6) + (7)

$\text{Area }(1) = \frac{1}{2} \times 90 \times 100 = 4500m^2$

$(2) = \frac{(100 + 105)}{2}10 = 10250m^2$

$(3) = \frac{1}{2} \times 90 \times 105 = 4725m^2$

$(4) = \frac{1}{2} \times 50 \times 110 = 2750m^2$

$(5) = \frac{1}{2} \times (110 + 45)70 = 5425m^2$

$(6) = \frac{(45 + 95)}{2}\ 120\ 8400m^2$

$(7) = \frac{1}{2} \times 40 \times 95 = 1900m^2$

$\text{Total area} = 37{,}950m^2$

$\text{In hectares} = \frac{(37950)}{10{,}000}\text{ ha} = 3.795\text{ha}$

(c) (i) bearing of E from x is 0.25 $\pm 1^o$

` (ii) Distance Ex = (12.8 0.1 x 20m) = 256 $\pm$ 2m

14. Area $A = \frac{1}{2} \times 170 \times 80 = 6800$

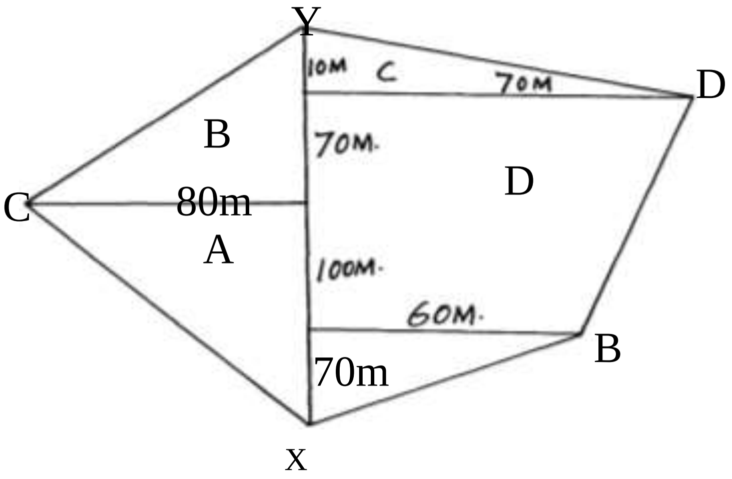
$B = \frac{1}{2} \times 80 \times 80 = 3200$

$C = \frac{1}{2} \times 10 \times 70 = 350$

$D = \frac{1}{2} \times 170 \times 130 = 11050$

$E = \frac{1}{2} \times 70 \times 60 = \underline{2100}$

$\text{Total} = 23{,}500\ m^2$



15. (a) $\text{L.s.f} = \frac{1}{40{,}000}$

$\frac{1}{40{,}000} = \frac{3.25}{x}$

$x = 130{,}000\text{cm}$

(b) $\text{A.s.f} = \left(\frac{1}{40{,}000}\right)^2$

$\left(\frac{1}{40{,}000}\right)^2 = \frac{x}{36{,}000{,}000}$

$x = 0.0225cm^2$

16.

Peter

(a) bearing = 180 + 20 = 200^o

(b) $a^2 = 1500 +$

$a^2 = b^2 + c^2 - 2bc \cos A$

$a^2 = 1500^2 + 800^2 - 2 \text{ x } 1500 \text{ x } 800 \cos 60$

$= 2250000 + 640000 - 1200000$

$= 1690000$

$\therefore a = 1300m$

(c) $\frac{1300}{\text{Sin } 60} = \frac{1500}{\sin c}$

$1300 \sin c = 1500 \sin 60$

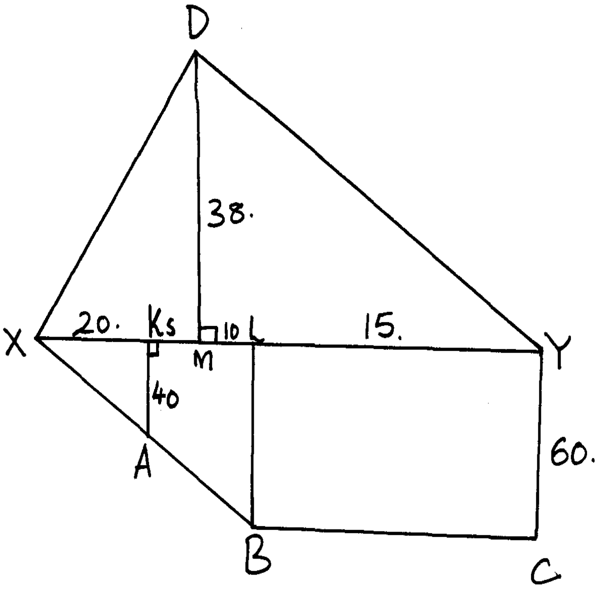
$\text{Sin } c = \frac{1500 \sin 60}{1300}$

$= 0.9993$

$\therefore c = 87.79^o$

$c = 87.80$

17.



. A of Δ XYD = ½ x 50 x 38 = $950m^2$

A of XBCY = ½ (50 + 15) 60

= ½ x 65 x 60

$= 1950m^2$

Total A $= (950 + 1950)m^2$

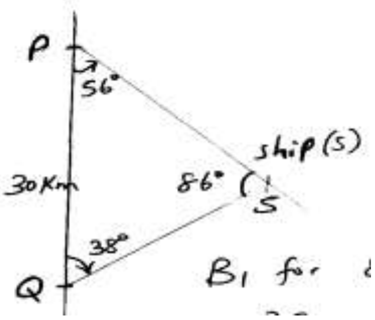
$= 2900m^2$

18. B1 for 86^o

$\frac{30}{\text{Sin } 86^o} = \frac{Q5}{\text{Sin } 56^o}$

$QS = \frac{30\sin 56^o}{\text{Sin } 86^o}$

$= 24.93km$



19. 1cm for 100000cm

$1cm^2 = (100000cm)^2$

Area $= 5.4 \times 4.5 \times 100000\ cm^2$

$= \frac{5.4 \times 4.5 \times 100000 \times 100000Km^2}{100000 \times 100000}$

$= 24.3km^2$

21. $\frac{\theta}{360} \times \frac{22}{7} \times 6370 \times 2 = 900$

$= \frac{900 \times 360 \times 7}{22 \times 6370 \times 2}$

$= 8.1^o$

Latitude of B $= 8.1^o - 5^o$ N

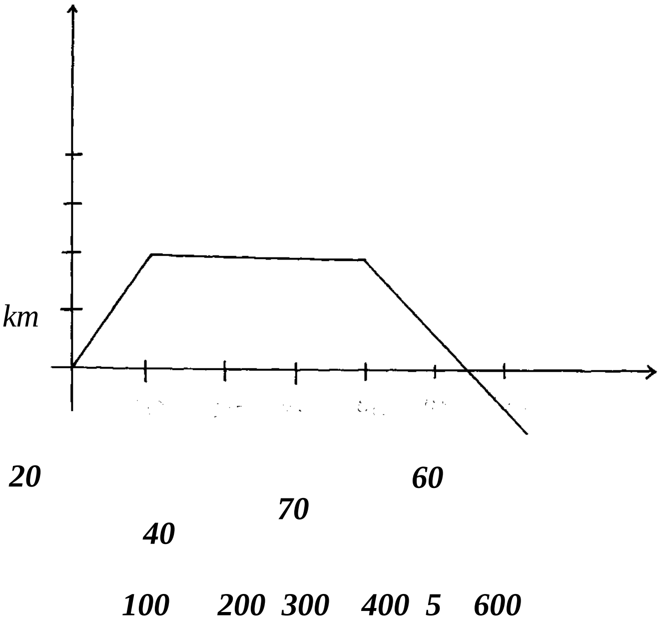
$= 3.5^o$ S

22. i) acc $= \frac{40 - 20}{100 - 50}$

$= {}^{20}/_{50} \qquad = 0.4m/s$

ii) $\frac{20 - 40}{460 - 400} = \frac{-20}{60} \qquad = 0.3333\ m/s^2$

iii) Area $= ½\ (520 + 300) \times 40 \times {}^{1}/_{1000} \qquad = 16.4$ km



23. a) Tan 11.3 $= \frac{200}{x}$

$x = \frac{200}{\text{Tan } 11.3} \qquad = 100.1m$

b) $\frac{(36 \times 1000)}{60 \times 60}$ m/s

D $= (10 \times 5)$ 50m Tan $\theta = 7.590$

< of depression $= 7.590$

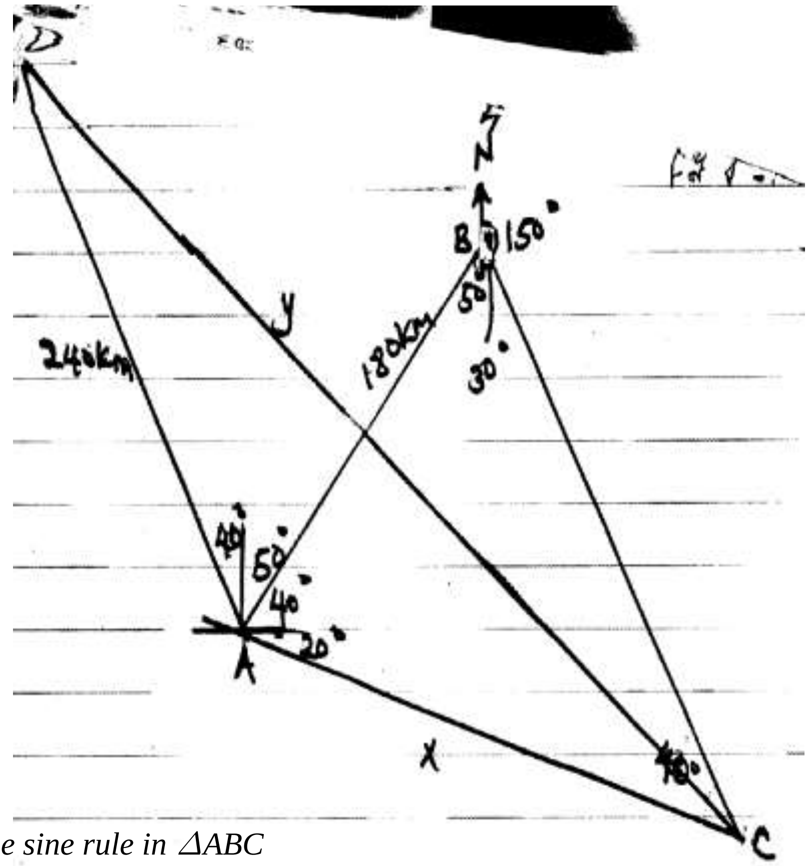
c) i) $\sqrt{50.9^2 - 49.9^2}$ = 10.04cm

ii) $\tan \theta = \frac{10.04}{200}$

$= 2.874°$

$= 3°$

24. a) Make a sketch to show positive of A, B, C and D



For √ sketch
For √ exp. of x
For √ ans.
For √Sub.
√cos 150
For taking sq. root.
For exp. of BC

Use sine rule in ΔABC

$\frac{X}{\sin 80^o} \quad \frac{180}{\sin 40^o} \Rightarrow x = \frac{180 \sin 80^o}{\sin 40^o}$

$= 275.8$

Hence AC = 276 km

(b) Use the cosine rule in Δ AD when ∠DAC = 150°

$y^2 = 240^2 + 276^2 - 2 \times 240 \times 276 \cos 150^o$

$= 576000 + 76180 - 132\,480 (-\cos 30^o)$

= 133776 + 114731 = 248507

y = 248507

= 498.5

Hence CD = 499 km

(c) Using sine rule in ΔABC we have

$$\frac{BC}{\text{Sin } 60^o} = \frac{180}{\sin 40^o}$$

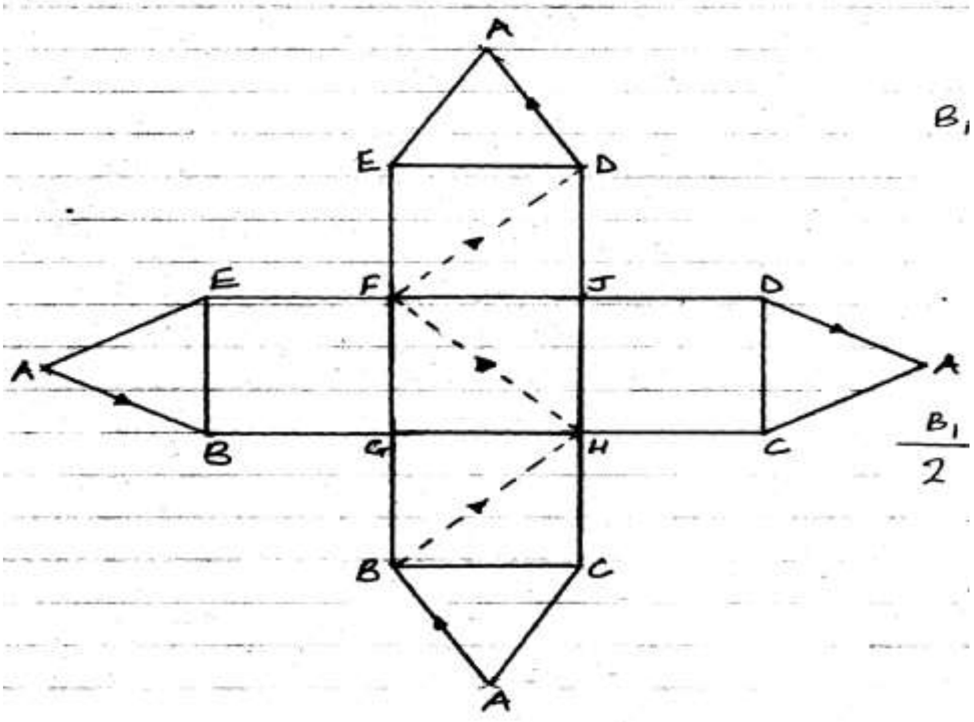
$$BC = \frac{180 \sin 60}{\text{Sin } 40}$$

= 242.5

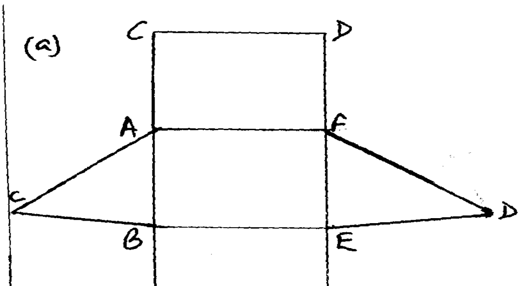
= 243 km

19. Common solids

1. Sketch of the net of the solid (not free hand) base n\must be square, other lengths must be within. Labeling of all verticals with the path correctly shown. AB and DA may be shown one.



2. (a)



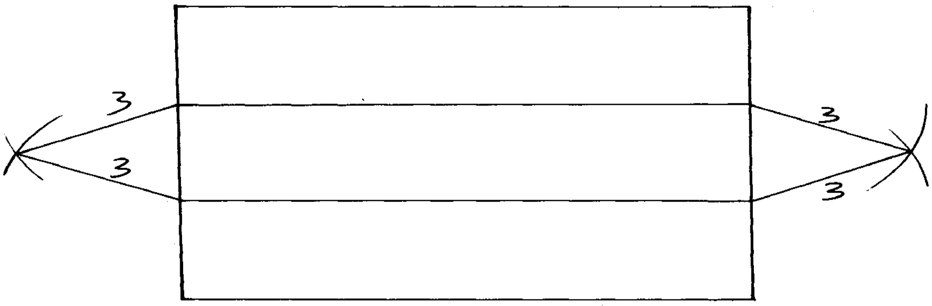
(b) Total surface area

$= 2 \quad 9 \times 3 \times 4 \times 2 + 10\,(6 + 5 + 7)$

$= 29.39 + 180 = 209.4\text{cm}^2$

3.

4.



20. Indices

1. $3^4 \times 3^{4x} + 3^{4x} = 246$

$3^{4x}\,(81 + 1) = 246$

$\frac{82}{82} \times 3^{4x} \overset{3}{=} \frac{246}{82}$

$3^{4x} \overset{1}{=} 3^1 \quad \surd$

$4x = 1$

$x = \underline{1}$

4

2. $5^{2y} x5^{1} = 4^{(5y+1)} – 15$

5^{y} x 5^{y} x 5^{1} = 4 x 5y x 51 – 15

Let 5y = t

$5t^2 = 20t – 15$

$t^2 = 20t – 15$

$t^2 – 4t + 3 = 0$

(t-1) (t-3) = 0

t = 1 or 3

5y = 1= 5^o

Or 5y = 3 y = $\frac{\log 3}{\log 5}$ = 0.6826

3. CBD = 90 - 42 = 48^o

Angle of triangle add to 180^o

DOB = 180^o – 42 = 138^o

Opposite angles of cyclic quadrilateral add to 180^o

DAB = $\frac{138^o}{2}$ = 69^o

Angle at circumference is half the nagle substended at centre by same chord

CDA

ABD= 90 – 48 = 42o

ADB = 180 –(69+42)

180-111=69^o

CDA = 90 + 69^o = 159^o

Show ΔADB is asoccesters

$\angle DAB = 69^o$

$\angle DAB = 69^o$

$\angle ADB = 69^o$

$\angle ABD = 42^o$

So two angles are equal hence it is asoccesters

4. $25^{\frac{3}{4}} = (25^{\frac{1}{2}})^{3/2} = 5$

$0.9^2 = ({}^{9}/_{10})^2 = {}^{92}/_{100}$

$2^2 = 2^2$

$$\frac{(\sqrt{5})^3 \text{ x } 9^2 \text{ x } 2^2}{(\sqrt{5})^5 \text{ x } 10^2 \text{ x } 3^3}$$

$$\frac{3 \text{ x } 4}{(\sqrt{5})^2 \text{ x } 10^2}$$

$$\frac{3}{5 \text{ x } 25} = \frac{3}{125}$$

5. $2^x = 0.0625 = \underline{625}$

1000

$2x = \frac{1}{16} = 2^{-4}$

$\therefore x = -4$

6. $16x^2 = 8^{4x-3}$

$2^{4x2} = 2^{3(4x-3)}$

$= 4^{x2} = 12x - 9$

$= 4^{x2} - 12x + 9 = 0$

$(2x-3)^2 = 0$

$2x - 3 = 0$

$x = 1.5$

No	Log
5.627	0.7503
$(0.234)^3$	T. 3692 $\underline{\quad x\ 3}$
	2.8579
8.237	0.4779 $\frac{0.9158}{2}$
2.399×10^{-3}	3.3800
	= 0.002399

7. $9^{x+1} + 3^{2x+1} = 36$
$3^{2x+2} + 3^{2x+1} = 36$
$3^{2x\,(9+3)} = 36$
$3^{2x} = 3^1$
$2x = 1$
$x = ½$

8. (a) $4p^2 – 3P – 10 = 0$
(b) $4p^2 – 8p + 5p = 0$
$(4p + 5)(p-2) = 0$
$p_1 = {}^{-5}/_4,\ p = 2$
When $y = {}^{-5}/_4$,
$4^{-y} = \frac{-5}{4}$
$y = \frac{\log_4(-5)}{2}$
$P = 2$
$4^{-y} = 2$
$2^{-2y} = 2^1$
$y = {}^{-1}/_2$

9.
$\frac{1}{16^x} = \frac{1}{32}$
x – ¼
$\frac{1}{2^{4x}} = \frac{1}{2^5}$
$2^{-4x^2 + x} + x = 2^{-5}$

$-4x^2 + x + 5 = 0$
$4x^2 – x – 5 = 0$
$4x^2 – 5x + 4x – 5 = 0$
$x(4x – 5) + 1(4x – 5) = 0$

$x = -1$ or $x = \frac{5}{4}$

]10. $15\,(ax)^4\,({}^{-2}/_{x}{}^{2}) \;= 4860$

$60a^4 = 4860$
$a^4 = 81$
$a = 3$

21. Reciprocals

1. 10 1 - 3 1
0.834 129.64

(10 x 1.199) – (3 x 0.007713)
11.99 – 0.923139
11.966861
12.0

2. 807 0.001239
0.0591 16.92
5(0.001239) + 4(16.92)
= 67.69

3. $^1/_3$ { 2 x 1.5065 + 5 x 1.2004 }

$^1/_3$ (3.013 + 6.002) (0.3333)

= 9.015 x 0.3333
= 3.005 (3 dp)

4. $$\frac{12 \times 0.25 - 12.4 \div 0.4 \times 3}{\tfrac{1}{8} \text{ of } 2.56 + 8.68}$$
$$\frac{3 - 31 \times 3}{0.32 + 8.68}$$
$$\frac{-90}{9}$$
= -10

5 $$\frac{4}{(8.68)^3} + {\frac{5}{34.46}}^{1/3}$$
$$\frac{4}{653.97} + (0.1451)^{1/3}$$
4(0.1529) + 0.5255
0.6116 + 0.5255 = 1.1371

6. $\frac{1}{a} = 0.007874 + 0.0869$

$= 0.9483$

$a = 10.55$

7. $3.5932 = 12.91$

$\Rightarrow \frac{1}{1.291 \times 10} + 2 \frac{1}{5.26 \times 10^{-1}}$

$= (0.7746 \times 10^{-1}) + 290.1901 \times 10)$

$= 0.07746$

$+ \underline{3.802}$

3.87946

$\sqrt{3.87946} = \sqrt{3.879}$

$= 1.9695$

$= 1.970$(4s.f)

8.

No	s.f	rec
0.6638	6.638×10^{-1}	$0.1500 \times 10 = 1.5000$
0.833	8.33 x 10-1	$0.1200 \times 10 = 1.200$

$= {}^{1}/_{3}\,(2\,(105) + (1.2))$

$= {}^{1}/_{3}\,(3 + 6)$

$= {}^{1}/_{3} \times 9 = 3$

9. $3 \times 1.485 + 13 \times 6.410$

$= 4.455 + 83.33$

$= 87.785$

ALT

${}^{30}/_{6.735} + {}^{130}/_{1.56} = 30 \times 0.1485 + 130 \times 0.641$

$= 4.455 + 83.33$

$= 87.785$

22. Common logarithms.

1.

	No.	Log		
	2849	3.4547		**All logs read correctly**
$\boxed{-}$			+	
	0.00574	3. 7589		
	1.2136			
-	36.891.1	1. 5669		**Correct Addn /subst. of logs.**
	0.023	$\underline{2.3617}$		

3.2052

-

2. 0084 x ¼

$3.178 \times \bar{1}0^{-1}$ 1. 5021

0.3178

2. $\log y = \log B + n \log x$
$n \log x = \log y - \log B$
$n = \frac{\log (^{y}/_{B})}{\log x}$

3. $= 6 \log_2 4 + 10 \log_3 3$
$= 12 \log_2 2 + 10 \log_3 3$
$= 12 + 10$

4. $\log \frac{2x - 11}{2} = \frac{\log 3}{x}$

$(2x - 11) = {}^{3}/_{x}$
$2x^2 \_ 11x - 6 = 0$
$(2x + 1)(x - 6) = 0$
$x = -½$ or 6
$x = 6$

5.

No.	Log
0.5241	T.7194
$(0.5241)^2$	T.7194x2
	$\underline{\text{T.4388}}$ +
83.59	1.9222
	1.3610
0.3563	T.5518
$3\sqrt{0.3563}$	(3+2.5518) ÷3
	T.8506
	0.3610 –
	1.8506
3.239×10^1	1.5104
= 32.4	

6. <u>No.   Log</u>
38.32 $\underset{+}{1}$.5834

12.964 $\underline{1.1127}$

2.6961

86.37 1.9364

6.285 $\underline{0.7783}$

$\underline{2.7347}$

\- 1.9587

$\dfrac{-\bar{3} + 2.9587}{3}$ = 1.9866

= 0.9695

7. $H^3 = \dfrac{3d(L-d)}{10L}$ ~

~ $3dL - 10H^3L = 3d^2$

$L(3d - 10H^3)\ 3d^2$

~ $L = \dfrac{3d^2}{3d - 10H^3}$

8.
	No.	Log
	6.195	0.7920
	11.82	1.0726
		1.8646
	83.52	1.9218
		1.9428 x ¼
		$\dfrac{4. \ + \ 3.9428}{4}$
	0.9676	1.9857

9. Log y^2 (x-1) = log 9 y^2 (x-1) = 9 ….(1)
log (xy) log 6 xy = 6 ….2
from (2) x = $^6/_y$
substitute in (1) $y\dfrac{(6-1)}{y} = 9$
$6y - y^2 = 9$
$y^2 - 6y + 9 = 0$
$(y-3)^2 = 0$
y = 3
∴x = 2

5

10. $^4/_5 \log_{10}25 + \log_{10} 25x2 - \log 10$
$4 \log 2 = \log_{10} 25x2 - 3\log 2$
$2 \log 10 + 2 \log 5$
Log 10 x 100

11.

NO	LOG
0.9895	$\bar{1}.9954$
$(0.9895)^2$	1.9954 x 2
	1.9908
0.004974	$\bar{3}.6968$
	$3.\bar{6}876 \div 4$
	1.4219 x 3
6.598	2.2657
	0.8195 –
	2.2657
$3.579 X10^2$	2.5538
OR 357.9	

Use sine rule

12. Log 3x + 8 – log 8 = log (x-4)

$$\text{Log}\left(\frac{3x + 8}{8}\right) = \log (x-4)$$

3x + 8 = x -4

3x + 8 = 8x – 32

5x = 40

13.

No.	Log
36.72	1.5649
0.46^2	2(T.6628)
	<u>T.3256</u>
185.4	0.8905
	<u>2.2682</u>
	$2.9223 \times \frac{1}{3} = \frac{\bar{3}}{3} + \frac{1.6223}{3}$
3.474×10^{-1}	
Or 0.3474	$\bar{1}.5408$

14. No Log

Sin 44.5 1.8457

Tan 14.9 1.4250 2.5686 -

Cos 82 1.1486 +

$$\frac{1.2772}{2}$$

10 x 4.351 ___________ 0.6386

15. From square roots 12.25 = 3.5

$\frac{3.264 \times 1.215 \times 3.5 \times 107}{1.088 \times 0.4725 \times 107}$

$\frac{3264 \times 1215 \times 35}{1088 \times 4725}$

27 = 3

16. $\text{Log}_8 (x + 5) – \log_8(x -3) = \text{Log}_8\, 4$

$\text{Log}_8 \left(\frac{x + 5}{x – 3}\right) = \log_8 4$

$\frac{x + 5}{x – 3} = 4$

$4x – 12 = x + 5$

$3x = 17$

$x = 17 = 5^2/_3$

Or $\log_8 \frac{x +5}{x – 3} = \frac{2}{3}$

$8^{2}/_3 = \frac{x + 5}{x – 3}$

$2^3(^{2}/_3) = \frac{x + 5}{x -3}$

$2^2 = \frac{x +5}{x -3} \Rightarrow 4 = \frac{x + 5}{x – 3}$

$4x -12 = x + 5 \Rightarrow 3x = 17$

$x = \frac{17}{3} = 5^2/_3$

17.

No	Log
6.57^2	0.8176
	2x
	1.6352
$4.317 X 10^1$	
43.17 + 6.57	
49.74	
$(7.92)^2$	1.6967
	0.8987
	X2
	1.7974
30.08	1.4783 + 3.2757
$2.636 X 10^{-2}$	2.4210
	= 0.02636
	= 0.0264 (4 d.p)

No	Log
6.57^2	0.8176
	2x
	1.6352
$4.317 X 10^1$	
43.17 + 6.57	
49.74	
$(7.92)^2$	1.6967
	0.8987
	X2
	1.7974
30.08	1.4783 + 3.2757
$2.636 X 10^{-2}$	2.4210
	= 0.02636
	= 0.0264 (4 d.p)

18. Log 120 = log 4 + log 3 + log 10
  = log22 + log3 + log 10
  = 2log2 + log3 + log 10
  = 2(0.30103) + 0.47712 + 1
  = 2.07918

19. $Log_2 (3x – 4) = {}^1/_3\ lo_2\ 8x^6 – log_2 4$

$\mathrm{Log}_2\ (3x-4) = \log_2\ (2^3x^6)\quad - \log_2 4$

$\mathrm{Log}_2\ (3x-4) = \log_2 2x^2 - \log_2 4$

$\mathrm{Log}_2\ (3x-4) - \log_2 \frac{2x^2}{4}$

$= 3x - 4 = \frac{2x^2}{4}$

$2x^2 - 12x + 16 = 0$

$x^2 - 6x + 8 = 0$

$x - 2x - 4x + 8 = 0$

$(x-2)(x-4) = 0$

$x = 2$ or $x = 4$

20.

No	Log
5.627	0.7503
$(0.234)^3$	T. 3692 $\underline{x\ 3}$ 2.8579
8.237	0.4779 $\quad \frac{0.9158}{2}$
2.399×10^{-3}	3.3800
	= 0.002399

21. Det 2 - -3 = 5

Area of $A^IB^IC^I = 5 \times 15$

$= 75\ \mathrm{cm}^2$

22. $\mathrm{Log}10(6x-2) - \log10 = \log10(x-3)$

$\mathrm{Log}\ \frac{(6x-2)}{10} = \log\ (x-3)$

$\frac{6x-2}{10} = x-3$

$6x - 2 = 10x - 30$

$x = 7$

23.

No.	Log
0.07526^2	2.8766 x 2 = 3.7532
6.652	0.8230 = 0.8230
	4.9302

$\frac{4.9302}{3} = 6 + \frac{2.9302}{3}$

$= 2.9767$

Antilog $= 9.4776 \times 10^{-2}$

$= 0.094776$(accept 0.09478)

No.	Log
4.283	0.6317
0.009478^2	3.9767 X 2 +
	5. 9534
	4.5851 -
Log 9.814	1.9964
	4. 5887 ÷ 5
2.0785×10^{-1}	1.3177
= 0.20785	

23. Equations of straight lines

1. a) Length of diagonal $= \sqrt{10^2 + 8^2}$

$= \sqrt{164}$

Vertical height $= \sqrt{16^2 - \left(\frac{\sqrt{164}}{2}\right)^2} = 14.66cm$

b) Height of the slant surfaces

$\sqrt{16^2 - 4^2} = \sqrt{240}$

$\sqrt{16^2 - 5^2} = \sqrt{231}$

Area of slant surfaces

$(\frac{1}{2} \times 8 \times \sqrt{240} \times 2) = 124.0\ cm^2$

$(\frac{1}{2} \times 10 \times \sqrt{231} \times 2) = 152.0cm^2$

Area of the rectangular base $= 8 \times 10 = 80cm^2$

Total surface area = $\underline{356cm^2}$

c) Volume

$= (\frac{1}{3} \times 80 \times 14.66) = 391.0cm^3$

2. Gradient of line AB $= \frac{3 - 3k}{K + 1}$

Equation of other line can be written as

$Y = \frac{-3x}{2} + \frac{9}{2}$

$\therefore$ its gradient $= {}^{-3}/_{2}$

Hence $\frac{3 - 3k}{K + 1} = \frac{-3}{2}$

$6-6K = -3k- 3$

$-3K = -9$

$K= 3$

$A(-1, 9), \quad B (3,3)$

3. $M_1 = 2x - 3x2$

$M_2 = 1 - 2ax$

$M_1 = M_2$ at $x = {}^1/_3$

$2x - 3x^2 = 11 - 2ax$

${}^2/_3 - 3 ({}^1/_3)^2 = 1 - 2ax{}^1/_3$

${}^2/_3 - {}^1/_3 = 1 - {}^2/_3 a$

$-{}^3/_2 = -{}^2/_3a$

${}^9/_4 = a$

4. $M1 = \frac{5-1}{4--2} = \frac{4}{6} = \frac{2}{3}$

$M2 = {}^{-3}/_2$

i.e. ${}^{-3}/_2 = \frac{y-5}{x-4}$

$2 (y - 5) = -3 (x - 4)$

$2y - 10 - -3x + 12$

$3x + 2y - 22$

5. Points $(3, 0)$ and $(-5, 2)$

$M = - ¼$

$y - 0 = - ¼$

$x - 3$

$y = - ¼ x + ¾$

7. $Grad = \frac{2}{3}$

$\frac{y-4}{x+2} = \frac{2}{3}$

$y = \frac{2}{3}x + \frac{16}{3}$

8. $3y - 5x = 4$ 0r equivalence

$5y = 3x - 10$

$y = \frac{3}{5}x - 2$

$\therefore Gradient = \frac{-5}{3}$

$5 = \frac{y-3}{x+1}$

$3y - 9 = 5x - 5$

9. $L.S.F = \underline{\quad 4 \quad} = \underline{1}$

$\quad\quad 2000000 \quad\quad 500000$

$A.S.F = \frac{1}{5 \times 10^5}{}^2 = \frac{1}{2.5 \times 10^{11}}$

Area of rectangle = $(2.4 \times 1.5)\ cm^2$
$= 3.6cm^2$
Actual area = $\frac{3.6 \times 2.5 \times 10^{11}\ ha}{100 \times 10000}$
$= 9 \times 10^5$
= 900,000ha

10. $2y - 5x = 11$
$Y = \frac{5}{2} x + \frac{11}{2}$
$g = \frac{5}{2}$
$\frac{5}{2} m = -1$
$M = -\frac{2}{5}$
$\frac{Y - 4}{X + 4} = -\frac{2}{5}$
$5y + 2x = 14$
P(x,o)
$5 X o + 2x = 14$
$X = 7$
Q(o, y)
$5y + 2 X o = 14$
$Y = 2.8$
P (7,0)
Q (0, 2.8)

11. i) $K\left(\frac{3-7}{2}, \frac{4+2}{2}\right)$ (-2, 3)
$P\left(\frac{3+1}{2}, \frac{4-2}{2}\right) = (2,1)$

ii) $K_1 = \frac{3-1}{-2-2} = -½$
$= 2$

12. Gradient of L1 = $\frac{1}{5}$
Gradient of L2 = -5
$Y = mx + c$
$2 = -5 (1) t c$
$2 = -5tc$
$C = 7$
Epuding L2
$Y = -5x + 7$

13. $3y - 5x = 4$ 0r equivalence

$5y = 3x - 10$

$y = \frac{3}{5}x - 2$

$\therefore$Gradient $= \frac{-5}{3}$

$5 = \frac{y-3}{x+1}$

$3y - 9 = 5x - 5$

14. Gradient $= g = \frac{m-1}{4-2} = \frac{m-1}{2}$

$3y = 5 - 2x$

$y = {}^{5}/_{3} - {}^{2x}/_{3}$ $\quad g_1 = {}^{-2}/_{3}$

$g \text{ x } g1 = \frac{m-1}{2} \; \frac{-2}{3} = -1$

$-2(m - 1) = -6$

$-2m + 2 = -6$

$-2m = -8$

$M = 4$

15. $L_1 \; y = -\frac{2}{3}x - \frac{4}{3}$

$M_1 = -\frac{2}{3}$

$M_2 = \frac{3}{2}$

$L_2 \; y = \frac{3}{2}x + c \quad x = 1, y = 1$

$1 = \frac{3}{2} + c$

$c = -½$

$L_2 \; y = \frac{3}{2}x - \frac{1}{2}$

16. BP $=$ shs. $\frac{144}{6} \text{ x } 100$

SP $=$ shs. $\frac{140}{100} \text{ x } \frac{144}{6} \text{ x } 100$

Let pineapples sold at shs. 72 for every shs. 3 be x

∴ At shs. 60 for every 2 will be 144 – x

$\frac{x}{3}$ x 72 + $\frac{144 - x}{3}$ = 3360

24x + 30 (144 – x) = 3360

-6x = -960

x = 60

17. $\frac{x+2}{3} - \frac{x-1}{2} = \frac{5}{1}$

2(x + 2) – 3(x – 1) = 30

22x + 4 – 3x + 3 = 30

-x + 7 = 30

-x = 23

x = -23

24. Reflection and congruence

1. (a) Dist. traveled in 3hrs s. drawing

Plane A – 400 x 3 = 1200km – cm

Plane B – 500 x 3 – 7.5cm

Plane C – 300 x 3 = 900km – 4.5cm

(b) Dist. BA = 12.8 0.1 x 200 = 2560km 20km

T = $\frac{D}{S}$ = $\frac{2560}{500}$ hrs

= 5.12hrs of 5hrs, 7.2mns

≈ 5hrs, 7min (nearest min)

(c) Bearing of B from C = $360^o - 20^o = 340^o$

Dist. BC = (10.9 ± 0.1 x 200)km

= 2180km ± 20km

25. Rotation

1. V.S.F = $3^3 : 5^3$ = 27 : 125

Volume of larger tank = $\frac{8.1 \text{ x } 125}{27}$

= $37.5m^3$

26. Similarities and enlargement

1. $E.S.F = \frac{4 - x}{0 - x} = 3$

$4 - x = -3x$

$2x = -4$

$x = -2$

$\frac{6 - y}{2 - y} = 3$ $\quad 6 - y = 6 - 3y$

$-2y = 0$

$y = 0$

Centre of enlargement

= (-2, 0)

2. a) L.S.F = 1:500

Height in cm = (500 x 5)= 2500cm

∴ Height in m = $^{2500}/_{100}$ = 25m

b) A.S.F = 1:250000

= 1:25 (in m^2)

∴ if 25 = 36

= $(^{36}/_{25})m^2$ $\quad$ = $1.44m^2$

c) V.S.F = 1:500

$1:125m^3$

Corresponding volume

= $(^{125}/_{120})m^3$

= $1.042\ m^3$ $\quad$ = $10420cm^3$

3. Let DE = x cm

∴ AD = 3 + x

$\frac{3 + x}{x} = \frac{9}{4}$

$12 + 4x = 9x$

$x = 2.4$ cm

DE = 2.4

4. $L.S.F = \frac{12}{8} = \frac{3}{2}$

$A.S.F = \frac{9}{4} = \frac{336}{x}$

$x = 149^1/_3cm^2$

Area of QRTS = $336 – 149^1/_3$

= $186^2/_3cm^2$

5. (a) $\frac{4}{3} = \frac{64}{x}$

$x = 48cm$

(b) ¾ = $\frac{810}{y}$

$\frac{27}{64} = \frac{810}{y}$

$27y = 810 \times 64$

$y = 1920grams$

6. ΔABC is similar to ΔADE

$DE = \frac{7}{4}$

$DE = \frac{(7 \times 8)}{4}cm$

$= 14cm$ $= {}^{-7}/_{23}$

7. Area scale factor = 12: 108

= 1: 9

Linear scale factor = $\sqrt{1} : \sqrt{9}$

= 1 : 3

Volume scale factor = $1^3 : 3^3$

= 1 : 27

Volume of the smaller cone = $\frac{810cm^3 \times 1}{27}$

$= 30cm^2$

8. ½ h (a + b) = Area of trap.

$\frac{1}{2} x^{3} (DC + 4) = 15.6$

$DC + 4 = \frac{15.6 \times 2}{3}$

$DC = 6.4$

$\frac{DC}{BE} = \frac{DA}{EA}$

$\therefore \frac{3 + x}{x} = \frac{6.4}{4}$

$12 + 4x = 6.4 x$ √

$2.4x = 12$ √

$x = 5cm$

27. The Pythagoras theorem

1.

P 24.5^o 33.2^o R Q ***x***

From Δ PTR, $\tan 24.5° = {}^{h}/_{x}$ ____ x _____ ${}^{h}/_{\tan 24.5°}$◦

From ΔQTR, $\tan 33.2° = {}^{h}/_{x-5}$ ____ $x = {}^{h}/_{\tan 33.2°}$◦ $+ 5$

$\therefore {}^{h}/_{\tan 24.5°} = {}^{h}/_{\tan 33.2°}$◦ $+ 5$ ____ ◦${}^{h}/_{\tan 24.5°}$ - ${}^{h}/_{\tan 33.2°}$◦ $= 5$

$h\ [{}^{1}/_{0.4557} - {}^{1}/_{0.6544}] = 5$

$h = (2.194 - 1.528) = 5$

$h = {}^{5}/_{0.666} = 7.508$

$\therefore$ height $= 7.5m$

2. $L.S.F = \frac{2}{3}$

$V.S.F. = \frac{2}{3} = \frac{8}{27}$

Ratio $= 8 : 27$

28. The trigometric ratio 1

1.

$\text{Tan } 30^o = \frac{x}{100+y}$ x

$x = (100 + y) \tan 30^o$

$(100 + y) \tan 30^{o\ =}\ y \tan 60^o$

$\text{Tan } 60^o = \frac{x}{y} = x = y \tan 60^o$

$(100 + y)\ 0.5774 = 1.1732y$

$57.74 = 1.155y$

$y = \frac{57.74}{1.155}$

$y = 49.99 \equiv 50m$

$\therefore x = 50 \tan 60$

$x = 86.6m$

2. $\sin \theta = 0.70$

$\theta = 44.43°, 135.57°$

3. (a) (i) Area of triangle $A^1B^1C^1 = ½ \times 4 \times 4$

$= 8$ sq. units

(b) (ii) Reflection in the line $y = x$

(c) combine transformation $= \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$

$\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$

Det $\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$ $0 – 2 \times 2 = - 4$

Inverse transformation $= - ¼ \begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix} = \begin{pmatrix} 0 & {}^{-1}/_2 \\ {}^{-1}/_2 & 0 \end{pmatrix}$

4.

$\tan 45 = \frac{AB}{60}$

$AB = 45$

$\tan \theta = \frac{45}{240}$

$= 0. 1875$

$\theta = 10.62^o$

5.

Area A: ½ x 25 (33 + 21) = 675

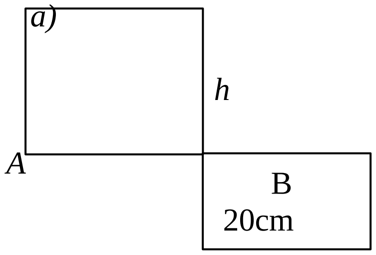
Area B: ½ x 40 (21 x 42) = 1260

Area C: ½ x 30 x 42 = 630
Area D: ½ x 25 x 40 = 500
Area E: ½ x 5 (40 + 25) = 162.5
Area F: ½ X 60 (25 + 36) = 1830
Area G: ½ x 5 x 36 = 90 √
$= 5,147.5m^2$

6. $\therefore$ *Philip takes 10 days.*

$2\cos 2x = 0.600$
$\cos 2x = 0.3000$
$2x = 72.5^o, 287.5$
$x = 36.25^0, 143.75$

7. a)



$\tan 32 = \frac{h}{20 + x}$
$h = (20 + x) \tan 32^o = 12.498 + 0.6249x$
$\tan 40^o = {}^h/_x$
$h = x \tan 40^o = 0.8391x$
$0.8391x = 12.498 + 0.6249x$
$0.8391x – 0.6249x = 12.498$
$0.2142x = 12.498$
$x = \frac{12.498}{0.2142} = 58.35m$
$\therefore$ *The distance of A from the house*
$= (20 + 58.35)m \quad = 78.35$

b) $h = x \tan 40^o = 58.35 \times 0.8391 \quad = 48.96m$
$\therefore$ *The total height of the house*
$= 1.82m + 48.96m \quad = 50.78m$

11. $\tan 32^oc = \frac{h}{20 + x}$
$h = (20 + x) \tan 32^o$
$\tan 40^o = \frac{h}{x}$
$h = \tan 40^o$

$\therefore x \tan 40^o = (20 + x) \tan 32^o$
$0.8391x = (20 + x)\ 0.6249$

$0.8391x = 12.498 + 0.6249x$

$0.8391x - 0.6249x = 12.498$

$x = 58.35m$

$20 + 58.35 = 78.35m$

(b) The height of the house

$\tan 40^o = \frac{h}{58.35} = h = 58.35 \tan 40^o$

$h = 58.35 \times 0.8391$

$h = 48.96 + 1.82$

$h = 50.78$

12. $\frac{24}{\sin 48} = 2R \Rightarrow R = 16.15 \text{ cm}$

$\text{Area} = 3.14 \times 16.15^2$

$= \underline{819.26 \text{ cm}^2}$

13. a)

$Hyp = 5^2 + 12^2$

13

x

$= 13$

12

$\cos x = {}^{12}/_{13}$

(b) Sin2990-x)

$= ({}^{12}/_{13})^2 = {}^{144}/_{169}$

]14. $\tan\theta = {}^{8}/_{15}$ C

8 17

B 15 A

$AB^2 = 8^2 + 15^2$

$AB = \sqrt{289} = 17$

$\sin\theta = {}^{8}/_{17}$, $\cos\theta = {}^{15}/_{17}$

$\dfrac{\sin\theta - \cos\theta}{\cos\theta + \sin\theta} = \dfrac{{}^{8}/_{17} - {}^{15}/_{17}}{{}^{15}/_{17} + {}^{8}/_{17}} = {}^{-7}/_{17} \times {}^{17}/_{23}$

$= {}^{-7}/_{23}$

29. Area of a triangle

1. a) $BC^2 = 50^2 + 80^2 - 2 \times 50 \times 80 \cos 30$

$= 2500 + 6400 - 6928.20 = 1971.8$

$\therefore BC = \sqrt{1971.8}$

$= 44.40m$

$= 44m$

b) Area of the plot

$= \frac{1}{2} \times 50 \times 80 \times \sin 30 = 1000m^2$

$= \dfrac{(1000)}{10000}$ ha

$= 0.01ha$

c) i) Length of wire required

$= (50 + 80 + 44) \times 4 = 696m$

ii) Complete rolls to be bought = 2

iii) Cost (2 x 4000) = Shs.8000

30. Area of polygons

1. $\dfrac{180(n-2)}{180(n-1-2)} = \dfrac{4}{3}$

$540n - 1080 = 720n - 2160$

$720n - 540n - 2160 - 1080$

$180n = 1080$

$n = 6$

Area of hexagon $= 6\ (\frac{1}{2} \times 10 \times \sin 60)$

$= 6 \times 43.30 = 259.81\ cm^2$

2.

Area ∠rt $\Delta = \frac{1}{2} \times 8 \times 6$

$S = \frac{12 + 14 + 10}{2}$

$A = 18(18-12)(18-14)(18-10)$

$= 18 \times 6 \times 4 \times 8$

$= 3456$

$= 58.79$

Total area $= 24 + 58.79 = 82.79$

31. Area of part of a circle

1. (a) $A = \frac{120}{360} \times \pi \times 10^2 - \frac{1}{2} \times 100 \times 10 \sin 12$

$= 104.72 - 43.30 = 61.42m^2$

(b) (ii) $\frac{120}{360} \times 2 \times 10 \times 20$

$= 418.9m^2$

(b) Total area $= 61.42 + 61.42 + 418.9$

$= 541.74m^2$

Cost $= 541.74 \times 310 = 167,939$

2. a) $\cos 54° = {}^{x}/_{10}$

$X = 5.878$

∴ size $= 2 \times 5.878 = 11.756$

Area of $\Delta = \frac{1}{2} \times 10^2 \sin 72° = 47.55$

Total area of Δs $= 47.55 \times 5 = 237.8$cm2

b) Area of circle $= {}^{22}/_{7} \times 10 \times 10 = 314.8$

Shaded region $= {}^{3}/_{5}(3.143 - 237.8)$

$= 45.9cm^2$

3. (a) $7.8^2 = 6.6^2 + 5.9^2 - 2 \times 6.6 \times 5.9 \cos R$

$\cos R = \frac{6.6^2 + 5.9^2 - 7.8^2}{2 \times 6.6 \times 5.9}$

$= \frac{78.37 - 60.84}{77.88}$

$= 0.2251$

$\angle R = 77^o$

$\frac{7.8}{\sin 77} = 2r$

$r = \frac{7.8}{2 \sin 77}$

$= 4$ cm

(b) $\frac{5.9}{\sin p} = \frac{7.8}{\sin 77}$

$\sin P = \frac{5.9 \sin 77}{7.8}$

$= 0.7370$

$\angle P = 47.5^o$

$\angle Q = 180 - (77 + 47.5) \quad = 55.5^o$

(c) Area of shaded region

$= 3.142 \times 4^2 - ½ \times 6.6 \times 5.9 \sin 77$

$= 50.27 - 18.97 = 31.30$

4. $({}^{60}/_{360} \times {}^{22}/_{7} \times 24 \times 24) - ({}^{60}/_{360} \times {}^{22}/_{7} \times 12 \times 12)$

$301.71 - 75.43 = 226.26$

32. Surface area of solids

1. (a)

E

L

xcm

l

D

4cm

6cm

B

6cm

C

$\underline{x} = \underline{4}$

$x + 6 \qquad 6$
$6x = 4x + 24$
$x = 12$ cm

$L = \quad 12^2 + 4^2$

$= \quad 160$

$= 12.65$ (2 d.p)

$L = \quad 18^2 \; + 6^2$

360
$= 18.97$
$SA = \pi (RL – rL)$
$= 3.142 (6 x 18.97 – 4 x 12.65)$
$= 3.142 x 63.22 \quad = 198.64 cm^2$

(b) Cost of material for one lamp shape
$= \underline{198.64} x 800$
10000
= Sh15.90
Cost of 10 lamp shape = 2 x 10 x 15.90 = sh 318

2. Area of the remaining cross-section
$= 4.22 x \pi$
$= (17.64\pi)cm^2$
Area of the curved surface
$= (8.4\pi x 150$
$= \underline{1260}\pi cm^2$
2
Area of the flat surface
$= (150 x 8.4)cm^2$
$=1260cm^2$
Total area = $(1260 + 630 \pi + 17.64\pi$
$= (1260 + 647.64\pi)cm^2$
$= 3295cm^2/ \; 3295.44cm^2$

3. Surface area = $2(0.6 x 2.8)m^2 + 2(0.6 x 3.2)m^2$
$= (3.36 + 3.84)m^2$
$= 7.2m^2$

4. a) Area of hemispherical part
$= ½ X 4 UR^2$
$= 2 X {}^{22}/_{7} \; x 35 X 35$
$= 7700cm^2$

b) Slant height for original cone

$$\frac{L}{L-60} = \frac{35}{14}$$

$L = 100cm$

c) Surface area of frustrum

$= URL - url$

$= {}^{22}/_{7}\ X\ 35 \times 100 - {}^{22}/_{7} \times 14\ X\ 40$

$= 11000 - 1760 = 9240\ cm^2$

d) Area of base

${}^{22}/_{7}\ X\ 14^2 = 616\ cm^2$

e) Total surface

$= 7700 + 9240 + 616 = 17556cm^2$

5. a)TA $= 2\ X\ 6.8\ X\ 3.5 + 2\ X\ 4.2\ X\ 3.5m^2$

$= 47.6 + 29.4\ m^2 \qquad = 77m^2$

b) $77 - ({}^{75}/_{100}\ X\ 2.5\ X\ 2 + {}^{400}/_{100}\ X\ 1.25)m^2$

$77 - (3.75 + 5)\ m^2$

$77 - 68.25\ m^2 = 8.75m^2$

c)i) Cost of paint A

$= 68.25\ X\ 0.8\ X\ 80 = $ Kshs.43681

ii) Cost of paint B

$$\frac{68.25\ X\ 35}{0.5}$$

= Kshs.4777.5

d) No of tins

$$= \frac{54.6\ X\ 1000}{400}$$

$= \underline{136.5} \qquad\qquad = 137$ tins

No. of tins

$$= \frac{136.5}{1.25}$$

$= 109.2 \qquad = 110$ tins

6. Top surface area $= 8x8 = 64cm^2$

Bottom surface area $= 12x12 = 144cm^2$

Height of slanting faces

$H = 9^2 - 2^2 = 8.775cm$

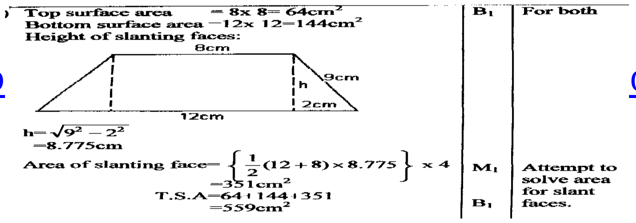
Area of slanting face $= ½\ (12 + 8) \times 8.775 \times 4$

$= 351cm^2$

T.S.A $= 64 + 144 + 351 = 559cm^2$

For both

Attempt to solve area for slant face

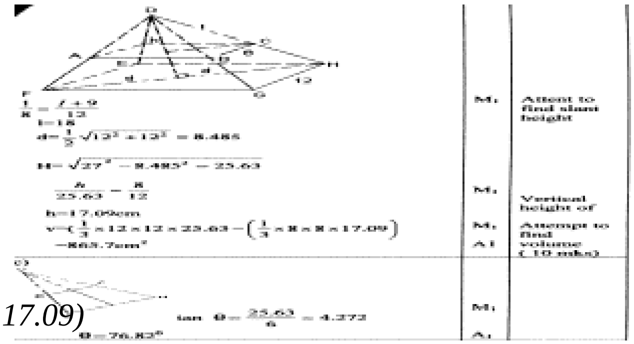


Top surface area $= 8x\ 8 = 64cm^2$ Bottom surface area $= 12x\ 12 = 144cm^2$ Height of slanting faces:	B_1	For both
$h = \sqrt{9^2 - 2^2}$ $= 8.775cm$		
Area of slanting face $= \left\{ \frac{1}{2}(12+8) \times 8.775 \right\} \times 4$ $= 351cm^2$	M_1	Attempt to solve area for slant faces.
T.S.A $= 64 + 144 + 351$ $= 559cm^2$	B_1	

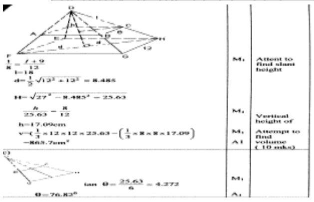
$^{1}/_{8} = {}^{1+9}/_{12}$
$1 = 18$
$D = ½\ 12^2 + 12^2 = 8.485$

$H = \ \ 27^2 – 8.485^2 = 25.63$
$^{h}/_{25.63} = {}^{8}/_{12}$
$h = 17.09cm$
$v = (^1/_3 \times 12 \times 12 \times 25.63 – (^1/_3 \times 8 \times 8 \times 17.09)$
$\ \ = 865.7cm^2$

(c) $\tan \theta\ ^{25.63}/_6 = 4.272$
$\theta = 76.82^o$



$\frac{1}{8} = \frac{l+9}{12}$ l=18 $d = \frac{1}{2}\sqrt{12^2 + 12^2} = 8.485$	M_1	Attent to find slant height
$H = \sqrt{27^2 - 8.485^2} = 25.63$ $\frac{h}{25.63} = \frac{8}{12}$	M_1	Vertical height of
h=17.09cm $v = (\frac{1}{3} \times 12 \times 12 \times 25.63 - (\frac{1}{3} \times 8 \times 8 \times 17.09)$	M_1	Attempt to find volume
$=865.7cm^2$	A1	(10 mks)
$\tan\theta = \frac{25.63}{6} = 4.272$	M_1	
$\theta = 76.82^0$	A_1	


$\frac{1}{8} = \frac{l+9}{12}$ l=18 $d = \frac{1}{2}\sqrt{12^2 + 12^2} = 8.485$	M_1	Attent to find slant height
$H = \sqrt{27^2 - 8.485^2} = 25.63$ $\frac{h}{25.63} = \frac{8}{12}$	M_1	Vertical height of
h=17.09cm $v = (\frac{1}{3} \times 12 \times 12 \times 25.63 - (\frac{1}{3} \times 8 \times 8 \times 17.09)$	M_1	Attempt to find volume
$=865.7cm^2$	A1	(10 mks)
$\tan\theta = \frac{25.63}{6} = 4.272$	M_1	
$\theta = 76.82^0$	A_1	

33. Volume of solids

1. a) Length of diagonal = $\surd\ 10^2 + 8^2$
$= \surd 164$

Vertical height = $\surd 16^2 – (\frac{\surd 164}{2})^2$

$= 14.66cm$

b) Height of the slant surfaces
$\surd 16^2 – 4^2 = \surd 240$
$\surd 16^2 – 5^2 = \surd 231$
Area of slant surfaces
$(½ \times 8 \times \surd 240 \times 2) = 124.0\ cm^2$
$(½ \times 10 \times \surd 231 \times 2) = 152.0cm^2$
Area of the rectangular base= $8 \times 10 = 80cm^2$

Total surface area = $\underline{356cm^2}$

c) Volume
$= (^1/_3 \times 80 \times 14.66) \ = 391.0cm^3$

2. Volume of the cylinder
$= (^{22}/_7 \times 6 \times 6 \times 12)cm^3 \qquad = 1357.71cm^3$
Volume of a sphere
$= (^4/_3 \times {}^{22}/_7 \times 3 \times 3 \times 3)cm^3 \qquad = 113.14cm^3$
∴ No. of spheres formed
$= \underline{1357.71}$

$113.14cm^3$

= 12 spheres

3. Let the smaller length be x cm

$\therefore$ Dimensions are x, 2x, 3x

$x \;.\; 2x \;.\; 3x = 1024$

$6x^3 = 1024$

$x^3 = \frac{1024}{6}$

$x = 3\sqrt{\frac{1024}{6}}$

Dimensions are 5.547, 11.09, 16.64

4. $({}^{60}/_{360} \text{ x } {}^{22}/_{7} \text{ x } 24 \text{ x } 24) – ({}^{60}/_{360} \text{ x } {}^{22}/_{7} \text{ x}12 \text{ x } 12)$

301.71 – 75.43 = 226.26

5. (a)(i) $2\pi rh + 2r\pi^2 + \pi r^2$

$= 2 \text{ x } 22/7 \text{ x } 1.4 \text{ x } 1.4) + 2 \text{ x } 22/7 \text{ x } 1.42) + (22/7 \text{ x } 1.42)m^2$

$= (12.32+ 12.32 + 6.16)m^2= 30.8m^2$

OR $r(2h + 2r + r)$

$= 22 \text{ x } 1.4 (2\text{x } 1.4 + 3(1.4)= 30.8m^2$

(ii) shs. (75 x 30.8)= Shs.2,310

(iii) Total vol.

$= {}^{22}/_{7} \text{ x } 1.42 \text{ x } 1.4) + (½ \text{ x } {}^{4}/_{3} \text{ x } {}^{22}/_{7} \text{ x } 1.42)m^3$

$= 8.624 \;\; 4.106 = 12.7306m^3$

capacity = (12.7306 x 1000)liters= 12730.6litres

(b) First 2days = 185 x 2 = 370litres

Remaining amount = (12730.6 – 370)liters

= 12360.6litres

Days to use = $\frac{12,360.6}{200}$

= 61.803days

In all it takes = (61.803 + 2)days = 63.803days

6. a) $\frac{h + 3}{h} = \frac{9}{6}$ √

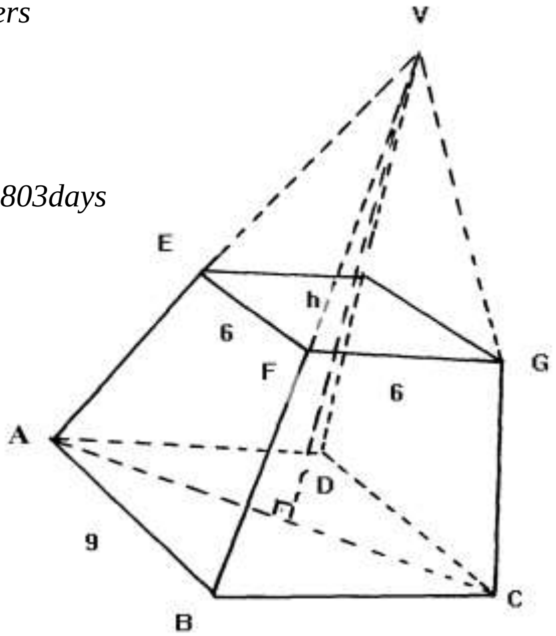
6h + 18 = 9h

h = 6 cm √

height = <u>6 + 3 = 9 cm</u>

b) Base = 9 x 9 = 81 cm^2

Top = 6 x 6 = 36 cm^2



Sides = 3.67 x 15 x ½ x 4

= 110.15 cm^2

Total = 227.15 cm^2

c) Vol. of bigger = $^1/_3$ x 81 x 9

= 243

Vol of smaller = $^1/_3$ x 36 x 6

= 72

Vol. of frustrum = 171 cm^2

d) sin $\theta = \frac{9}{11.02}$

θ = 54.8°

7. Volume of a hemisphere

$\frac{2}{3}\pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 12 \times 12 \times 12$

$= \frac{176}{7} \times 144$

= 3620.571429 = 3620.57

Volume of a cone

$^2/_3\pi r^2 h$

$\frac{1}{3} \times \frac{22}{7} \times 6 \times 6 \times h = 36.20.57$

$\frac{6 \times 44h}{7} = 3620.57$

264h = 3620.57 x 7

$h = \frac{3620.57 \times 7}{264}$

= 95.9981 = 95.998

8. $V = \frac{22}{7} \times 2 \times 2\ 1.5 + \frac{22}{7} \times 3 \times 3 \times 1.5 + \frac{22}{7} \times 4.4. \times 1.5$

$= \frac{132}{7} + \frac{297}{7} + \frac{528}{7}$

V of hole $= \frac{22}{7} \times 1 \times 1\ 4.5$

$= \frac{99}{7}$

$V = \frac{957}{7} - \frac{99}{7} = \frac{858}{7}$ = 122.57 cm^3

Mass = 2.8 x 122.57

= 343.196g

≃ 343.2g

9. Volume of hemisphere = ½ x $\frac{4}{}$ x $\frac{22}{}$ x 7 x 7 x 7

$\quad 3 \quad 7_{1}$

$= 718.67\ cm^3$

Vol. of cylinder $= \pi r^2 h = \frac{22}{\underset{1}{7}} \times \overset{1}{7} \times 7 \times 5 = 770\ cm^3$

Vol of frustrum $= {}^1/_3 \times \frac{22}{7} \times 7 \times 7 \times h_1 -$

${}^1/_3 \times \frac{22}{7} \times 3.5 \times 3.5 \times h_2$

Height of cone $\Rightarrow \frac{h_1}{h_2} = \frac{7}{3.5}$ but $h_1 = h_2 + 6$

$\frac{h_2 + 6}{h_2} = \frac{7}{3.5} \Rightarrow 7h_2 = 3.5h_2 + 21$

$3.5\ h_2 = 21$

$h_2 = 6\ cm$

$h_1 = 12\ cm$

$\therefore$ Vol. of frustrum $= \underset{1}{{}^1/_3} \times \frac{\overset{1}{22}}{7} \times \overset{4}{7} \times 7 \times 12\ -$

$\underset{1}{{}^1/_3} \times \frac{\overset{11}{22}}{7} \times \underset{1}{3.5} \times \underset{2}{3.5} \times \overset{2}{6}$

$= 616 - 77 = 539\ cm^3$

Total volume $= 718.67\ cm^3 + 770cm^3 + 539\ cm^3$
$= 2027.67\ cm^3$

a) S.A of top $= \pi r^2\ \frac{22}{7} \times 3.5 \times 3.5 = 38.5\ cm^2$

S.A of curved part of frustrum $= \frac{22}{7} \times 7 \times 13.89\ -$

$\frac{22}{7} \times 3.5 \times 6.945$

305.580
- 76.395
229.185 cm^2

S.A of curved part of cylinder $= 2\pi r \times h = 2 \times \frac{22}{7} \times 7 \times 5$
$= 2220\ cm^2$

S.A of hemisphere $= ½ \times 4\ \pi r^2 = \frac{22}{7} \times 7 \times 7 = 308\ cm^2$

Total S.A = $\underline{795.685\ cm^2}$

10. L/S.F = $^{2.2}/_{3.3} = {}^{2}/_{3}$

$^{4.8}/_{4.8 + h} \quad = {}^{2}/_{3}$

h= 24

volume of smaller cone

$^{1}/_{3} \times {}^{22}/_{7} \times 2.2 \times 2.4$

$= 12.169$

Volume of large cone

$^{1}/_{3} \times {}^{22}/_{7} \times 3.3 \times 3.3\ (4.8 + 2.2)$

$\therefore$ V of frustum

$82.14 - 12.17 = 69.97\ cm^3$

11. (a) Volume $= \frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 \times \frac{3}{2} r = 31.5\pi$

$4r^3 + 3r^3 = 31.5 \times 6$

$r = 3\ \frac{31.5 \times 6}{7}$

$= 3cm$

(b) slant height of con $= \ 4.5^2 + 3^2$

$= 5.408cm$

Surface are $= 2\pi \times 3^2 + \pi \times\ 3 \times 5.408 = 107.5cm^2$

(c) Height $= \frac{31.5}{4^2\pi}$

$= 1.969cm$

(d) Density $= \frac{144}{231.5\pi}$

$= 1.46g/cm^3$

12. Volume of cube side x cm $= (xcm)^3$

$\therefore\ x^3cm^3 \ = \frac{1280}{20}\ cm^3$

$x \quad = 3 \quad \frac{1280}{20}$

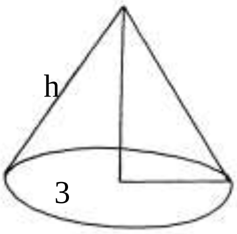
3

$= 3 \quad 64$

$= 4$ cm

13.

$^{9}/_{3} = {}^{14 + h}/_{h}$



$9h = 42 + 3h$

$6h = 42$

$h = 7$

volume of the frustrum $= (^{1}/_{3} \times {}^{22}/_{7} \times 9 \times 9 \times 21)cm^3$

$= (^{1}/_{3} \times {}^{22}/_{7} \times 3 \times 3 \times 7)cm^3$

$= 1782 – 66 = 1716cm^3$

34. Quadratic equations

1. $(3x + 5)^2 + (\quad 611)^2 = (7x = 2)^2$

$(9x^2 + 30x + 25) + 611 = 49x^2 + 28x + 4$

$- 40x^2 + 2x + 632 = 0$

$20x^2 - x = 316 = 0$

$x = \frac{1 \pm \quad 2581}{40}$

$= \frac{160}{40}$ OR $x = 4$

Area $= (½ \times 611 \times 17$

$= 210.1cm^2$

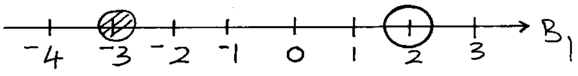
2. $7x – 4 \le 9x + 2$ $\qquad$ $9x + 2 < 3x + 14$

$\frac{-6}{2} \le \frac{2x}{2}$ $\qquad$ $6x < 12$

$\qquad$ $x < 2$

$-3 \le x$

$\therefore -3 \le x < 2$



Integral values are -3, -2, -1, 0 and 1

35. Linear inequalities

1. $\frac{12 \times 0.25 – 12.4 \div 0.4 \times 3}{⅛ \text{ of } 2.56 + 8.68}$

$\underline{3 – 31 \times 3}$

$0.32 + 8.68$
$\underline{-90}$
9
$= -10$

2. $x - 9 \leq - 4 < 3x - 4$
$x - 9 \leq - 4$
$x \leq 5$

$3x - 4 > - 4$
$3x > 0$
$x = 0$
$0 > x \leq 5$ √

$1, 2, 3, 4, 5$ √

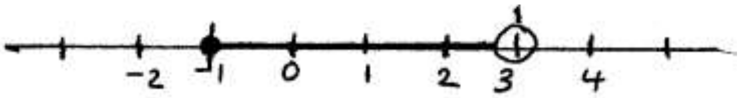
3
3. $x > 3 - 2x$
$x \leq \frac{2x + 5}{3}$
$3 - 2x < x$
$-2x < x - 3$
$-3x < - 3$
$x < 1$
$2x + 5 \geq 3x$
$-x \geq 5$
$x \leq -5$
$-5 \leq x < 1$

4. $3 - X \leq 1 - ½ X$
$3 - 1 \leq X - ½ X$
$2 \leq ½ X$
$X \geq 4$

$-x + 5 \leq 14 - 2x$
$2x - x \leq 14 - 5$
$x \leq 9$
$4 \leq X \leq 9$

5. $4x - 3 \leq 6x - 1$
$-2x \leq 2$
$x \geq -1$

$6x - 1 < 3x + 8$



$3x < 9$
$x < 3$

$-1 \leq x < 3$

6. $2\ (2\text{-}x\ ) < 4x\ \text{-}9$

$4 – 2n < 4x\ \text{-}9$

$4 + 9 < 4x + 2n = 13\ 6x$

$= {}^{13}/_{6} < n \qquad = 2^{1}/_{6} < n$

and $4x – 9 < x + 11$

$4n –n < 11 + 9$

$3n < 20$

$x < {}^{20}/_{3} = < {}^{2}/_{3}$
Integral values 3, 4, 5, 6

7. $L_3 : y \geq 1$
$L_1: y + x \ \geq \text{-}\ 1$
$L_2: y – x$

8. a) $x^2 + 2xy + y^2 = x^2 + xy + xy + y^2$
$= x(x + y) + y(x + y)$
$= (x + y)\ (x + y)$
$\therefore\ (x + y)^2 = 8 \text{ x } 8 = 64$

b) $x^2 + 2xy + y^2 = 64$
$(x^2 + y^2) + 2xy = 64$
$34 + 2xy = 64$
$2xy = 30$

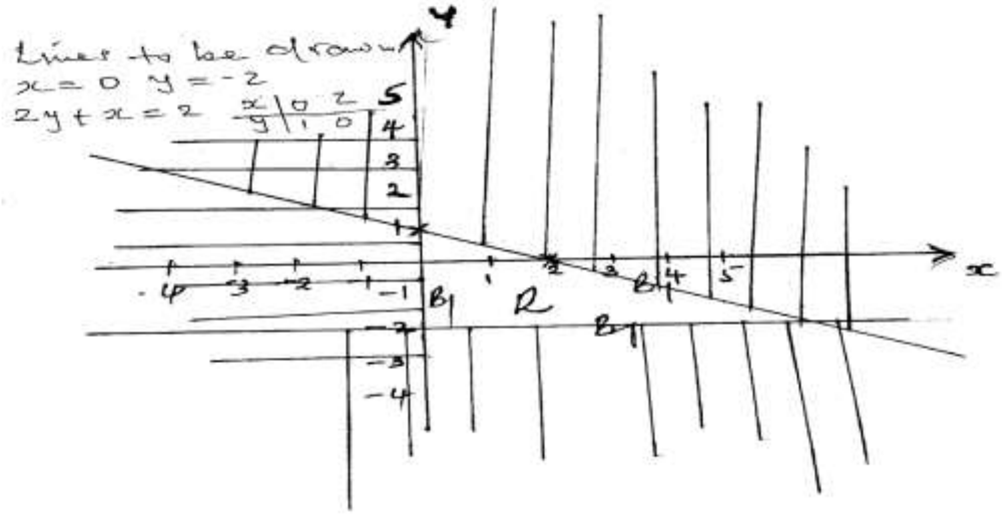
9. Equation of L1
(3.5, 4) (0, 2)
$\dfrac{y\text{-}2}{x\text{-}0} = \dfrac{2}{3.5\text{-}0}$
$3.5y – 7 = 2x$
$\therefore y = {}^{4}/_{7}x = 2x$
Inequality of
$y \leq {}^{4}/_{7}x + 2$
Or $7y\ 4x + 14$

Equation of L3
$\dfrac{y\text{-}2}{x – 4} = \dfrac{2}{\text{-}0.5}$
$\text{-}0.5(y\text{-}2) = 2(x\text{-}4)$
$\text{-}5y + 1 = 2x\ \text{-}8$
$\text{-}5y = 2x\ \text{-}9$
$y = \text{-}4x + 18$
in equality $y \leq\text{-}4\ x + 18$

Equation of L2
(0, 3) (4, 2)
$\dfrac{y\text{-}2}{x – 4} = \dfrac{3\text{-}2}{0\ \text{-}4}$
$\text{-}4(y\text{-}2) = x\text{-}4$
$\text{-}4y + 8 = x\ \text{-}4$
$\text{-}4y = x\ \text{-}12$
inequality $y \geq \text{-}\ ¼\ x + 3$

10. Lines to be drawn $x = 0$, $y = 2$

$2y + x = 2$	x	0	2
	y	1	0



11. $3(1 + x) < 5x – 11$

$3 +3 x) < 5x – 11$

$-2x < - 14$

$x >7$

$5x – 11< 45$

$5x < 56$

$x < 11.2$

Integral values are 8, 9, 10, 11

12.

y	x
x	8
y	0

36. Angle properties of circles

1. Area of $\Delta AXY = ½ \times 4^2 \times \sin 97.2^0$

$= 7.94\ cm^2$

Area of sector $AXY = \frac{97.2}{360} \times \pi \times 4^2$

$= 13.57\ cm^2$

Area of shaded part $= 13.57 – 7.94 = 5.63\ cm^2$

Area of $\Delta\ BXY = ½ \times 6^2 \sin 30$

$= 9\ cm^2$

Area of sector $BXY = \frac{30}{360} \times \pi \times 6^2$

$= 9.42\ cm^2$

Area of shaded part

$= (9.42 – 9)\ cm^2 = 0.42\ cm^2$

Area of shaded region $= (5.63 + 42)\ cm^2 = 6.05\ cm^2$

2. (i) $\angle AOB = 2 \angle ACB$

$= 100^o$

$\angle OAB = \frac{\underline{180 – 100}}{2}$ *Base angles of Isosceles* Δ

$= 40^0$

(ii) $\angle ADC = 180^0 - 70^0$

$= 110^0$

3. $^2/_5 \div ½\ 0f\ ^4/_9 – 1^1/_{10}$

$= ^2/_5 \div ½\ X\ ^4/_9 – ^{11}/_{10}$

$= ^2/_5\ x\ ^9/_2 – ^{11}/_{10}$

$= ^9/_5 – ^{11}/_{10} = ^{18 -11}/_{10} = ^7/_{10}$

$^1/_8 – ^1/_6\ X\ ^3/_8 = ^1/_8 – ^1/_{16}$

$= ^{2-1}/_{16} = ^1/_{16}$

$$\frac{^2/_5 \div ½\ 0f\ ^4/_9 – 1^1/_{10}}{^1/_8 – ^1/_6\ of\ ^3/_8} = \frac{^7/_{10}}{^1/_{16}}$$

$= ^7/_{10}\ X\ ^{16}/_1$

$= ^{56}/_5 = 11^1/_5$

4. a) $DAC = DCA = ½ (180 – 100)$ (base sios $= 40^o$

(b) $BAC =$ DCA alt ,$\angle$s AB//AD)

$= 40^o$

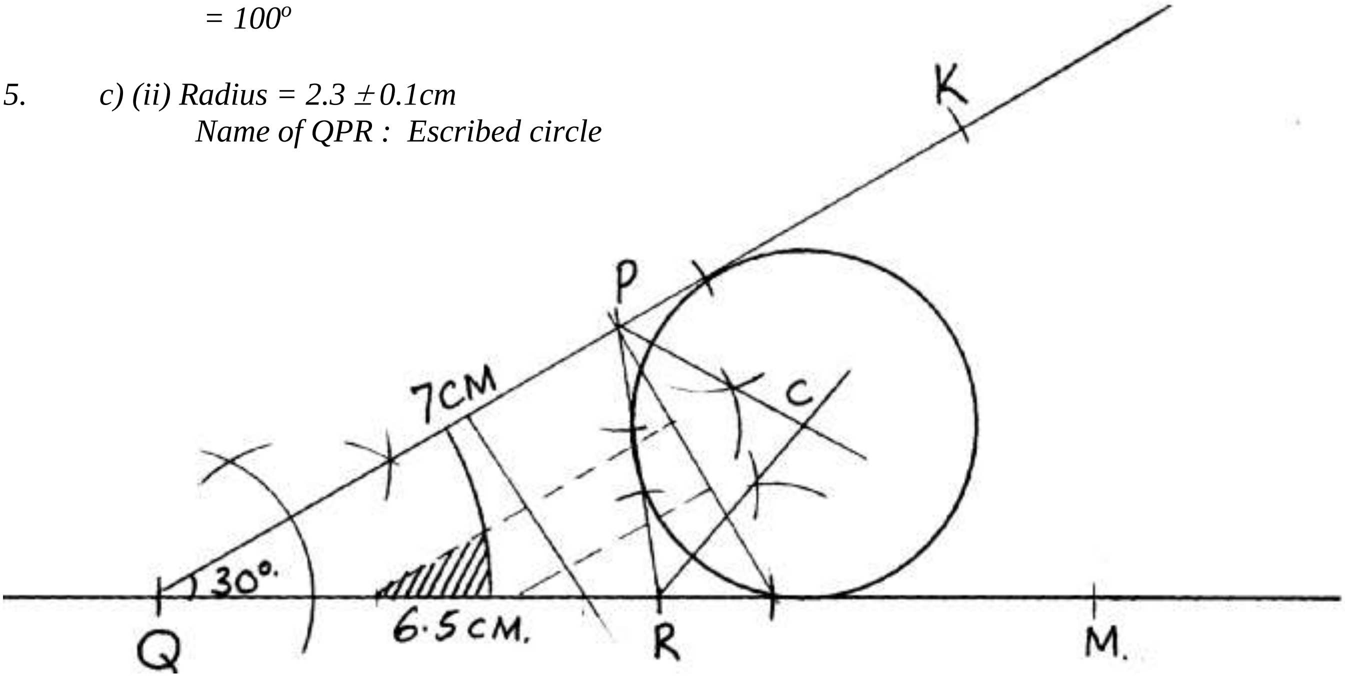
(b) $DAB = DAC + BAC = 40 + 40 = 80^o$

$BCD = 180^o – 80^o$

$= 100^o$

5. c) (ii) Radius $= 2.3 \pm 0.1cm$

Name of QPR : Escribed circle



6. (i) $\angle ACB = 10^o$ ($\angle$s subtended by chord AB)
(ii) $\angle AOD = 160^o$ ($\angle$ at centre line at circumference)
(iii) $\angle CAB = 40^o$ ($\angle$s subtended by chord AB)
(iv) $\angle ABC = 130^o$ (Opposite $\angle$s of cyclic quadrilateral)
(v) $\angle AXB = 60^o$(sum angle of triangle

7. i) $\frac{80}{360} \times \frac{22}{7} \times 9 \times 9$
$= 63.6429\ cm^2$

ii) ½ ab Sin C
$= \frac{1}{2} \times 9 \times 9 \text{ Sin } 80^0$
$= 39.8847\ cm^2$

iii) $\frac{180}{360} \times \frac{22}{7} \times 9 \times 9$
$= 127.2857\ cm^2$

Segment: $63.6429 – 39.8847$
$= 23.7582 \times 2 = 47.5164\ cm^2$
$\therefore 127.2857 – 47.5164$
$= 79.7693cm^2 = 79.77\ cm^2$

8. (a) $\angle RST = 180^o – 46^o$ Opposite angel in cyclic quadrilateral
$= 134^o$
(b) $\angle SUT = 180^o – 46^o – 27^o$ (Sum of angles in a traingle QRU)
$= 180^o – 173^o = 7^o$

(c) $\angle ROT = 2 \times 46^o$ (angle substended by chord RT at the centre
$= 92^o$
(d) $\angle PST = 180^o – 37^o – 48^o – 53^o$
Sum of angles in a triangle PST

(e) Reflex $\angle SOP = (2x\ 37^o) + 2x\ 42^o) = 158^o$
Angle subtended chord at centres is twice angle at circle

9. $\angle POQ = 80^o$
Radius = $\underline{1.7}$

Sin 40 = 2.645cm

Area of the triangle = ½ x 2.645^2 sin 80 = $3.445cm^2$

Area of the sector = ($\frac{80}{360}$ x π x 2.645^2) = $4.884cm^2$

Area of the shaded segment = (4.884 – 3.445) = $1.439cm^2$

10. a) ∡BDC = 90° -33°, 3rd angle of

= 57° ΔBCD, ∡BCD = 90.

∡ADC = ∡ADB + ∡BDC

= 48° + 57° = 105°

b) Consider Δ BCE

∡ AEB is an exterior opposite angle

∴ ∡ AEB = 33° + 48° = 81° ✓

37. Vectors

1.

Sin 60 = $\sqrt{}^3/_2$ 1

Sin 45 = $^1/\sqrt{2}$ $\frac{\sqrt{3}}{2}\;\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}}$

= 1

$\frac{\sqrt{3}}{2\sqrt{2}} - \frac{1}{\sqrt{2}}$

= $\frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{2}$

= $\frac{\sqrt{6} - 2\sqrt{2}}{4}$

2. OP = OA + ¼ AB ~ ~ ~

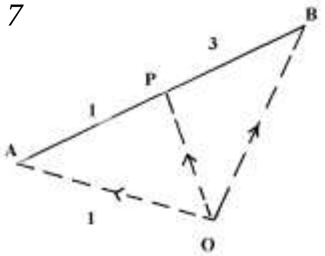
= $\underset{\sim}{O}A$ + ¼ ($\underset{\sim}{OB}$ – OA)~

= OA + ¼ OB – ¼ OA ~ ~ ~

= ¾ OA + ¼ OB ~ ~

= ¾ $\underset{\sim}{O}A$ + ¼ $\underset{\sim}{O}B$

= ¾ 12 + ¼ 16 = 3 + 4 = 7



8 4 6 1 7

3. $m\begin{pmatrix}4\\3\end{pmatrix} + n\begin{pmatrix}-3\\2\end{pmatrix} = \begin{pmatrix}5\\8\end{pmatrix}$

$4m - 3n = 5$ ……….. (i) x 2
$3m + 2n = 8$ ……….(ii) x 2
$8m - 6n = 10$
$\underline{9m + 6n = 24}$
$17m \quad = 34$
$m = 2$
$4 \times 2 - 3n = 5$
$-3n = -3$
$n = 1$
$\therefore m = 2, n = 1$

4. (a) (i) $BM = \frac{2}{5}a - b = \frac{1}{5}(2a - 5b)$
(ii) $AN = \frac{2}{3}b - a = \frac{1}{3}(2b - 3a)$

(b) $BX = \frac{t}{5}(2a - 5b)$
$AX = \frac{h}{3}(2b - 3a)$
$OX_1 = OB + BX = b + t(\frac{2}{5}a - 5b)$
$= (-t)b + \frac{2}{5} + a$
$OX = OA + AX = a + h(2b - 3a)$
$= (1-h)a + \frac{2}{3}hb$

(c) $OX_1 = OX_2$
$\frac{2}{5} + a + (\frac{1}{3} - t)b = (1-h)a + 2hb$
$\frac{2}{5}t = 1-h$ ....(i)
$(1 - t) = \frac{3}{4}h$ ....(ii) $t = \frac{5 - 5h}{2}$

$1 - (\frac{5 - 5h}{2}) = \frac{2h}{3} = 11h = 9$

$h = \frac{9}{11}$

$t = \frac{5 - 5}{2}\ \frac{9}{11} = \frac{5}{11}$

(i) BX : XM = 1:10

(ii) AX: XN = 3:8

5. a) i) MA = ½ a

ii) AB = a

iii) AC = a + c

iv) $AX = {}^{2}/_{7}\,AC = {}^{2}/_{7}\,(-a + c)$

b) MA = ½ a

$AX = {}^{2}/_{7}\,c - {}^{2}/_{7}\,a$

$MX = \frac{1}{2}a + {}^{2}/_{7} - {}^{2}/_{7}\,a$

$= {}^{3}/_{14}\,a + {}^{2}/_{7}c$

Co-ordinates of $P = (\frac{1 + 3}{2}, \frac{6 + 0}{2}, \frac{8 + 4}{2})$

$= (2, 3, 6)$

$/OP/ = \sqrt{2^2 + 3^2 + 6^2}$

$= \sqrt{4 + 9 + 36}$

$= \sqrt{49} \quad = 7$ units

c) Co-ordinates of O (0,0,0)

Co-ordinates of A (1, 6, 8)

Mid points of $AO = (\frac{1 + 0}{2}, \frac{6 + 0}{2}, \frac{8 + 0}{2})$

$= (0.5, 3, 4)$

6. a) $AB = DC \Rightarrow 1 - x = 2 \Rightarrow x = -1$

$6 - y = 4 \Rightarrow y = 2$

$\therefore D = \underline{\ (-1, 2)}$

b) (i) $RQ\ \boxed{= \underset{\sim}{Q}} - R \underset{\sim}{=} q - \underset{\sim}{\ }{}^{3}/_{2}q - \frac{1}{2}p$

$= -\frac{1}{2}\ \ q \underset{\sim}{\ } - p \underset{\sim}{=} \frac{1}{2}\ \ p \underset{\sim}{-} q \quad \underset{\sim}{\surd} \qquad \sim$

~ ~

~ ~

~ ~

(ii) PR $\underset{\sim}{=}$ $^3/_2\, q$ - ½ p – P √

= $^3/_2$ q - p

$^3/_2\, \underset{\sim}{q}$ = - ½ Also -$^3/_2$ p = ½ kp

⇒k = -3 ⇒ k = −3

Hence P, Q, R, Q Collinear.

(iii) $P\underset{\sim}{Q}$ = q - p , QR = ½ (q – P)

PQ : QR = 2 : 1

7. (a) PQ = PO + OQ = -p + q

Or = OP + PR = P + 2/3 PQ

= P + 2/3 (-p+q)

= $^1/_3p$ + $^2/_3q$

QT = QO + OT = -q + ½ OR since OT = TR

= -q + ½ ($^1/_3p$ – $^2/_3q$)

= $^1/_6p$ – $^2//_3q$ OR $^1/_6$ (p-4q)

(b) TS = TO + OS = - ½ OR + ¼ OP

= - ½ ($^1/_3p$ + $^2/_3q$) + ¼ p = $^{-1}/_6p$ – $^1/_3q$ + ¼ p

= $^1/_{12}p$ – $^1/_3q$ or $^1/_{12}$(p-4q)

QT: TS = $^1/6$(p-4q): $^1/12$(p-4q) = $^1/6$:$^1/12$ = 2:1

∴QT = 2TS OT//TS but T is a common point hence Q, T, S are collinear

(c) Vector OT can be expressed in 2 ways

1st OT = ½ OR given

= ½ ($^1/_3$ P + $^2/_3q$) = $^1/_6q$ + 1/$_3q$………..(i)

2nd using OPT

OT = OP + PT = P + $^5/_6$PM

But PM = PO + OM = -P +KOQ = -P +Kq

OT = P + $^5/_6$ (-P +kq)

= P – $^5/_6$kq

= $^1/_6p$ + n$^5/_5$kq………………(ii)

Aqn (i) and (ii) represent the same vector OT

$^1/_6p$ + $^1/_3q$ = $^1/_6p$ + $^5/_6$kq……………..(iii)

Comparing coefficients of q in eqn (iii) have$^5/_6$k = $^1/3$

15k = 6

8. 3a = 3(-3) = (-9)

2 6

½ b = ½ (4) = (2)

-6 -3

$^{1}/_{10}c$ = $^{1}/_{10}$ (5) = (0.5)

-10 -1

P = (-9) - (2) + 0.5)

6 -3 -1

= (-10.5)

8

/P/ = $\sqrt{(-10.5)^2 + 8^2}$

= √110.25 = 64

= √174.25

= 13.20037878

= 13.20 (2 d.p)

9. (i)BM = BO + OM

$= {}^2/_5 a - b$

(ii) AN = AO + ON

$= \frac{2}{3}\ b - a$

(b) OX = OB + BX

$= b + k\,(2\ a - b)$

$\underset{\sim}{=}\frac{2}{5}\ ka \underset{\sim}{+} b(1-k)$

OX = OA + AX

$= a + h\ (\frac{2}{3}b - a)$

$= a\ (1-h) + 2\ hb$

$= a(10h)\ 2hb$

(c) ${}^2/_5\ a = a\ (1-h)$ also $b(1-k) = 2hb$

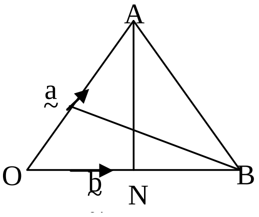
$2k = 1-h \quad 1-k = 2h$

$k = \frac{5}{2} - \frac{5h}{2}$

$\therefore 1 - \frac{5}{2} + \frac{5h}{2} = \frac{2h}{3}$

$\frac{5h}{2} - \frac{2h}{3} = \frac{5}{2} - 1$

$1\ \frac{5h}{6} = \frac{3}{2}$



$h = \frac{3}{2} \times \frac{6}{11} = 9$

$k = \ \frac{5}{2} - \frac{5}{2}\ \ \frac{9}{11}$

$= \frac{5}{2} - \frac{45}{22}$

$= \frac{5}{11}$

10. (i) AN = AO + ON

$= -a\ + \frac{4}{5}\,b$

(ii) $\underset{\sim}{BM} \underset{\sim}{=} BO + OM$

$\underset{\sim}{=} -b + {}^2\!\underset{\sim}{/}_5\, a$

(iii) $AB = A\underset{\sim}{O} + O\underset{\sim}{B}$

$\underset{\sim}{=} -a \underset{\sim}{+}\ b$

$AX = sAN$

$\sim \qquad \sim$

$BX = tBM \sim \qquad \sim$

$OX = OB + BX \qquad \sim$

$= b + tBM$

$= b + t(-b + {}^{2}/_{5}a)$

$= b - tb + {}^{2}/_{5}ta \qquad \sim$

$= b(1-t) + {}^{2}/_{5}ta)$

$OX = OA + AX$

$= a + sAN$

$= a + s(-a + {}^{4}/_{5}b)$

$= a - Sa + {}^{4}/_{5}\ sb$

$a(1-s) + {}^{4}/_{5}sb$

$b(1-t) + {}^{2}/_{5}ta = a(1-s)\ {}^{4}/_{5}sb$

$b(1-t) = {}^{4}/_{5}\ sb$

$\sim$

$1-t = {}^{4}/_{5}s$-------------(i)

$a\ (1-s) = {}^{2}/_{5}ta$

$1-s = {}^{2}/_{5}ta$

$s = 1 - {}^{2}/_{5}t$-------------(ii)

$1-t = {}^{4}/_{5}(1 - {}_{2}/_{5}t)$

$1 - t = {}^{4}/_{5} - 8/_{25}t$

$-{}^{17}/_{25} = -\ 1/_{5}$

$t = {}^{5}/_{17}$

$s = {}^{15}/_{17}$

$\sim \qquad \sim \qquad \sim \qquad \sim$

11. $\dfrac{115800}{76.84} \times \dfrac{97.5}{100}$

$= 1469.35\ \checkmark$

$= 1469.35 - 270$

$= 1199.35\ \checkmark$

$= 1199$ dollars

12.

$RM = \quad - \quad =$

$\underset{\sim}{R}M = \quad (-3)^2 + 82(-1)^2$

$\tilde{}74 = 8.602$ units

13. (a) (i) OB = a + b

(ii) BC = BA + AO +OC

= -b + -a + 2b

= b – a

(b) CX = CO + OA + AB + BX

= -2b + a + b + hBC

= a – b + h(b - a)

= a – b + hb - ha

= (1 - h)a + (h – 1) b

(c) CX = CO + OA + AX

= 2b + a + KAT

but AT = AO + OT

= -a + 3b

CX = 2b + a + K(3b – a)

= a – Ka + 3Kb + 2b

= (1- K) a + 3 (K + 2) b

(d) I – h = 1 – k ....(i)

h – 1 = 3k + 2.......(ii)

from (i) h = k

sub in (ii) h-1 = 3h + 2

$h = {}^{-3}/_{2}$

$K = {}^{-3}/_{2}$

14. $a + b = (2 – 3)i + (1 + 4)j + (-2-1)k$

$= -i + 5j – 3k$

$/a + b/ \quad (-1)^2 + (5)^2 + (-3)^2$

$= \quad 35$

$= 5.916$

15. i) BD = BA + AD

$= -b + {}^{3}/_{5}c$

AE = AB + BE

= b + ½ BC = b + ½ (c – b)

$= \frac{1}{2} b + \frac{1}{2} c$

ii) $BF = t\left(\frac{3}{5}c - b\right)$
$AF = n\left(\frac{1}{2} b + \frac{1}{2} c\right) = \frac{n}{2}(b + c)$
$AF = AB + BF$
$= b + t\left(\frac{3}{5}c - b\right) = b + \frac{3}{5}tc + tb$
$= (1 - t)\, b + \frac{3}{5}tc$
$(1 - t)b + \frac{3}{5}tc = \frac{n}{2}b + \frac{n}{2}c$
$1 - t = \frac{n}{2}\,;\; 2 - 2t = n$ ………… (i)
$\frac{3}{5}t = \frac{n}{2}\,;\; 6t - 5n = 0$ ………..... (ii)

Sub from équation (ii)
$6t - 5(2 - 2t) = 0$
$6t - 10 + 10t = 0$
$16t = 10$
$t = \frac{10}{16} = \frac{5}{8}$
$n = \frac{3}{4}$

iii) $BF = \frac{5}{8} BD$
F divides BD in the ratio 5 :3
$AF = \frac{3}{4} AE$
F divides AE in the ratio 3 :1

16. $BA = \begin{matrix} -8 \\ -2 \end{matrix}$

$\frac{1}{2} BC = \frac{1}{2} \begin{matrix} -3 \\ -4 \end{matrix} = - \begin{matrix} 1\frac{1}{2}) \\ -2 \end{matrix}$

$OP = \begin{matrix} -8 \\ -2 \end{matrix} + \begin{matrix} -1\frac{1}{2} \\ -2 \end{matrix} = \begin{matrix} -9\frac{1}{2} \\ -4 \end{matrix}$

Co-ordinates of P (-9 ½ , -4)

17. $OB = \frac{5}{7}OQ + \frac{2}{5}OA$

O

$OQ = \frac{7}{5}OB - \frac{2}{5}OA$

$OQ = \frac{7}{5}\begin{matrix} 2 \\ -1 \end{matrix} - \frac{2}{5}\begin{matrix} -3 \\ 4 \end{matrix}$

$= \begin{matrix} \frac{14}{5} \\ \frac{-7}{5} \end{matrix} - \begin{matrix} \frac{-6}{5} \\ \frac{8}{5} \end{matrix} = \begin{matrix} \frac{20}{5} \\ \frac{-15}{5} \end{matrix} = \begin{matrix} \underline{4} \\ -3 \end{matrix}$

Q= (4, -3)

38. Representation of data

1.

Length	Frequency
$11.5 \le x \le 13.5$	6
$13.5 \le x \le 15.5$	9
$15.5 \le x \le 17.5$	6
$17.5 \le x \le 23.5$	3

2. Food: $^{40}/_{100} \times 360 = 144°$

Transport: $^{10}/_{100} \times 360 = 36°$

Education: $^{20}/_{100} \times 360 = 72°$

Clothing: $^{20}/_{100} \times 360 = 72°$

Rent: $^{10}/_{100} \times 360 = 36°$

3.

Class	Tally	Frequency	Upper Limit
10 – 29	//// ///	8	29.5 B_2 for
30 – 39	//// /	6	39.5 all tally
40 – 69	//// //// //// //// //// ///	28	69.5 B_2 all
70 – 74	//// /	6	74.5 - frequency
75 - 89	//// ///	8	89.5 - B_1
90 – 99	////	4	99.5 B_1

Modal class 40 – 69 B1

1.2

1.0

0.8

0.6

S_1- scale
B_3- Au Histogram
B_2- any 4
B_1- any 3

0.4

0.2

4. *See the graph paper.*
For correct class boundaries

For correct class intervals.

All frequency densities

Correct scale

All the bars drawn.

Top mid pts. Of bars indicated.

For the mid pts. Joint to make a polygon.

For correctly identifying the modal mark point.

For reading correctly the modal mark $\equiv 53.5 \pm 0.1$

5. (a)

Marks	Frequency
5-9	20
10-19	50
20-30	40
40-49	30

(b) Modal class is 10-19

(c)(i)

Class	x	f	fx	Cf
5-9	7	20	140	20
10-19	14.5	50	725	70
20-39	29.5	40	1180	110
40-49	44.5	30	1335	140
		ΣF = 140	ΣFx =3380	

$$x = \frac{\Sigma fx}{\Sigma f} = \frac{3380}{140} = 24.14$$

(ii) Median mark is at 70 + 71 = 70.5^{th} position

$$\text{Median} = 119.5 + \left(\frac{0.5}{40}\right) \times 20$$

$$= 19.5 + 0.25$$

$$= 19.75$$

6. Total No. of sessions
$= 8 + 7 + 4 + 3 = 22$
Angle for:
English = $^8/_{22} \times 360 = 130.9°$
Maths = $^7/_{22} \times 360 = 114.5°$
Chemistry = $^{4/}{}_{22} \times 360 = 65.5°$
CRE = $^3/_{22} \times 360 = 49.01°$

7. 180 – 189
Class limits

class	limits	f	cf
149.5	159.5	2	2
159.5	169.5	9	11
169.5	179.5	12	23
179.5	189.5	16	39
189.5	199.5	7	46
199.5	209.5	4	50

Median = $^{50}/_2 = 25$

$179.5 + \frac{25 - 23}{16} \times 10$

$= 179.5 + \frac{20}{16} = 180.75$

$179.5 + \frac{26 - 23}{16} \times 10$

$179.5 + \frac{30}{16} = 181.38$

$\frac{180.75 + 181.38}{2}$

$= 181.06$

8. a) i) 145 – 153
ii) Median class
$(^{40 + 1}/_2)^{th}$ value ∴ median class = 145 – 153
This is the 20.5th value
The value also in the 145 – 153 class

b)

Class	x	f	fx
118- 126	122	3	366
127- 135	131	4	524
136 – 144	140 B1	10 B2	1400
145 – 153	149	12	1788
154 – 162	158	5	790
163 – 171	167	4	668

172 - 180	176	2	352
		Ef = 40	Efx = 5888

B2 for all values of fx correct and B1 for 4 values of fx and above orrect

$\text{Mean} = \frac{Efx}{Ef} = \frac{5888}{40} = 147.2\text{mm}$

Median $20^{th} = 144.5 + ({}^{11}/_{12}$ x $9) = 152.75$

$21^{st} = 144.5 + ({}^{12}/_{12}$ x $9) = 153.5$

$\text{Median} = \frac{152.75 + 153.5}{2} = 153.125$

(Alternatively one could work out the 20.5 value directly using median formula)

39. Measures of central tendency

1. $4 + 6 + 10 + 14 + x + 24 + 14 + 6 = 100$

$78 + x = 100$

(i) $x = 22$

(ii) Modal class = 55 -59

Marks	x	*f*	*fx*	c*f*
30-34	32	4	128	4
35-39	37	6	222	10
40-44	42	10	420	20
45-49	47	14	659	34
50-54	52	22	1144	56
55-59	57	24	1368	80
60-64	62	14	868	94
65-69	67	6	462	100
	B_1	$\Sigma f = 100$ B_1	$\Sigma fx = 5210$	B_1

$\Sigma fx = 5210$

(i) $\text{Mean} = \frac{5210}{100}$

$= 52.10$

(ii) $\text{Median} = 49.5 + \frac{50-34}{22} \times 5$

$= 53.14$

2. $\text{Log}_{10}\, 5^2 - \log_{10} 2^3 + \log 2^5$

$\text{Log}_{10}\ \frac{25 \times \overset{4}{32}}{\underset{1}{8}}$

2

√Application of logarithmic laws.

√Application

C.A.O

$Log_{10}\ 100 = log_{10}^{10}$

$= 2\ log\ _{10}^{10}$

But $log_{10}^{10} = 1$

$.\therefore = 2$

3. Modal class 150-154

Height	Frequency	c.f
140- 144	3	3
145 – 149	15	18
150 – 154	19	37
155 – 159	11	48
160 -164	2	50

Height Frequency c.f

$= 149.5 + \frac{(25\text{-}18)}{19} \times 5$

$= 149.5 + \frac{7}{19} \times 5$

$= 149.5 + 1.842$

$= 15.34$

4.

H	20-24	25-29	30-34	35-39	40-44	45-49
F	3	19	25	20	18	15
CF	3	22	47	67	85	100

$Md = 34.5 + \frac{(50 - 47)}{20} \times 4$

$= 34.5 + {}^{12}/_{20} = 35.1$

5. a) $2x^2 + 6x - 2x = 0$

$32 - 24 - 2x = 0$

$-2x = -8$

$x = 4$

b) $2x^2 + 6x - 8 = 0$

$x^2 + 3x - 4= 0$

$x^2 + 4x - x - 4 = 0$

$x(x - 4) - (x + 4) = 0$

$(x - 1)\ (x + 4) = 0$

$.\therefore$ the other root is 1

6. $\Sigma xf = 61 \times 10 + 65.5 \times 20 + 71 \times 40 + 77 \times 15$

$= 610 + 1310 + 2840 + 1155$

$= 5915$

$\frac{\Sigma xf}{\Sigma f} = \frac{5915}{85}$

X Mean = 69.59

7.

Marks	30-39	40-49	50-59	60-69	70-79	80-89	90-99
No. of candidates	2	3	10	12	8	3	2
C.F	2	5	15	27	35	38	40

a) Number who sat = 40
b) The modal class = 60 – 69
c)

Marks	x	f	X – 64.5= d	fd
30-39	34.5	2	-30	-60
40-49	44.5	3	-20	-60
50-59	54.5	10	-10	-100
60-69	64.5	12	0	0
70-79	74.5	8	10	80
80-89	84.5	3	20	60
90-99	94.5	2	30	60
		£f = 40		£ fd = -20

$$\text{Mean} = 64.5 + \frac{-20}{40}$$
$$= 64.0$$

d) The median mark

$= ½ (20^{th}$ and 21^{st}) marks

$$= ½ \left(59.5 + \frac{5}{12} \text{ x } 10 + 59.5 + \frac{6}{12} \text{ x } 10\right)$$
$$= ½ (59.5 + 4.16666 + 59.5 + 5)$$
$$= ½ (128.16666667) \qquad = 64.083$$

8. 1, 1, 2, 2, 3, 4, 4, 6

a) Mode = 4
b) Median = 3
c) $\text{Mean} = \frac{1 \text{ x}2 + 2 \text{ x } 2 + 3 \text{ x } 1 + 4 \text{ x } 3 + 6 \text{ x } 1}{9}$

$= 3$

9. a) i) Modal class = 60 – 69

ii) class where medium lies
median class 50- 59

Class	Centre X	Fd	D= x – A
0 - 9	4.5	-50	-50
10 – 19	14.5	-80	-40
20 – 29	24.5	-120	-30
30 – 39	34.5	-140	-20

40 – 49	44.5	-100	-10
50 – 59	54.5	0	0
60 – 69	64.5	200	10
70 – 79	74.5	120	20
80 – 89	84.5	90	30
90 – 99	94.5	40	40
		εfd -40	

Mean = $54.5 - \frac{40}{70}$

= 53.93

10. Cumulative frequency

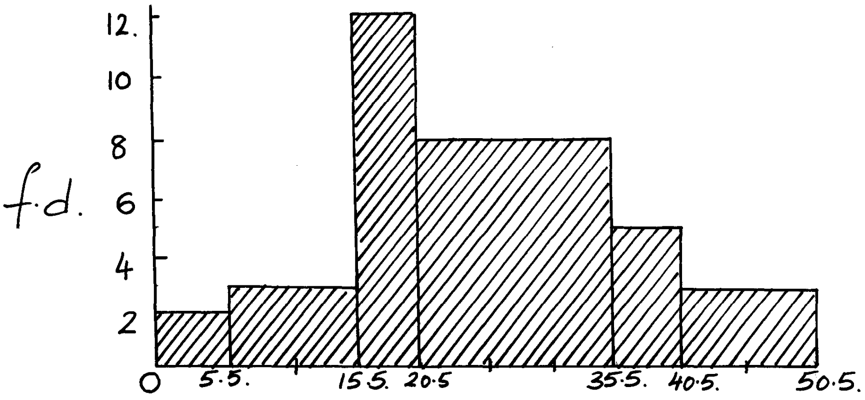
3,11, 30, 44, 50

Median = L1t $\frac{(^{n}/_{2} - cfa)}{Fn}$

= $8 + \frac{(25 - 11)}{19} \times 4$

= 10.947

11.



40. Linear motion

1. Distance covered by Kinyua in $1^{2}/_{3}$hrs

= 5 x 90 = 150km

Distance traveled by Nyaboke during the rest = ($^{1}/_{3}$ x 120) = 40km

$\frac{x}{90} = \frac{390 - x}{120} \Rightarrow 120x = 90(390 - x)$

= 167.1km

Time = $\frac{167.1}{90}$ = 1.86

8.33 + 1.86 = 10.19; they met at = 10.11a.m

580 – (150 + 167 .1) = 262.9km from M

Before the rally driver started, Nyaboke had traveled for 1 ½ hrs

($^{3}/_{2}$ x 120) = 180km

$\frac{x}{120} = \frac{x + 180}{80}$

$180x - 120x = 21600$

$x = 360km$

Distance from K = 580 – (180 + 360)

$x = 40km$

Time = $\frac{540}{180}$ = 3hrs

(9.30 + 3hrs) = 12.30p.m

2. Distance covered by the car after 15 min =(¼ x 80)km = 20km

Distance covered together = 130km

Relative speed = (80 + 40) = 120km/h

Time taken to meet

= $(\frac{130}{120})$ hrs

= 1hr 5 min

Time they met = 10:15 a.m +

$\underline{\quad\quad 1:05}$

11:20 a.m

3. . a) ½ X 50h + ½ X 100 h + 150h = 2700

225h = 2700

H = $\frac{2700}{225}$ = 12m/s

Maximum speed = $\frac{12 \times 60 \times 60}{1000}$

= 43.2km/h

b) Acceleration = $^{12}/_{50}$ m/s

= $^{6}/_{25}$ m/s

c) ½ X 50 x 6

150 m

d) Time for half of journey

½ X 12 (50 + t + t) = ½ X 2700

6(50 + 2t) = ½ X 2700

50 + 2t = 225

T = $\frac{225 - 50}{2}$ = 87.5

Total time

= 50 + 87.5 = 137.5 sec

4. Time taken at 10km

= $^{45}/_{10}$ = 4.5 hrs

Time taken at 15km/hr

$^{45}/_{15}$ = 3hrs

Total time taken = (4.5 + 3) = 7.5
(4.5 + 3) = 7.5 hrs
Average speed
= $^{90}/_{7.5}$
= 12km/hr

5. $D = \frac{5}{4} \times 80 + \frac{50}{1000}$
= 100.05km
Speed = 120 – 80 = 40km/h
$T = \frac{D}{S} = \frac{100.05}{40}$
= 2.50125hours

(b) $D = S \times T = 120 + \frac{100.05}{4000} + \frac{199}{800}$
$= \frac{120 \times 11000}{40000}$
= 330km

(c) Total time = $\frac{330}{80}$
= $4^1/_8$hrs
Time lapse = $4\frac{1}{8} - \frac{5}{4} + \frac{100.05}{40000} + \frac{199}{800}$
$= 4\frac{1}{8} - 4$ = $^1/_8$hrs

6. a) Distance traveled by bus before the matatu started off the journey is
Distance = speed x time
= 60 x 2 ½
= 150km

Relative speed = 100- 60 = 40km/hr
The matatu would cover the bus head start of 150km in 150/40 hrs = 3.75hrs = 3hrs 45 min
∴ The matatu will overtake the bus after 3hrs 45 minutes
This will be 1:15 + 3:45 = 5.00pm

b) Time taken by the matatu to complete the remaining 350km = 350/100 = 3 ½ hrs
= 3hours 30 minutes

Time taken by the bus to complete the remaining 350
= $^{350}/_{60}$ = $5^5/_6$ hrs = 5 hours 50 minutes
Matatu waits for 5hr 50min – 3hr 30 min = 2 hrs 20 min

7. Total distance = 100 + 140 + 150 = 490

Total speed = 88 + 164 = 252 km/hr

252 km/hr into m/h = $\frac{252 \times 1000}{3600}$ = 70m/h

Time taken = $^{490}/_{70}$ = 7 sec

8. Distance = (5 + 15)m = 20m = 0.02km

S ⇒ Bus = 40 km/h

Trailer = xkm/h

Relative speed = (40 – x) km/h

T = 4.8 sec. = $\frac{4.8h}{3600}$

$S = \frac{D}{T}$

$(40 - x) = \frac{0.02}{\frac{48}{3600}}$

$\simeq \frac{0.02 \times 3600}{48}$

= 15 km/h

40 – x = 15

x = 25 km/h

9. L.C.M = $2^4 \times 3^2 \times 5^3 = 1800$

GC.D. = $2 \times 3 \times 5^2 = 150$

10. Total distance = 60 cm

Total time taken = $3\ ^1/_5$ hrs

Let speed in still water be x km/h

Speed upstream = (x – 5) km/h

Speed downstream = (x + 5) km/h

$$\frac{30}{x - 5} + \frac{30}{x + 5} = \frac{16}{5}$$

$$30x - 150 + 30x + 150 = \frac{16}{5}(x^2 - 25)$$

$300x = 16x^2 - 400$

$x = -^5/_4$ or 20

∴ Speed in still water is 20 km/hr

11. *When David left, Ojwang had covered 15 x* $^3/_2$ *= 22.5 km.*

a) (i) Remaining dist. = 40 – 22.5 = 17.5 km

Relative speed = 15 + 25 = 40 km/h

Time taken before meeting = $\frac{17.5}{40}$ *= 0.4375 hrs*

Ojwang covered 15 x 0.437 = 5.5625 km

Distance from Ojwang's house = 22.5 + 6.5625 √

= 29.0625 km

(ii) 0.4375 = 26 min 15 sec

∴ They met at 10.30 + 26.15

= 10.56. 15 am.

(iii) 40 – 29.0625 √ *= 10.9375 km*√

b) Time take = $\frac{10.9375}{12}$ √ *= 0.9115 hrs*

= 54 min, 41 sec.

They arrived at 10.56. 15 + 54.41 + 10 min

= 12.00. 56 pm. √

12. *(a) In 10minutes Kamau has travelled*

$\frac{10}{60}$ *x 24 = 6km*

Distance left = 42 – 6 = 36km

Relating speed = 24 + 50.4k/hr

= 74.4km/hr

Time taken to meet = $\frac{42}{74.4}$ *= 0.565hrs*

= 34minutes

Time for meeting is 6.10

34

6.44a.m

$\frac{34}{60}$ *x 50.4 = 28.56km from R or 13.44 from S*

(b) Kamau arrival time

$\frac{42km}{24km/hr}$ *= 1.75hrs*

1hr .45 minutes

6.00a.m

1.45

7.45a.m

(c) Mrs Ronoh speed = $\frac{D}{T}$

= 50.4km/hr

Twice = 50.4 x 2 = 100.8

7.00a.m, Mr. Kamau covered = 1x24= 24km

Retain speed = 100.8- 24 = 76.8km/hr

So $\frac{24}{76.8}$ = 8.75

He was overtaken at 7.00

$\underline{+ 18.75}$

7.18am

At distance of D = S x t

= $\frac{100.8 \times 189.75}{60}$

31.5km from S or 10.5km from R

13. i) A gains on B at the rate of (72 – 56) Km/hr or 16km/h

∴ in 1 hr A gains on B 16km

In 545 A gains on B

$\frac{16 \times 1000 \times 54\ m}{60 \times 60}$ = 240

The sum of the lengths of the two trains is 240m but the length of the first train is 100m

The length of the second train is 140m

ii) Relative speed = (72 + 56) km/h = 128km/hr

Distance between A and B decrease at the rate of 128km/hr

The distance decreases by 240m

$\frac{60 \times 60 \times 240}{128 \times 1000}$ s = $\frac{27}{4}$ seconds

= 6 ¾ s

14. (a) Time = $\frac{D}{S}$

= $\frac{5}{x}$ hrs

(ii) Time = $\frac{7}{x + 24}$ hrs

(b) $\frac{5}{x} - \frac{36}{60} = \frac{7}{x + 24}$

$\frac{7}{x + 24} = \frac{25 - 3x}{5x}$

$35x = 25x - 3x^2 + 600 - 72x$

$3x^2 + 82x - 600 = 0$

$(3x + 100)(x-6) = 0$

x = $\underline{-100}$ or 6

3

His speed = 6km/hr

(c) Time = S x T

= $\frac{5}{6}$ x 60

= 50mins

15. a) Relative speed = 80 - 60

= 20 km/h

Time = $\frac{40}{20}$ hrs

= 2 hrs

(b) 1.50 p.m. = 13.50 hrs.

Time = 13.50 + 2 = 15.50 hrs

16. (a) Nairobi 400km Kisumu

Speed = 120km/h

Distance = 400km

Time taken = $\frac{400}{120}$ = 10 = 3hrs 20min

8.30 + 3hrs 20min = 11:50a.m

(b) at 8.30a.m distance covered by bus = ½ x 80 = 40km

Dist. Left = 360km speed = 200km/h

Time taken = $\frac{360}{200}$ = 1hr 48mins

They met at 8:30+ 1hr 48mins

= 10:18a.m

(c) 8 – 10.18a.m is 2hrs 18mins distance = 2 x 80 +$\frac{18}{60}$ x 80

= 160 + 24km = 184 from Nairobi

(d) car arrived in Nairobi after 3hrs 20mins

Bus traveled a time of 3hrs 20mins + 30mins

3hrs 50mins

Dist. = 3 x 80 + $\frac{50}{60}$ x 80 = 240 + 66 ${}^{2}/_{3}$

Distance from Kisumu = 93 ${}^{1}/_{3}$ km

17. Total distance = 25m

Relative speed= 54km/hr

To m/s = $\frac{54 \times 1000}{60 \times 60}$ = 15/ms

Time they met = $\frac{25}{15}$

= $1^2/_3$ sec

41. Quadratic expressions and equation 2

1. (a)

x	-2	-1	0	1	2	3	4	5	6
y	-17	-9	-3	1	3	3	1	-3	-9

For all √values of y B1

for at least 5 √values.

(b) $y = 5x - x^2 - 3$

$\underline{0 = 5x - x^2 - 3}$

$y = 0$

$x = \underline{0.75 \text{ or } 4.3 \pm 0.1}$

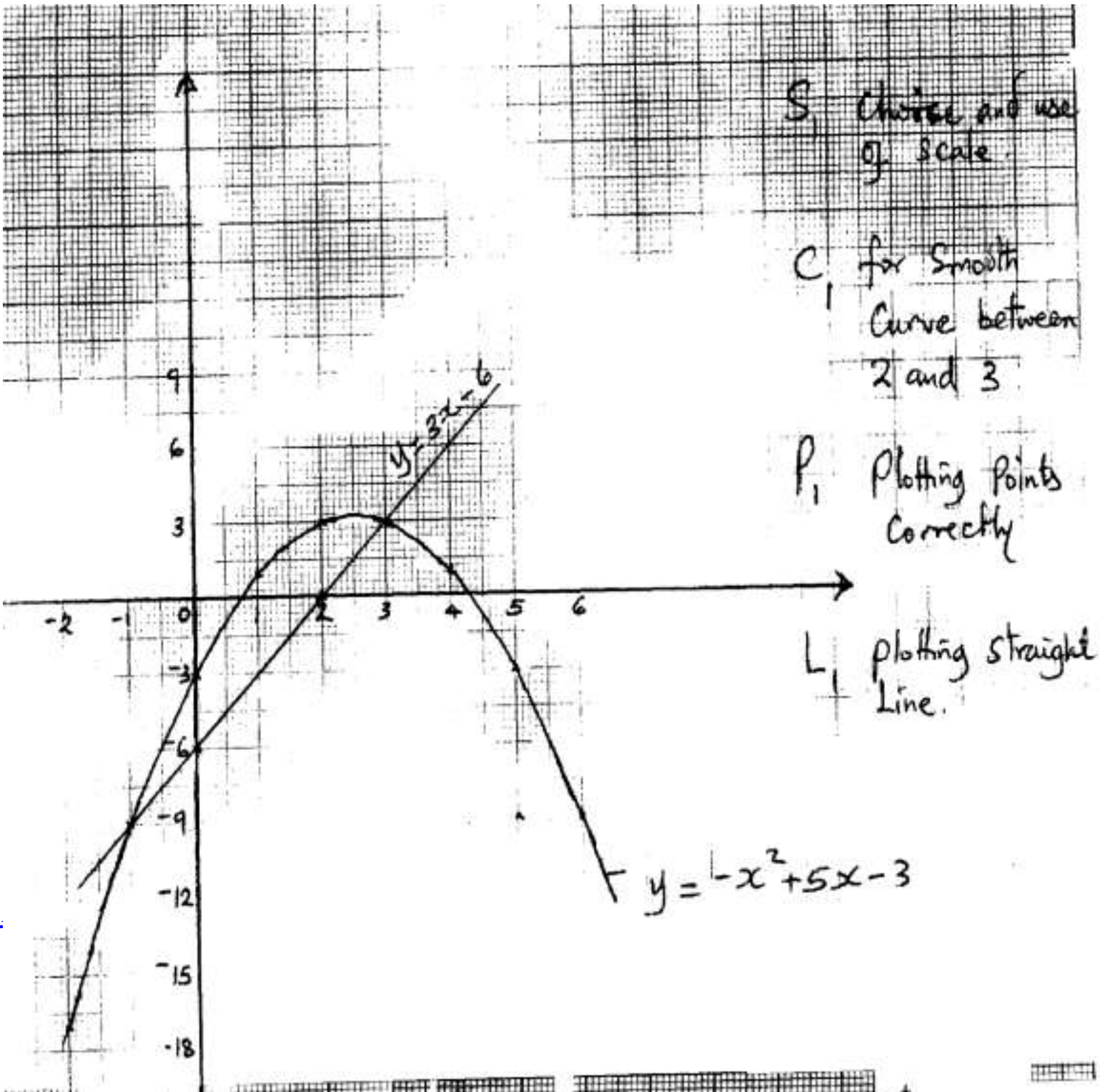
(c) $y = 5x - x^2 - 3$

$\underline{0 = 2x - x^2 + 3}$

$y = 3x - 6$

x	0	-1	2
y	-6	-9	0

$x = -1 \text{ or } 3 \underline{+} 0.1$



2. $x - 2.5 - \sqrt{3} \qquad x - 2.5 + \sqrt{3} \quad = 0$

$x^2 - 2.5x + x\sqrt{3} - 2.5x + 6.25 - 2.5\sqrt{3}$

$x\sqrt{3} + 2.5\sqrt{3} = 0$

$x^2 - 5x + 6.25 - 3 = 0$

$x^2 - 5x + 3.25 = 0$

$4x^2 - 20x + 13 = 0$

3. $17.35 \text{ X } 13.85 = 240.3$

$17.35 \text{ X } 13.75 = 237.2$

$\therefore 17.3 \text{ X } 13.8 = 238.7$

Max err $240.3 - 238.7 = 1.5$

Min err $238.7 - 237.2 = 1.6$

Max err $= \frac{1.6 + 1.5}{2} = \frac{3.1}{2} = 1.55$

Product 238.7 ± 1.55

Last product 240

Max err = 1.55

Relative err = $\frac{1.55}{28.1\%}$

error = $\underline{1.55} \times 100 = 0.6\%$ 28.1

Relative err = $\frac{1.55}{238.7}$

4.

x	-6	-5	-4	-3	-2	-1	0	1	2	3	4
y		04	-2		-8	-8		-2	4	12	

(c) (i) $x^2 + 3x - 6 = 0$

$x = -4.5$ or 1.5 ± 0.2

(ii) $y = x^2 + 3x - 6$

$x^2 + 3x - 2$

$y = -4$

$x = 5$ or 4 ± 0.2

5.

x	-4	-3	-2	-1	0	1	2	3

y	21	10	3	0	1	6	15	28

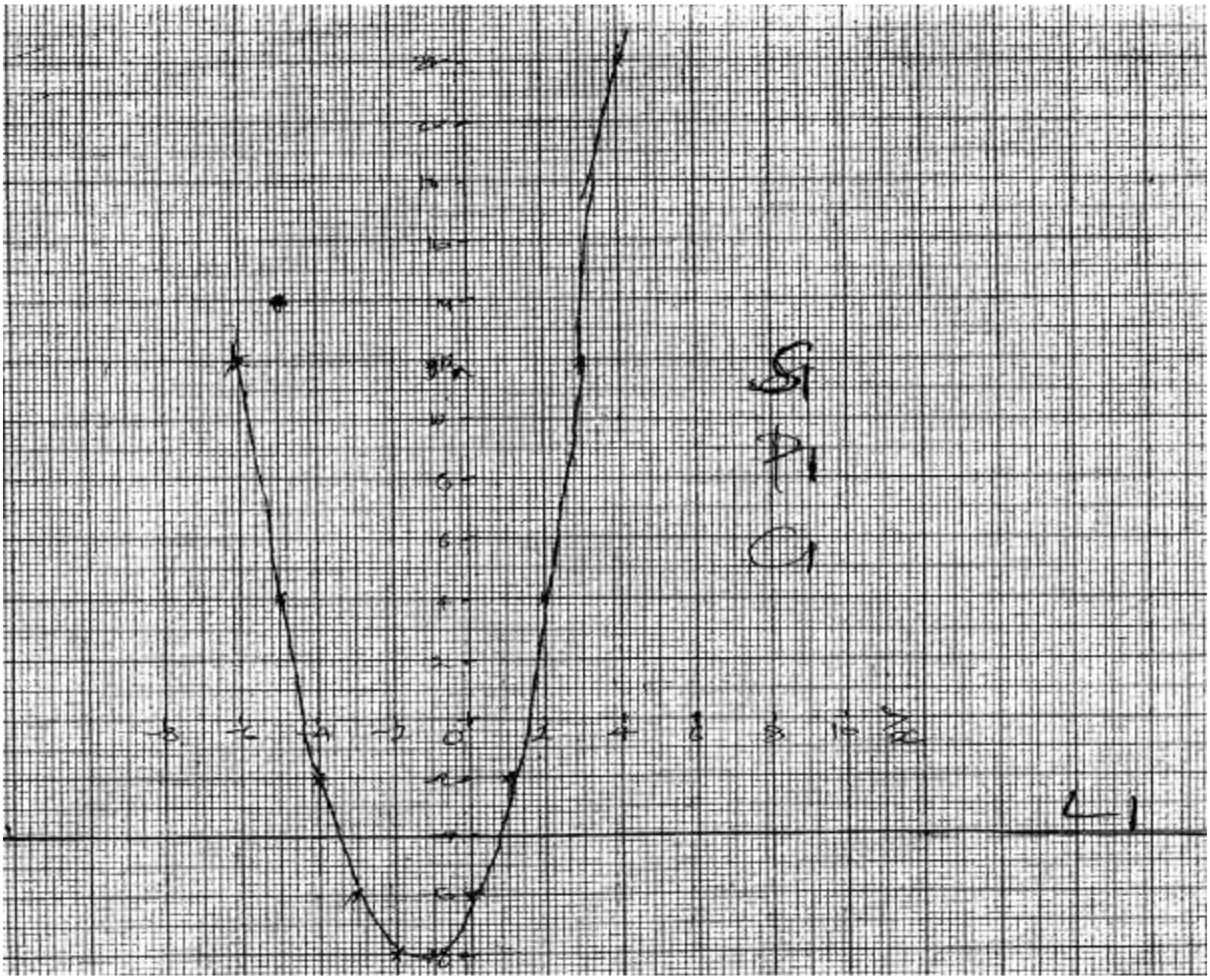
(c) $2x^2 + 3x + 1 = 0$

$\underline{2x + 4x - 3 = 0}$

$-x + 2 = y$

$x = 0.6$ or $x = -2.6 \pm 0.1$

(d) $x = 0.30 - x = -1.8 \pm 0.1$



6. a) i $\frac{480,000}{x}$ /=

ii) $\frac{480,000}{x - 4}$ /=

b) $\frac{480,000}{x - 4} = \frac{480,000}{x} + 20,000$

Multiply all hr' by L.C.M.

$480,000x = 480,000(x - 4) + 20,000(x^2 - 4x)$
Dividing by 10,000

$48x = 48x - 192 + 2x^2 - 4x$
$48x - 48x + 4x - 2x^2 + 192 = 0$
$4x - 2x^2 + 192 = 0$

$x = \frac{-b \pm \quad (b^2 - 4ac)}{2a}$
$= \frac{-4 \pm \quad 1552}{-4}$
$= \frac{-4 \pm \quad 39.3954}{-4}$
$x = \frac{-4 + 39.3954}{-4}$ or $x = \frac{-4 - 39.3954}{-4}$
But x cannot be –ve hence
$x = \frac{-43.3954}{-4} = 10.8489$
$= 11$

c) Original : new cont.
$\frac{480,000}{11} : \frac{480, 000}{7}$
d) Size of land bought = 6 hectares
$\frac{6}{7} = 0.857143$
$\simeq 0.8571$ hectares

7.

19.

x	-3	-2	-1	0	1	2
y	13	4	-1	-2	1	8

(iii) $y = 2x^2 + x - 2$
$\underline{0 = 2x^2 + 2x - 3}$
$y =- \quad x + 1$

x	-3	-2	-1	0	1	2
y	5	3	2	1	0	-1

$y = 2x^2 + x - 2$
$\underline{0 = 2x^2 + x - 5}$
$y = \quad 3$

8. (a) Dist. traveled in 3hrs s. drawing
Plane A – 400 x 3 = 1200km – cm
Plane B – 500 x 3 – 7.5cm
Plane C – 300 x 3 = 900km – 4.5cm

(b) Dist. BA = 12.8 0.1 x 200 = 2560km 20km

$T = \frac{D}{S} = \frac{2560}{500}$ hrs

= 5.12hrs of 5hrs, 7.2mns

≈ 5hrs, 7min (nearest min)

(c) Bearing of B from C = $360^o - 20^o = 340^o$

Dist. BC = (10.9 ± 0.1 x 200)km

= 2180km ± 20km

9. a)

x	-2	-1.5	-1	-0.5	0	0.5	1
x^2	4	2.25	1	0.25	0	0.25	1
4x	-8	-6	4	-2	0	2	4

4	4	4	4	4	4	4	4
y	0	0.25	9	2.25	4	6.25	9

$A = \frac{1}{2} h \quad (y_1 + y_7) \quad + 2(y_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots y_6)$

$= \frac{1}{2} \times \frac{1}{2} \quad (0 + 9) \quad + 2\,(0.25 + 9 + 2.25 + 4 + 0.25$ √

$= \quad \frac{1}{4} \qquad 9 + 4.25$ √

= <u>13.25 sq. units</u> √

b) $\int_{-2}^{0} (x^2 + 4x + 4)\, dx \quad + \quad \int_{0}^{1} (x^2 + 4x + u)\, dx$

$\left[\frac{x^3}{3} + 2x^2 + 4x\right]_{-2}^{0} + \left[\frac{x^3}{3} + 2x^2 + ux\right]_{0}^{1}$ √

$= \left(-\frac{8}{3} + 8 - 8 \right) + \left(\frac{1}{3} + 2 + 4\right)$ √

= 9 √

Error = 13.25 – 9 = 4.125

$\% = \frac{4.125}{9}$ √ x 100

= <u>45.84%</u>

10. a)

x	-2	-1.5	-1	-0.5	0	0.5	1
x^2	4	2.25	1	0.25	0	0.25	1
4x	-8	-6	4	-2	0	2	4

4	4	4	4	4	4	4	4
y	0	0.25	9	2.25	4	6.25	9

$A = \frac{1}{2} h \quad (y_1 + y_7) \quad + 2(y_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots y_6)$

$= \frac{1}{2} \times \frac{1}{2} \quad (0 + 9) \quad + 2\,(0.25 + 9 + 2.25 + 4 + 0.25 \quad \surd$

$= \quad \frac{1}{4} \qquad 9 + 4.25 \quad \surd$

$= \underline{13.25 \text{ sq. units}} \ \surd$

b) $\int_{-2}^{0} (x^2 + 4x + 4)\, dx \quad + \quad \int_{0}^{1} (x^2 + 4x + u)\, dx$

$\left[\frac{x^3}{3} \ + 2x^2 \quad + 4x\right]_{-2}^{0} \quad + \quad \left[\frac{x^3}{3} \quad + 2x^2 + ux\right]_{0}^{1} \quad \surd$

$= \quad (- {}^{8}/_{3} \ + 8 – 8) \ + ({}^{1}/_{3} \ + 2 + 4) \quad \surd$

$= 9 \quad \surd$

Error = 13.25 – 9 = 4.125

$\% = \frac{4.125}{9} \ \surd \quad \times 100$

$= \underline{45.84\%}$

11. $y = 2x^2 – 4x – 5$ $\qquad\qquad$ $y = 2x +3$

X	-3	-2	0	1	2	3	4	5			x	-4	-2	0	2
$2x^2$	18	2	0	2	8	18	32	50			y	-5	-1	3	7
4x	-12	-8	-4	0	4	8	12	16	20						
5	5	5	5	5	5	5	5	5	5						
y	25	11	1	-5	-7	1	11	25	11	B_2					

(a) x =1
(b) -0.9 x 2.8
x = -1 and x =4

12.

X	-1.5	-1	0	1.5	2	2.5	3.5
Y	-4	0	5	5	3	0	-9

(0.75, 6.125)
Y= -2
Range of values -1.3, < x < 2.75
Integral values; -1, 0, 1, 2

13. a)

x	-4	-3	-2	-1	0	1	2
$2x^2$	32	18	8	2	0	2	8
$4x - 3$	-19	-15	-11	-7	-3	1	5
y	13	3	-3	-5	-3	3	13

(b)Roots for $x = -2.6 \pm 0.1$

$x = 0.6 \pm 0.1$

$y = 2x^2 + 4x - 3$

-

$\underline{0 = 2x^2 + x - 5}$

$y = 3x + 2$

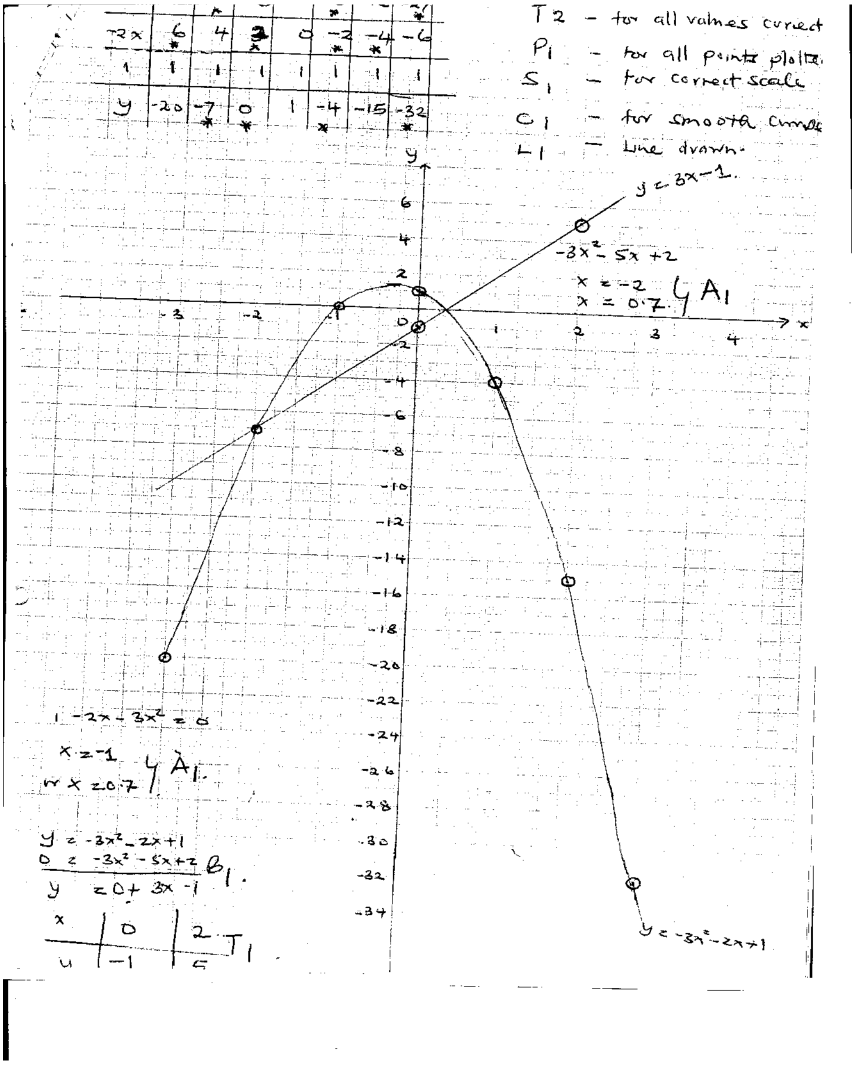
Roots read from the 2 pts of intersection of the line and curve.

$X = -1.9 \pm 0.1$

$X = 1.4 \pm 0.1$

14.

x	-3	-2	-1	0	1	2	3
$-3x^2$	-27	-12 *	-3	0	-3*	-12	-27*
$-2x$	6 *	4	2 *	0	-2 *	-4 *	-6
1	1	1	1	1	1	1	1
y	-20	-7 *	0 *	1	-4 *	-15	-32 *



$1 - 2x - 3x^2 = 0$

$x = -1$

or $x = 0.7$ A_1

$y = -3x^2 - 2x + 1$

$\underline{0 = -3x^2 - 5x + 2}$ B_1

$y = o + 3x - 1$

x	0	2
y	-1	5

T_1

15. $x^2 + ax - b = 0$

$(x-1)(x+5) = x^2 + ax - b$

$x^2 + 4x - 5 = x^2 + ax - b$

$a = 4, b = 5$

16. $Let\ a = 1.5 + \sqrt{2}$
$b = 1.5 - \sqrt{2}$
$\therefore (x - a)(x - b) = 0$
$x^2 - xb - ax + ab = 0$
$x^2 - x(1.5 - \sqrt{2}) - x(1.5 + \sqrt{2}) + ab = 0$
$x^2 - 1.5x + x\sqrt{2}) - x\ 1.5x - \sqrt{2}) = 0$
$x^2 - 3x + ab$
$x^2 - 3x + (1.5 + \sqrt{2})(1.5 - \sqrt{2}) = 0$
$x^2 - 3x + 2.25 - 2 = 0$
$x^2 - 3x + ¼ = 0$
$4x^2 - 12x + 1 = 0$

17. a) i) $a^2 + b^2 = 89 \qquad a + b = 13$
$a^2 + 2ab + b^2 = (a + b)^2 = 13^2 = 169$

ii) $2ab = 169 - 89$
$= 80$

iii) $a^2 - 2ab + b^2 = a^2 + b^2 - 2ab$
$= 89 - 80 = 9$

iv) $(a - b)2 = 9$
$a-b = \pm 3$

b) $a + b = 13$
$\underline{a - b = 3}$
$2a = 16$

42. Approximation and errors

1. Maximum perimeter = $2(12.05 + 8.05) = 40.2cm$
Actual perimeter = $2(12.0 + 18.0) = 40.0cm$
Error = $40.2cm - 40.0cm = 0.2cm$
%error = $\frac{(0.2 \times 100)}{40}$
$= 0.5\%$

2. $A = ½ \times 12 \times 8 = 48$
i) Absolute error
$= \frac{[\ ½ \times 12.5 \times 8.5 - ½ \times 11.5 \times 7.5\ ]}{2}$
$= 5$
ii) % error = $5/24 \times 100\%$
$= 10.4\%$

3. $A = L \times W$
$A = x(14-x) = 14x - x^2$

$\underline{dA} = 14 - 2x = 0$

dx   14 = 2x, x = 7

Maximum area = 7(14 -7)
= 7x 7 = 49cm^2

4.

Shortest possible length of 2nd piece
= 5.15 – 3.085= 2.065m

5. Absolute error 10 ± 0.05 and 15 ± 0.05

Max area = 10..5 x 15.05

Min area = 9.95 x 14.95 = 148.7525

a.e = $\frac{150.2525 – 15 + 150 – 148.7525}{2}$
= 1.25
% error = $^{1.25}/_{150}$ x 100
= 0.8333%

6. 17.35 X 13.85 = 240.3
17.35 X 13.75 = 237.2
∴17.3 X 13.8 = 238.7
Max err 240.3 – 238.7 = 1.5
Min err 238.7 – 237.2 = 1.6
Max err = $\frac{1.6 + 1.5}{2}$ = $\frac{3.1}{2}$ = 1.55
Product 238.7±1.55
Last product 240
Max err = 1.55
Relative err = $\frac{1.55}{28.1\%}$
error = $\frac{1.55}{28.1}$ x 100 = 0.6%
Relative err = $\frac{1.55}{238.7}$

7. 14 Kg to the nearest $^{10}/_{1000}$ Kg
A.E = 0.01

$$\% E = \frac{0.01}{14} \times 100$$

$$= 0.07$$

8.

X	0°	3°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
Cos x	1	0.87	0.5	0	-0.5	0.87	-1.0	-0.87	0.5	0	0.5	0.87	1
2 cos (x + 30)	1.73	1	0	-1.0	-1.73	-2.0	-1.73	-1.0	0	1	1.73	2.00	1.73

b) i) Amplitude of $y = \cos x$ is 1 unit
And $Y = 2\cos(x + 30)$ 2 units

ii) period of $y = 2\cos(x + 30°)$
330°

c) $\cos x = 2\cos(x + 30°)$
$x = 40° \pm 1$
$x = 219° \pm 1$

9. $\frac{y + x}{y - x} = \frac{12 + 6}{8 - 6}$ — ***Correct substitution***

$= \frac{18}{2}$ — ***Simplification***

$= 9$ — ***CAO***

43. Trigometry 2

1. $5 \sin x + \cos x$

$= 5\ \frac{12}{13} - \frac{5}{13}$

$= \frac{60}{13} - \frac{5}{13} = \frac{55}{13}$

$= \frac{12}{13}$

2. $\underline{2 \cos 3\theta} = \underline{1}$

1 2 2

$\cos 3\theta = 0.5$

$3\theta = \cos^{-1} 0.5$

√Identification of exact number of quadrants to satisfy the equation.

√Values of at least 4 soln. of θ

$\frac{3\theta}{3} = \frac{60^o}{3}, \frac{300^o}{3}, \frac{420^o}{3}, \frac{66^o}{3}, \frac{78^o}{3}, \frac{102^o}{3}$

$\therefore\ \theta = 20^o, 100^o, 140^o, 220^o, 260^o, 340^o$

3.. $\frac{\frac{1}{2} \text{ X } \frac{\sqrt{3}}{2}}{\frac{\sqrt{3}}{2} \text{ X } \frac{1}{\sqrt{2}}}$

$\frac{\sqrt{3}/4}{\sqrt{3}/2 - 1/\sqrt{2}} \text{ X } \frac{\sqrt{3}/2 + 1/\sqrt{2}}{\sqrt{3}/2 + 1/\sqrt{2}}$

$\frac{3/8 + \sqrt{3}/4\sqrt{2}}{3/4 - 1/2} = \frac{3/8 + \sqrt{3}/4\sqrt{2}}{1/4}$

$= 3/2 + \sqrt{3}/\sqrt{2}$

4. a) $b^2 = a^2 + c^2 - 2ac \cos B$

$b^2 = 7^2 + 5^2 - 2.5..\ 7 \cos 100$

$= 74 - 70(-0.173648)$

$= 74 + 12.15537$

$b^2 = 86.15537$

$b = 9.28199$

AC = 9.3 km

b) $\frac{9.3}{\sin 100} = \frac{5}{\sin \theta}$

$\text{Sin } \theta = \frac{5 \sin 100}{9.3} = 0.529466$

$\theta = 31.9694$

$\theta \simeq 32^0$

$32 - 20 = 12^0$

$\text{Bearing} = 360^0 - 12^0 \qquad = 348^0$

c) 020^0

5.

$\text{Sin } 60 = \sqrt{3}/2 \qquad 1$

$\text{Sin } 45 = 1/\sqrt{2} \qquad \frac{\sqrt{3}}{2 \quad \sqrt{2}} \quad \frac{1}{\sqrt{2}} \quad - \quad \underline{1}$

$= \frac{1}{\frac{\sqrt{3}}{2\sqrt{2}} - \frac{1}{\sqrt{2}}}$

$= \frac{\sqrt{6}}{5} - \frac{\sqrt{2}}{2}$

$= \sqrt{6} \quad - 2\sqrt{2}$

4

30° 45°

6. 2 3 2 1

60° 45°

1

$1 + \frac{1}{\sqrt{2}} x \frac{\sqrt{3}}{2}$

$1 + \frac{\sqrt{3}}{2\sqrt{2}} \; x \; \frac{2\sqrt{2}}{2\sqrt{2}}$

$\frac{1}{1} + \frac{2\sqrt{6}}{4}$

$\frac{4 + 2\sqrt{6}}{4}$

7. $\frac{\sqrt{5}\,(2\sqrt{2} + \sqrt{5}\,) + \sqrt{2}(2\sqrt{2} - \sqrt{5})}{(2\sqrt{2})2 - (\sqrt{5})^2}$

$\frac{2\sqrt{10} + 5 + 4 - \sqrt{10}}{8 - 5}$

\- $\frac{9 + \sqrt{10}}{3}$

$3 + {}^{1}/_{3}\sqrt{10}$

8\. a) $b^2 = a^2 + c^2 - 2ac \cos B$

$b^2 = 7^2 + 5^2 - 2.5..\ 7 \cos 100$

$= 74 - 70(-0.173648)$

$= 74 + 12.15537$

$b^2 = 86.15537$

$b = 9.28199$

$AC = 9.3$ km

b) $\frac{9.3}{\sin 100} = \frac{5}{\sin \theta}$

$\sin \theta = \frac{5 \sin 100}{9.3} = 0.529466$

$\theta = 31.9694$

$\theta \simeq 32^0$

$32 - 20 = 12^0$

$\text{Bearing} = 360^0 - 12^0$

$= 348^0$

c) 020^0

44. Surds

1.. 3 + 1 = 3 7 + 2 + 1 7
7 – 2 7 7 – 4 7

3 + 1 = 3 7 + 7 -2)
7 – 2 7 7 -2 7
3 7 + (7-2)
7 - 2 7
= 3 7 + 7 -2 7 + 2 7
7 – 2 7 7 + 2 7
= 49 – 28
= (3 7 + 7-2) (7 + 2 7
21
= (4 7 – 2) 7 + 2 7
21

2.

4 + 4 5 + 5 – (6-3 5 + 2 5-5)
4-5
8 + 5 5
-1
a = -8 b = -5

3. 14 (7 + 2) – 14 (7 - 12)
7 – 12
14 . 7 + 14. 12 - 14 . 7 + 14 . 12
-5

4.

$(2-1)^2 = 2 – 2 \quad 2 + 1 = 3 2 \quad 2$

$(2 – 1)^3 = 2 – 1(3-2 \quad 2$

$= 5 \quad 2 – 7$

$$\frac{2-\ 2}{5\ \ 2-7} \times \frac{5\ \ 2+7}{5\ \ 2+7} = \frac{2\ \ 2+7)-\ \ 2\ \ 2+2)}{1}$$

$= 17\ \ 2-6\ \ = -6+17\ 2$

5. $(2-3)(3+2)$

$\frac{3(2)2-2)2}{}$

$\frac{3x2-3+2-2}{9x2-4x3}$

$\frac{6-3+2-6}{18-12} = 6$

6. i) Or = $16^2 - 5^2$

$= 256 - 25$

$= 15.198$ cm

ii) $\tan\theta = \frac{5.066}{4} = 1.2665$

$\therefore \theta\, 51.71^0$

7. $\text{Log}_{10}5 - \log_{10}10^2 + \log_{10}(2y+10) = \log_{10}(y-4)$

$\text{Log}_{10}\left\{\frac{5(2y+10)}{10^2}\right\} = \log_{10}(y-4)$

$10y + 50 = 100y - 400$

$90y = 450$

$y = 5$

8. $\sqrt{3} - \ \sqrt{2}\quad \sqrt{3}\ - \ \sqrt{2}$

$\sqrt{3}\ + \ \sqrt{2}\quad \sqrt{3}\ - \sqrt{2}$

$= 3 - \ \sqrt{6}\ - \ \sqrt{6}\ + 2$

$3 - \ \sqrt{6} + \ \sqrt{6} - 2$

$= 5 - 2\sqrt{6}$

$3 - 2$

$= 5 - 2\sqrt{6}$

45. Further logarithms

1.

No	Log
1934^2	3.2865 X 2
√0.00324	= 6.5729
	-3.5105 : 2
	= 2.7553
	= 5.328
2.8727	0.4583
	= 4.8699
Anti log 4.8699 = 7.4114 X 10	
= 74114	

2. a) monthly taxable pay;

15% of monthly salary = $^{15}/_{100}$ x 20000
= kshs.3000

Monthly pay = Kshs.(20000 + 3000 – 700)
= Kshs. 22300

In Kenya pounds = $^{22300}/_{20}$
= KE 1115

b) Total tax payable (Gross tax)

1 – 342__________ 342x2 = Kshs.684
343 – 684 ________ 342 x3=Kshs.1026
685 – 1026 _______ 342 x4= Kshs.1368
1027 – 1368 _____ 89x5 = Kshs.445
Total tax = Kshs.3523

c) Net tax
= Gross tax – relief
= Kshs.(3523 – 600) = Kshs.2923

d) Net pay;
= Kshs.20000 – (2923 + 2100 + 200 + 2/100 x 20000)
= Kshs. (20000 – 5623) = Kshs.14377

3. 6 month depreciation rate = 8%
Number of periods = 8
$400,000 (1 – 0.08)^8 = 205288$

4. Mid ordinate
Area = 1.2 (6.2 + 4.3 + 2.6)
= 15.72

5. N. $\log \dfrac{2^5 \times 2^7}{3^6} = \log \dfrac{2^{12}}{3^6}$

6 6

$= \log \frac{2^2}{3} = \frac{4}{3}$

$D; \log \frac{2^5 \text{ x } 2^1}{3^3} = \log \frac{2^6}{3^3} = \overset{3}{\log} \frac{2^2}{3^3} = {}_3\log \frac{4}{3}$

$\frac{N}{D}; \log_6 \frac{4}{3}$

$\log^3 \frac{4}{3}$

$= 6 \log \frac{4}{3}$

$3 \log \frac{4}{3}$

${}^6/_3 = 2$

6. $\log (x+5) = \log(4)$

$(x+2)$

$x + 5 = 4$

$x + 2$

$(x+5)(x+2) = 4$

$x^2 + 2x + 5X + 10 = 4$

$x^2 + 7x + 6 = 0$

$x^2 + 6x + x + 6 = 0$

$x(x+6) + 1(x+6) = 0$

$(x+1)(x+6) = 0$

$x = -1 \quad x = -6$

7. $a = 100$

$r = \frac{200}{100} = 2$

$\frac{a(r^n - 1)}{r - 1} \succ Sn$

$\frac{100(2^n - 1)}{2 - 1} \succ 3{,}100$

$2^n - 1 > 31$

$2^n > 32$

$2^n > 2^5$

$n > 5$

$n = 6$

8. a)

2	3	5	7
2	32	52	72
3	23	53	73
5	25	35	75
7	27	37	57

b) P(E) $= \frac{4}{16}$

$= \frac{1}{4}$

9. $x^2 + y^2 - 6x = 3 - 4y$

$x^2 - 6x + (^{-6}/_2)^2 + y^2 + 4y + (^4/_2)^2 = 3 + (^{-6}/_2)^2 + (^4/_2)^2$

$(x - 3)^2 (y + 2)^2 = 3 + 9 = 4$

$(x - 3)^2 (y + 2)^2 = 16$

C (3, -2)

Gradient $\frac{\Delta y}{\Delta x} = \frac{7 - -2}{6 - 3} = 3$

10. $A = P(1 + \frac{r}{100})^n$

$= 10000 (1 + \frac{4}{100})^6$

$= 10000(1.04)^6$

= 12653.19 (12,653)

11.

No.	Std. Form	Log
13.6	1.36×10^1	1.1335
	+	
Cos 40^0		1.8842
	1.0177	
63.5	6.35×10^1	1.8028
	1.2149 ÷3	

$= \frac{\underline{3} + \underline{2.2149}}{3\;3}$

0.5474	5.474×10^{-1}	1.7383

0.5474

12. $\text{Log}_{10} 5^2 - \log_{10} 2^3 + \log 2^5$

$\text{Log}_{10} \frac{25 \times \overset{4}{32}}{\underset{1}{8}}$

✓Application of logarithmic laws.

✓Application

C.A.O

$\text{Log}_{10} 100 = \overset{2}{\log}_{10}{}^{10}$

$= 2 \log_{10}{}^{10}$

But $\log_{10}{}^{10} = 1$

$\therefore = 2$

13. $\text{Log } \frac{3x + 8}{2^3} = \log (x - 4)$

Division of logs.

$\frac{3x + 8}{8} = x - 4$

Dropping logs and simplification.

C.A.O

$3x + 8 = 8(x - 4)$
$3x + 8 = 8x - 32$
$-5x = -40$
$x = 8$

46. Commercial Arithmetic 2

1. After 1st year = $\frac{95}{100}$ x 4200000)
= Shs.357,000
After 2nd year = ($\frac{87}{100}$ x 357000)
= sh310590
After 3rd year = ($\frac{88}{100}$ x 310590
= shs.273319.20
After 4th year = ($\frac{91}{100}$ x 273319.20)
=shs.248720.50
After 5th year = ($\frac{248720.50}{100}$ x 93) = shs.231310
The next 6years
$A = 231310 (1- 0.05)^6 = 170034.10$
Then $140000 = 170034.10 (1-0.04)^n$
$(0.96)^n = \frac{140000}{170034.10} = 0.8234$
$n = \frac{\log 0.8234}{\log 0.96}$
$= \frac{0.0844}{0.01773} = 4.76$yrs
Total no. of years = 5 + 6 + 4.76yrs = 15.76years

2. Gross tax = 4830 + 1120 + 600 = sh 6550 per month
Annual gross tax = 6550 X 12= 78,600
$\frac{10}{100}$ X 120,000 = sh.12,000
$\frac{15}{100}$ X 120,000 = sh.18,000
$\frac{25}{100}$ X 120,000 = sh. 30,000

Re. tax = 78600 – (12000 + 18000+30000)

=78600 – 60,000 = 18,6000

$\frac{35}{100}$ X x =18,600

0.35x = 18,600

x = sh 53142.86

Taxable income p.a = 36,000+53142.86

=sh.412142.86

Monthly salary = $\frac{413142.86}{12}$ + 12,000

= 34428.57 + 1200 = Sh 35628.57

3. a) Sin 86.3° = $^{XB}/_{AB}$

Sin 86.3°= $^{XB}/_{30}$

XB = 30sin86.3°

XB = CD = 29.93746855 cm

b) < ABX = 90° - 86.3°

= 3.7°

∴ < ABD = 3.7° + 90°

= 93.7°

c) < DBF obtuse = 360° - 187.4°

= 172.6°

Arc DEF = $^{ø}/_{360}$ πD or $^{ø}/_{360}$ x2πr

But cos 86.3° = $^{AX}/_{AB}$

Cos 86.3° = $^{AX}/_{30}$

AX = 1.935969248 cm

DB = 16 – 1.935969248 = 14.06403075 cm

∴ Arc DEF = $^{172.6°}/_{360°}$ x $^{22}/_{7}$ x 14.06403075

= $\frac{106807.8751}{2520}$

= 42.38407742 cm

Arc CGH

< reflex CAG = 360° - (2x 86.3°)

= 187.4°

∴ Arc CGH = $^{187.4°}/_{360°}$ x2 x $^{22}/_{7}$ x 16

= $\frac{131,929.6}{2520}$

= 52.35301587 cm

Total length of belt to go round the belt

= CD + DEF + GF + CHG

$= 29.93746855 + 42.38407742 + 29.93746855 + 52.35301587$

$= 154.6120304$ cm

4. $\angle ABD = 31^{0}$

$\angle CBD = 37^{0}$

5. $A = 15{,}000(1 + {}^{8}/_{100})^{7}$

$= Ksh.25{,}707$

6. Principle = 30,000 – 6,000

= 24,000/=

Amount = 18 x 2000

= 36,000/=

$A = P\ \mathrm{T}1 + \frac{r}{100}$

$6{,}000 = 24000\ \ 1 + \frac{r}{100}^{18}$

$\frac{36000}{24000} = 1 + \frac{r}{100}$

$\frac{3}{2} = \frac{1}{00} + r$

$1 + \frac{r}{100} = \sqrt[18]{1.8}$

$1 + \frac{r}{100} = 1.023$

$\frac{r}{100} = 0.023$

$\Rightarrow \underline{2.3\%}$

7. Commission earned Kshs. (8368 – 6700) = Kshs. 1668/=

let sales in 3rd bracket be y

${}^{10}/_{100} \times 5000) + ({}^{15}/_{100} \times 3000) + ({}^{20}/_{100} \times y) = 1668$

$500 + 450 + 0.2y = 1668$

$0.2y = 1668 – 950 = 718$

$y = {}^{718}/_{0.2} = 35\%$

Total sales = (8000 + 3590)

= shs.11590

8\. Find the principal which in 12 years at 5% p.a compound interest amounts to sh.450,00

$A = P\left(1 + \frac{R}{100}\right)^{n}$

$I = A – P$

$\therefore A = \frac{(100 + R)^{n}}{100}$

$I = P\,(100 + \underline{R})^{n} - P$

100

= P (100 + R/100)n – 1

450000 = P = 450000= 565397

9. a)Taxable income = (25000 + 12000 + 3000)= 40000

b) Income tax

$10164 \times {}^{2}/_{20}$ = Shs.1016.40

$10164 \times {}^{3}/_{20}$ = Shs.1524.60

$10164 \times {}^{4}/_{20}$ = Shs.2032.80

Remaining :

$9508 \times {}^{5}/_{20}$ = Shs.2377

Total tax payable p.m = 6950.8 – 1162 = Shs.5788.80

c) Annual tax payable = 5788.80 x 12 = Shs.69465.60

10. (a) taxable income = Kshs. 25000 + Kshs.10480

= Kshs. 35480

b) tax charged:

1st 4350 = $4350 \times {}^{2}/_{20}$ = 683.25

2nd 4555 = $4555 \times {}^{3}/_{20}$ – 683.25

3rd 4555 = $4555 \times {}^{4}/_{20}$ – 911

4th 4555 = $4555 \times {}^{5}/_{20}$ - 1138.75

Rem. 17465 = 17645 x 6/20 – 5239

Total tax – 8407.5

800.00

7607.50

(c) 40/100 x 35480 – 14.192 = 49672

New income = 35480 + 14192 = 49672

Remainder = 49672 – 18015 = 31657

Tax charged = 31657 x 6/20 =12665.1

Total tax = 12665.1

% increase in income ax = 4257.6 x 100

7607.5 = 55.97%

11. $A = P(HR/100)^n$

$500000 = P(1+\frac{20}{100})^5$

$500,000 = ({}^{120}/_{100})^5$

$\frac{500,000}{(1.2)^5} = P$

P = Shs.200,938.786 ≈ shs. 200,939

12. Principal = 26, 000 - 6,000 = 20,000

Total H.P instalments = 1045.3 x 24= 25087.20

2

25087.20 = 20,000 1 + r

100

$1.254 = 1 + \frac{r}{100}\ ^{2}$

$1.120 = 1 + \frac{r}{100}$

$\frac{r}{100} = 0.12$ or 12%

13. No. of periods =12
r = 4% per period
$A = 1.04^{12} \times 15000$
= 24015.5

14. a) i) taxable income = 19200 + 12000 + 1300 + 2300 = 34800
b) Net tax
$8400 \times {}^{2}/_{20} = 840$
$9600 \times {}^{3}/_{20} = 1440$
$12000 \times {}^{4}/_{20} = 2400$
$4800 \times 5/_{20} = \underline{1200}$
5800
Net tax = 5800 – 1240
= 4560

c) Net salary = 34800 – (4560 + 5530)
= 24710

15. (a) 9000 + 350 + 800 + 1200 = 11350

(b) 9000 + 3000 = 12000

(c) Total taxes = 12000 x 12
= shs.144000p.a
$\underline{\text{Taxes}}$
450 x 2 = shs.9000
3000 x 3 = shs.9000
3000 x 4 = shs.12000
3000 x 5 = shs.15000
3000 x 6 = $\underline{\text{shs.18000}}$
Shs.63,000
144000 – 63000= shs.81000
7y = 81000y = 11571
Taxable income= 4500 + 3000 x 4 + 11571 = K 28071p.a
Gross salary = shs. 561420p.a

(d) Total allowances = 12000 x 12
= 144,000
Basic salary = 561420
\- $\underline{14400}$

Shs.417,420
Monthly basic pay = shs. 34785

16. (a) *Net tax 5512*
Add relief 1162
Tax payable 6674

Tax on 9680 earned
$9680 \times {}^{10}/_{100} = 968$

Tax on 9120 earned
$9120 \times {}^{15}/_{100}$ = Shs. 1368

Tax on next $9120 \times {}^{20}/_{100}$ = Shs.1824

Tax on next $9120 \times {}^{25}/_{100} = 2280$

Total $968 + 1368 + 1824 + 2280 = 6440$
$6674 - 6440 = 234$
Let x be charged at 30%
${}^{30}/_{100} \times x = 234$
$X = \frac{234 \times 100}{30}$ = Shs.780
Total chargeable Income
$780 + (9120 \times 3) + 9680 = 37820$
Salary $37820 - 15220$ = Shs.2260 *per month.*

b) *Net salary* $(37820 - 1270 - 6674)$ = Shs.29876

17. a) 1st *year after dep. Of 20%*
$800\,000 \times \frac{80}{100}$
= Khs. 640,000………………………………………………

2nd *year after dep. of 5%*
$= 640000 \times \frac{95}{100}$
= 608,000 ....

The next 3 yrs
$A = P\left(1 - \frac{R}{100}\right)^n = 608,000\left(1 - \frac{10}{100}\right)^3$

$= 698\,000\,(0.9)^3$
= Sh. 443,232 ………………………………………………
$800,000 - 443,232$ = Sh. 356,768 ……………………………………………….

(b) S.I $= 3000 \times {}^{15}/_{100} \times 2$

$= \text{Sh } 900$ ……………………………………………………

$$A = 3000 \quad 1 + \frac{15}{100}^{\;2}$$

$= 3000 \quad 1.15^{\;2}$

$= \text{sh. } 3967.50$ …………………………………………….

C.I = sh 967.50

967.50 – 900 = sh 67.50 ………………………………………….

18. (i) Taxable Income

$\frac{115}{100} \times 24\,800 + 12000 - 1220$

= 28520 + 12000 – 1220

= Ksh.39,300

= <u>K₤ 1965 p.m.</u>

(ii) Tax due 325 x 2 = sh 650

650 x 3 = sh 1950

325 x 5 = sh 1725 ………………………..

325 x 6 = sh 1950

340 x 7.50 = sh 2250

Total tax = <u>sh. 8825 P.m</u>……………………

without relief

(b) (i) Total deduction

$= \text{sh } (7280 + 2400 + 1200 + \frac{2}{100} \text{ of } 24\,800)$…………….

= (7280 + 2400 + 1200 + 496) + 1220

= sh (11376 +_ 1220) = <u>sh. 12,596 P.m</u> ………………………………………

(ii) Net income = sh (24800 + 1200 – 12596) = sh. 24,204 P.m…………………………

19. a) Total instalments = (24 x 1250)= Shs.30000

H.P = 7200 + 30000= 37200

b) 124% = 37200

100% =

$\text{C.P} = \frac{100}{124} \times 37200$

= 30000

c) $A = 30000\,(1 + {}^{18}/_{100})^2$

$= 30000\,(1.18)^2 = 41772$

Total interest = 41772 – 30000 = 11772

20. (a) (i) $(10,500 + 6,500) \times \frac{12}{20}$ = K₤ 10,20 p.a

(ii) 1st 1980 x 2 = Kshs. 3960
2nd 1980 x 3 = Kshs 5940
3rd 2480 x 5 = Kshs. 12 400
4th 1480 x 7 = Kshs. 10360
5th 1980 x 9 = Kshs.17 820
Last 300 x 10 = Kshs $\underline{3\ 000}$
Kshs. 53 480

PAYE = $\frac{53480 - 300 \times 12}{12}$

= Shs. 4156.70

(b) Net monthly pay
$17000 - 320 + \frac{2}{100} \times 17000$
= 17000 – 660
= Kshs 16 340.00

47. Circles –chords and tangents

1. a) i) $<DCF = \frac{180 - 92}{2} = 44° = < CAD$

ii) < BAO = 50°
Acute angle AOB = 80°
∴ obtuse angle = 360 – 80 = 280°

b) Area of the sector = $(^{80}/_{360} \times {}^{22}/_{7} \times 7 \times 7) = 34.22cm^2$
Area of the Δ = ½ x 7 x 7 x sin80= $24.13cm^2$
Area of the shaded segment = 34.22 – $\underline{24.13}$
$10.09cm^2$

2. < COB = 2 x 50 = 100 °
$< OCA =< OAC = \frac{180 - 100}{2} = 40$
∴ < BAC = 180 – (50 + 70)
= 60

3. PB. PA $(PT)^2$
$\frac{PB}{PT} = \frac{PT}{PA}$
$\frac{4}{12} = \frac{12}{4 + 2r}$

$\frac{4(4+2r)}{4} = \frac{12^2}{4}$

$4 + 2r = 36$

$2r = 32$

$r = 16$ cm

4. (a) $\angle BOE = 2\angle BCE = 2 \times 20^0 = 40^0$

(b) $\angle BOE = 40^0$

$\angle BEC = ½(360^0 - 60^0) = 150^0$

Angels subtended at the centre is twice at the Circumference.

c) $\angle CEF = 90^0 - 80^0 = 10^0$

d) $\angle BCO = \angle CBO = 60^0$

Base angles isosceles triangle.

$\angle OXC = 180^0 - (60^0 + 20^0)$

$= 100^0$

e) $\angle BCE = 20^0$

$\angle CXE = 180^0 - 100^0 = 80^0$

$\angle CEX = 80^0$

$\angle OEF = 180^0 - (80^0 + 50^0 + 10^0)$

$= 40^0$

5. (a) $PQ = 8^2 - 2^2$

$= 60$

$= 7.746$cm

(b) $\angle PAS = 2\cos^{-1}$

$= 151^o$

$\therefore$ Reflex $\angle PAS = 209^o$ OR $360^o - 151^o = 209^o$

(c) Length PYS $= \frac{209}{360} \times 2 \times 6 = 21.89$cm

Length QXR $= \frac{151}{360} \times 2 \times 4 = 10.54$cm

(d) Length of belt $= 7.74 \times 2 + 21.89 + 10.54$

$= 47.92$cm

6. a) i) In 1 hr; Tap A fills $^1/_3$

B - ¼

Capacity filled in 1 hr = $^{1}/_{3} + ¼$

= $^{7}/_{12}$

$^{7}/_{12}$ = 1 hr

1 = 1 x 1 x $^{12}/_{7}$

= 1 $^{5}/_{7}$ hrs.

ii) $^{1}/_{3} + ¼ - {}^{1}/_{6} = {}^{5}/_{12}$ ⇒ in one hr

$^{5}/_{12}$ = 1hr

1 = 1 x 1 x $^{12}/_{5}$

= 2 $^{2}/_{5}$ hrs

7. $\angle ABD = 31^0$

$\angle CBD = 37^0$

8. $x (x+9) = 4x9$

$x^2 + 9x – 36 = 0$

$(x^2 – 3x) + (12x -36=0)$

$x(x-3) + 12(x-3) =0$

$(x+12) (x-3) = 0$

$x -3 = 0$

$x = 3$ only

9. PO. OQ = BO .OA

8 x 6 = 4.5 x y

$y = \frac{8 \times 6}{4.5}$

= 10.67

10. < DGB = < ABG = 40° (alt.seg <,s)

a) < DGE = < DBE = 25° (<s in same segment)

b) <EFG

< GEB = 40°, = <BDG and < BED = 45° = <BGD

∴ In Δ GED, <GDE = 180 – (25 + 40 + 45) = 70°

∴<GFE = 180 – 70 = 110° (Sup angles)

d) Angle CBD in ΔBGE, Angle GBE = 180 – (110) = 70°

∴Angle CBD = 180 – (40 + 70 + 25) = 45°

Or Angle CBD = Angle BGD = 45° (Angles in Alt segment)

e) Angle BCD in Δ BCD, Angle BDC = 70 ° Angles in a straight line

∴Angle BCD = 180 – (70 + 45) Angles of a triangle = 65°

11. (a) $\text{Sin}\,\theta = \frac{4.5}{8} = 0.5025$

$\theta = \text{Sin}^{-1}\, 0.5625$

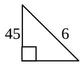
$= 34.23^o$

$\angle Apb = 68.46^o$

$\text{Sin}\,\alpha = \underline{4\text{-}5} = 0.75$

$\alpha = \text{Sin-1}\frac{6}{0.75}$

$= \angle 48.59^o$ θ



$\angle Aqb = 97.18^o$

(b) Area Of Segment PAB = $\frac{68.46}{360} X \frac{22}{7} X\ 8\ X\ 8 - ½\ X\ 8\ \text{Sin}\ 68.46$

$= 38.25 - 29.77$

$= 8.48cm^2$

Area Of Segment AQB = $\frac{97.18}{360} X \frac{22}{7} X\ 36 - ½\ 36\ \text{Sin}\ 97.18$

$= 30.65 - 17.86$ $= 12.68cm^2$

Area of quadrilateral APBQ = $½\ 64 \sin 68.46 + ½ \times 36 \sin 92.18$

$= 29.77 + 17.86$ $= 47.63$

Shaded area = $47.63 - (8.48 + 12.68)$ $= 26.47cm^2$

12. CBD = $90 - 42 = 48^o$

Angle of triangle add to 180^o

DOB = $180^o - 42 = 138^o$

Opposite angles of cyclic quadrilateral add to 180^o

DAB = $\frac{138^o}{2} = 69^o$

Angle at circumference is half the nagle substended at centre by same chord

CDA

ABD= $90 - 48 = 42o$

ADB = $180 -(69+42)$

$180-111=69^o$

CDA = $90 + 69^o$ $= 159^o$

Show ∆ADB is asoccesters

∠DAB = 69^o

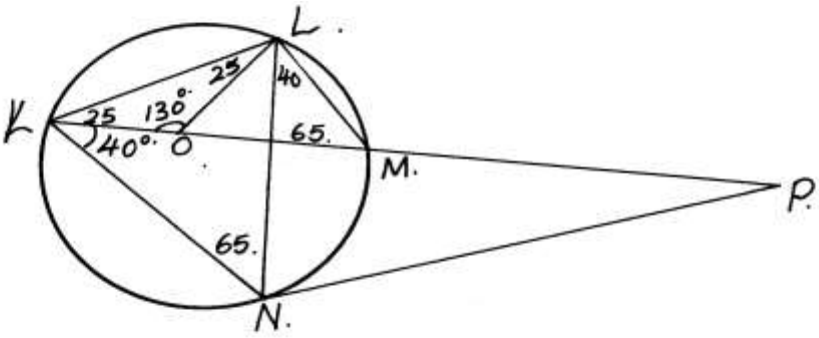
∠DAB = 69^o

∠ADB = 69^o

∠ABD = 42^o

So two angles are equal hence it is asoccesters

13.



a) MLN = 40^o angles subtended by same chord in the same segment are equal.

b) OLN = 90 – 65 = 25^o
Angle sum of Δ is 180^o or angle subtended by > diameter is 90^o.

c) LNP = 65^o exterior Δ is equal to opposite interior angle or angle btwn a chord and a tangent is equal to angle subtended by the same chord in the alternate segment.

d) MPN = 180 – 170 = 10^o angle sum of a Δ is 180^o

e) LMO = 65^o angles subtended by same chord.

14. (a)

$$Sin = {}^4/_{4.6} = 0.869565$$
$$= sin\text{-}10.89565 = 60.408^o$$
$$ABR = 2 \text{ x } 60.408^o = 120.8163^oC$$
$$\approx 120.82^o \text{ (2d.p)}$$

(b) Area of sector ABCR

$$= \frac{120.8163^o}{360^o} \text{ x } \pi \text{ x } 4.62)cm^2$$
$$= 22.30994cm^2$$

Area of sector OAPC

$$= \frac{60^o}{360^o} \text{ x } \pi \text{ x } 8^2)cm^2$$
$$= 33.51032cm^2$$
$$= 33.51cm^2(2d.p)$$

Area of ΔABC = (½ x 4.6^2sin 120.8163)cm^2 = 9.08625cm^2
Area of AOC = (½ x 82 sin 60) cm^2 = 27.7128cm^2
Sum of area of Δs = 36.799cm^2 36.80cm^2
$\therefore$Area of shaded part = area of sectors – area of Δs
= (22.31 + 33.51 – 36.80)cm^2 = 19.02cm^2(2dp)

15. (a) $\angle$TDC = ABT (exterior opp. angle of a cyclic quadrilateral)
= 100^o
(b) BAT = ATB (base s of isosceles ATB)
= 180 – 100 = 40^o
(c) $\angle$TCD = $\angle$X TD (angles in alternate segments)
= 60^o
Or $\angle$BTC + 40^o = 100^o(exterior angle of a Δ)
$\angle$BTC = 100^o – 40^o= 60^o

(d) DTC = 180^o- (58^o + 100^o) (angles in ΔTDC = 12^o

16. a) GBD = 90°

ABG = 180 – (90 + 36)

= 180 – 126 = 54°

GEB = ABG = 54°

b) BED = CBD = 36°

c) DGE = FEG = 20°

OEB = 90 – (36 +20)

= 90 – 56 = 34°

OBE = OEB = 34°

d) BGE = 36 + 20 = 56°

e) GFE = 180 – EDG

= 180 – 70 = 110°

17. $XZ^2 = 13.4^2 + 5^2 - 2 \times 13.4 \times 5 \cos 57.7^o$

$= 170.56 + 25 - 134 \times 0.5344$

$= 204.56 - 71.6096$

$XZ^2 = 132.9504$

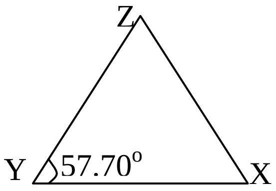
XZ = 11.5304cm

(ii) $2R = \dfrac{11.5304}{\text{Sin } 57.7^o}$

$2R = \dfrac{11.5304}{0.8453}$

2R = 13.60866

R = 6.08043cm



18. 52 = 62 + 62 – 2 x 6 x 6 cos A

72 cos A = 72 – 25 = 46

Cos A = $^{46}/_{72}$ = 0.6389

A = Cos-1 0.6389 = 50.29°

Area of the minor sector APQ

$= \dfrac{50.29}{360} \times 3.142 \times 6^2$

$= 15.801\text{cm}^2$

Area of the triangle APQ = ½ x 6 x 6 sin 50.29 = 13.847cm^2

Area of the minor segment = $(15.801 - 13.847)\text{cm}^2$ = 1.954cm^2

Area of triangle PBQ

$\sqrt{6.5 (6.5 - 4) (6.5 - 4) (6.5 - 5)}$

$\sqrt{6.5 \times 2.5 \times 2.5 \times 1.5} = 7.806cm^2$

Area of shaded region $= (7.806 - 1.954)cm^2 = 5.852cm^2$

19. a) $\measuredangle PQR = 180^o - 75^o$

$= 105^o$. NPQR is cyclic quadrilateral.

(b) $\measuredangle NRP = 90^o - 75^o$

$= 15^o$, Third angle of Δ NRP.

$\measuredangle PRS = 180^o - 65^o$, Angles on a

$= 115^o$, straight line.

$\therefore \measuredangle QSR = 180^o - (115^o - 35^o)$

$= 30^o$, 3rd angle of triangle PRS.

(c) Reflex $\measuredangle POR = 2 \measuredangle PQR$

$= 2 \times 105^o = 210^o$

(d) $\measuredangle MQR = \measuredangle MNR = 40^o$

Subtended by same chord MR

20.

(a) $\angle TDC = 100^o$ (Cyclic quadrilateral)

(b) $\angle TCB = 40^o$ (Cyclic quadrilateral)

(c) $\angle TCD = 58^o$ (Cyclic quadrilateral)

(d) $\angle BTC = 60^o$ (Sum angle of a Δ add upto 180^o)

(e) $\angle DTC = 22^o$ (angle sum of a straight line add upto 180^o)

21. $4 \times 10 = 5(5 + x)$
$40 = 25 + 5x$
$3 = x$

22. $T_{11} = a + 10d$
$T_2 = a + d$
$a + 10d = 4a + 4d$ ....(i)
$3a - 6d = 0$
$S7 = {}^7/_2\{2a + 6d\} = 175$ ...(ii)
$2a + 6d = 50$
$\underline{3a - 6d = 0}$
$5a = 50$
$a = 10 \qquad d = 5$

23. CBE $= 40^0$ (alt.segiment theoren)

$\angle BCE = 120^0$ (Suppl. To BCD = 60^0alt. seg.)
$\therefore (40 + 120 + E) = 180^0$ (Angle sum of Δ)
$\angle BEC = 20^0$

24. Taxable income p.a = 36,000+53142.86
=sh.412142.86

$$\text{Monthly salary} = \frac{413142.86}{12} + 12{,}000$$

$= 34428.57 + 1200 \quad = \text{Sh } 35628.57$

25. a) (i) $\angle PTQ = 180^o - 56^o = 124^o$
$124 + 38 = 162^o$
$180^o – 162^o = 18^o$
$90^o + 18^o = 108^o$
$180^o – 108^o = 72^o$
$180^o - (72^o + 56^o) = 52^o$
$\angle PRS = 52^o$

√Value of the constant.

(ii) $\angle RSQ = \angle RPQ = 18^o$

b) $A \propto B.\frac{1}{C^3}$

√Substitution √Formulation

$$A = \frac{K.B}{C^3}$$

√Values of constants.

√Substitution

$$12 = \frac{3K}{2^3}$$

$$K = \frac{\overset{4}{\cancel{12}} \times 8}{\underset{1}{\cancel{3}}} = 32$$

$$\therefore A = \frac{32B}{C^3}$$

$$\frac{10 \times (1.5)^3}{32} = B$$

$\therefore B = 1.055$

c) $y = K + Mx^2$ where K and M are constants

$7 = K + 100\,M$	$100 \times 0.005 + K = 7$
$5.5 = K + 400M^{-}$	$-0.5 + K = 7$
$1.5 = 300M$	$K = 7.5$

$M = 0.005$
$y = 7.5 – 0.005 \times 18^2$
$y = 7.5 – 1.62$
$y = 5.88$

26. a) $PN^2 = 5^2 - 4^2$
$PN = 3cm$
$QN^2 = 6^2 – 4^2$
$QN = 4.47cm$
$\therefore PQ = 3 + 4.47 = 7.47$

b)i) < APB

$\sin \frac{1}{2} \theta {}^4/_5 = 0.8$

$\frac{1}{2} \sin \theta = 53.13$

< APB

ii) $\sin \frac{1}{2} \propto = 4/6 = 0.6667$

$\frac{1}{2} \propto = 41.81$

$\propto 83.62$

$\therefore < AQB = 83.62°$

c) Area of the shaded region – Area of the segments

$= \frac{106.3}{360} \times \frac{22}{7} \times 5^2 - \frac{1}{2} \times 5 \times 5 \sin 106.3$

$= 23.19 - 11.998 = 11.192$

$\frac{83.6}{360} \times \frac{22}{7} \times 6 \times 6 - \frac{1}{2} \times 6 \times 6 \sin 83.6 = 8.38$

Total $11.192 + 8.38 = 19.52$

27. Using cosine rule

$7.8^2 = 6.6^2 + 5.9^2 - 2 \times 6.6 \times 5.9 \cos R$

$\cos C = \frac{6.6^2 + 5.9^2 - 7.8^2}{2 \times 6.6 \times 5.9}$

$= \frac{43.59 + 34.81 - 60.84}{77.88}$ $= \frac{78.37 - 60.84}{77.88}$

$= \frac{17.53}{77.88} = 0.2251$

$C = 77^o$

$\frac{7.8}{\sin 77} = 2r \Rightarrow r = \frac{7.8}{2 \times \sin 77}$

$= 4cm$

Area of circle $= 3.142 \times 4^2$ $= 50.27$

Area of PQR $= \frac{1}{2} (6.6)(5.9) \sin 77$

$= 18.97$

$\therefore$Area of shaded region $= 50.27 - 18.97 = 31.30 cm^2$

28. a) $\angle PAQ = 2 PAB = 42^o \times 2 = 84^o$

$\angle PBQ = 2 \angle ABQ = 30^0 \times 2 = 60^o$

(b) (i) Area of sector APQ $= \frac{84}{360} \times \frac{22}{7} \times 6 \times 6 = 26.4 cm^2$

Area of sector PBQ $\frac{60}{360} \times \frac{22}{7} \times 8 \times = 33.5 cm^2$

√ angle

√ angle

√

√

√

√

√ diff. areas

√ diff. areas

Exp. for total

√ answer.

(ii) Area of ΔAPQ = ½ x 6 x 65:- 84^o = 18 x 0.9945

= 17.9 cm^2

Area of Δ PBQ = ½ x 8 x 85: = 60^o = 32 x 0.8660

= 27.7 cm^2

(iii) For each circle, shaded area = sector area – triangle Area.

= area of sector APQ – area of triangle APQ

= 26.4 – 17.9 = 8.5 cm^2

2nd circle, shaded area

= area of sector PBQ – area of ΔPBQ

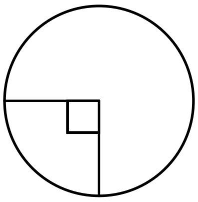
= 33.5 – 27.7 = 5.8 cm^2

Total shaded area = 8.5 + 5.8 = 14.3 cm^2

29. $\frac{90}{360}$ x 3.142 x 2 x 6.5

$\underline{10.2115 \text{ cm}}$

= 10.21 cm



48. Matrices

1.

$$\begin{matrix}3 & 2\\ 4 & -1\end{matrix}\quad\begin{matrix}a\\ b\end{matrix}\quad = \quad\begin{matrix}12\\ 5\end{matrix}$$

$$\begin{matrix}\frac{1}{11} & \frac{2}{11}\\ \frac{4}{11} & \frac{-3}{11}\end{matrix}\quad\begin{matrix}3 & 2\\ 4 & -1\end{matrix}\quad\begin{matrix}a\\ b\end{matrix}\quad = \quad\begin{matrix}\frac{1}{11} & \frac{2}{11}\\ \frac{4}{11} & \frac{-3}{11}\end{matrix}\quad\begin{matrix}12\\ 5\end{matrix}$$

Premultiplication by the inverse.

Simplification.

C.A.O

$$\begin{matrix}1 & 0\\ 0 & 1\end{matrix}\quad\begin{matrix}a\\ b\end{matrix}\quad = \quad\begin{matrix}2\\ 3\end{matrix}$$

$$\begin{matrix}a\\ b\end{matrix}\quad = \quad\begin{matrix}2\\ 3\end{matrix}$$

a = 2 √and b = 3 √

2. $(x-3) – (2x) = 0$

$x-3-2x = 0$

$-2x + x – 3 = 0$

$-x -3 = 0$

$x = 3$

3.
$$\begin{matrix} 1 & 5 \\ 3 & 7 \end{matrix} \quad \begin{matrix} 7 & 3 \\ -4 & -2 \end{matrix} \quad = \quad \begin{matrix} -13 & -7 \\ -4 & -2 \end{matrix}$$

$$\text{Determinant} = + 65 – 49 = 16$$

$$C^{-1} = 1 \begin{matrix} -5 & 7 \\ 7 & -13 \end{matrix}$$

4.
$$\begin{matrix} 3 & 2 \\ 2 & 2 \end{matrix} \quad \begin{matrix} a & b \\ c & d \end{matrix} \quad = \quad \begin{matrix} 9 & -3 \\ 2 & 1 \end{matrix}$$

$3a + 2c = 9$

$\underline{2a + 2c = 2}$

$a \quad = 7$

$c \quad = -6$

$3b + 2d = -3$

$\underline{2b + 2d = \ 1}$

$b \quad = -4$

$d \quad = 4.5$

$$\underset{\sim}{A} = \begin{matrix} 7 & -4 \\ -6 & 4.5 \end{matrix}$$

5. $20x\ (-3 - {}^{-}8)$

100 area of 1st image.

$100 \times (4 - {}^{-}3)$

700 area of 2nd image

6. Det. $9 + 2 = 11$

$$A^1 = \frac{1}{11} \begin{matrix} 3 & -2 \\ 1 & 3 \end{matrix}$$

$$\begin{matrix} 3 & 2 \\ 3 & -1 \end{matrix} \quad \begin{matrix} x \\ y \end{matrix} = \begin{matrix} 10 \\ 4 \end{matrix}$$

$$\begin{matrix} x \\ y \end{matrix} = \frac{1}{11} \begin{matrix} 3 & -2 \\ 1 & 3 \end{matrix} \quad \begin{matrix} 10 \\ 4 \end{matrix}$$

$\begin{matrix}x\\y\end{matrix} = \frac{1}{11}\begin{matrix}22\\22\end{matrix}$

$\begin{matrix}x\\y\end{matrix} = \begin{matrix}2\\2\end{matrix}$

P (2, 2)

7 $PQ = \begin{matrix}1 & 0\\0 & 1\end{matrix}$

$\begin{matrix}2 & -3\\-1 & 2\end{matrix} \quad \begin{matrix}x\\y\end{matrix} = \begin{matrix}5\\-3\end{matrix}$

$\begin{matrix}2 & 3\\1 & 2\end{matrix} \quad \begin{matrix}2 & -3\\-1 & 2\end{matrix} \quad \begin{matrix}x\\y\end{matrix} = \begin{matrix}2 & 3\\1 & q\end{matrix} \quad \begin{matrix}5\\-3\end{matrix}$

$\begin{matrix}x\\y\end{matrix} = \begin{matrix}1\\-1\end{matrix}$

$x = 1 \quad y = -2$

8. $\frac{1}{2}x - \frac{1}{4}y = 2$

$^2/_5 + {}^1/_6 = 6$

$2x \_ y = 8$

$12x + 5y = 180$

$\underline{10x - 5y = 40 \qquad +}$

$22x \qquad = 220$

$x = 10$

$\frac{1}{4}y = \frac{1}{2}(10)^{-2}$

$\frac{1}{4}y = 5-2 = 3$

$Y = 12$

9. $\begin{matrix}\mathbf{1} & \mathbf{0}\\\mathbf{0} & \mathbf{-1}\end{matrix}$

$\begin{matrix}\mathbf{-1} & \mathbf{-2} & \mathbf{-6}\\\mathbf{1} & \mathbf{4} & \mathbf{9}\end{matrix}$

$= \quad \begin{matrix}\mathbf{0} & \mathbf{1}\\\mathbf{1} & \mathbf{0}\end{matrix} \qquad \begin{array}{ccc}\mathbf{X^1} & \mathbf{Y^1} & \mathbf{Z^1}\\\mathbf{-1} & \mathbf{-2} & \mathbf{-6}\\\mathbf{1} & \mathbf{4} & \mathbf{9}\end{array}$

$$= \begin{pmatrix} \mathbf{1} & \mathbf{4} & \mathbf{9} \\ \mathbf{-1} & \mathbf{-2} & \mathbf{-6} \end{pmatrix}$$

Final image $X^{11}Y^{11}Z^{11}$

$X^{11}(1, -1)$ $Y^{11}(4, -2)$, $Z^{11}(9, -6)$

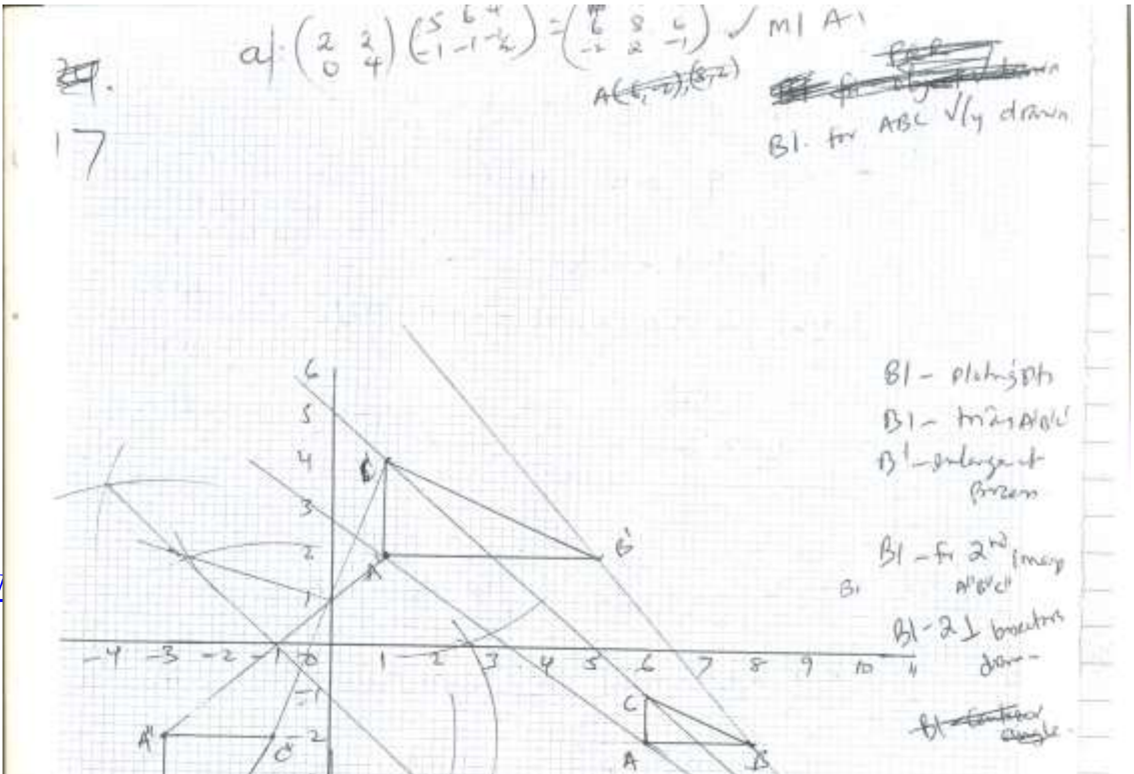
10.

$$a/: \begin{pmatrix} 2 & 2 \\ 0 & 4 \end{pmatrix} \begin{array}{ccc} P & Q & R \\ \hline 5 & 6 & 4 \\ -1 & -1 & -\frac{1}{2} \end{array} = \begin{array}{ccc} A & B & C \\ \hline 6 & 8 & 6 \\ -2 & 2 & -1 \end{array}$$

(c) Centre (-3,2)

Angle + 90°

$$a)\ \begin{pmatrix} 2 & 4 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} 5 & 6 & 4 \\ -1 & -1 & -\frac{1}{2} \end{pmatrix} = \begin{array}{ccc} A & B & C \\ \hline 6 & 8 & 6 \\ 2 & 2 & -1 \end{array}$$



11. Det $2 - \ -3 \ = 5$

Area of $A^I B^I C^I = 5 \text{ x } 15$

$= 75 \text{ cm}^2$

12. $\text{A.S.F} = \frac{110}{10} = 11$

$5X (X) - -6 = 11$

$5X^2 + 6 = 11$

$5x^2 = 5$

$X^2 = 1$

$X = \pm 1$

13. Area of the image = Area of the object x Det.

Det. $(\Delta) = 15 – 18 = -3$

$54 \text{ cm}^2 = A \text{ x } -3$

$\frac{54}{3} \text{ cm}^2 = A$

Area of Δ ABC = 18 cm^2

14. Det. $9 + 2 = 11$

$$A^1 = \frac{1}{11} \begin{matrix} 3 & -2 \\ 1 & 3 \end{matrix}$$

$$\begin{matrix} 3 & 2 \\ 3 & -1 \end{matrix} \quad \begin{matrix} x \\ y \end{matrix} = \begin{matrix} 10 \\ 4 \end{matrix}$$

$$x \quad = \underline{1} \quad 3 \ -2 \qquad 10$$

$y \quad 11 \quad 1 \quad 3 \quad 4$

$x \quad = \underline{1} \quad 22$
$y \quad\quad 11 \quad 22$

$x \quad = \quad 2$
$y \quad\quad\quad 2$

P (2, 2)

49. Formulae and variation

1. $P = kr^2$; $R = MT^2$
$18 = 9k \quad 3 = 25m$

$K = 2 \qquad M = \frac{3}{25}$

$P = 2R^2 \qquad R = \frac{3}{25}\, T^2$

2
$P = 2 \quad \frac{3}{25}\, T^2 \quad = \frac{18}{625}\, T^4$

$P = \frac{18 \text{ x } 10000}{625} = 288$

2. $v^2 = \frac{r}{r + c}$
$v^2 (r + c) = \frac{r}{r + c}(r + c)$
$v^2 r + vc = r$
$r - v^2 r = vc$
$r (1 - v^2) = vc$
$r = \frac{vc}{1 - v^2}$

Removing the sg. Root.

Factorization.

C.A.O

3. $X \alpha \frac{Y^3}{Z} \Rightarrow x = KY^3$
$6 = \frac{K(3)^3}{25}$
$6 = \frac{27K}{5}$
$K = \frac{10}{9}$

$$\therefore X = \frac{10}{9} \quad \frac{Y^3}{Z}$$

$$X = \frac{10}{9} \ \frac{(7)^3}{9}$$

$$= \frac{10 \text{ x } 34^3}{27}$$

$$= 127.04$$

$$\text{(a) } Y^3 = \frac{9}{10} \text{ x } Z$$

$$Y = 3 \quad \frac{9}{10} \text{ x } 4 \text{ x } 8$$

$$Y = 3 \ \frac{144}{5} = 3.07$$

$$\text{(b) } X_1 = \frac{KY^3}{Z}$$

M1

$$X_2 = \frac{K(1.2y)^3}{0.64Z}$$

$$\frac{1.728KY^3}{0.8 \ Z} - \frac{KY^3}{Z}$$ M1

$$\frac{\frac{2.16KY^3}{Z} - \frac{KY^3}{Z}}{\frac{KY^3}{Z}} \text{ x } 100\ \%$$ M1

$$= 116\%$$ A1

4. $K (b\text{-}a) = ab$

$Kb – ka = ab$

$Kb – ab = ka$

$B(k\text{-}a) = ka$

$$B = \frac{ka}{K – a}$$

5. $x – 2.5 - \sqrt{3} \qquad x – 2.5 + \sqrt{3} \quad = 0$

$x^2 – 2.5x + x\sqrt{3} - 2.5x + 6.25 – 2.5 \sqrt{3}$

$x\sqrt{3} + 2.5 \ \sqrt{3} = 0$

$x^2 – 5x + 6.25 – 3 = 0$

$x^2 – 5x + 3.25 = 0$

$4x^2 – 20x + 13 = 0$

6. $$Z = \frac{Kx^2}{y}$$

$Z = \frac{(1.2x)^2K}{0.64y}$

$= \frac{1.44Kx^2}{0.85y}$

$= 1.8\,\frac{Kx^2}{y}$

% increase = 80%

7. $ar^3 = 48$

$ar^6 = 384$

$\therefore \frac{ar^6}{ar^3} = \frac{384}{48}$

$r^3 = 8$

$r = 2$

$ar^3 = 48$

$8a = 48$

$a = 6$

$Sn = \frac{a(r^n - 1)}{r - 1}$

$\frac{6(2^6 - 1)}{2 - 1}$

$= 6(64 - 1)$

$= 6 \text{ x } 63$

$= 378$

8. $P = \frac{KQ^2}{R}$

$2 = \frac{16K}{6}$

$K = ¾$

$P = ¾\,\frac{Q^2}{R} = ¾ \text{ x } \frac{64}{4} = 12$

9. $B \,\&\, M^2 = {}^1/_N$

$B = Km^2 + {}^Q/_N$

$(96 = 4K + 2Q)^3$

$(46 = 3K + 0.5Q)^4$

$104 = 4Q$

$Q = 26$

$K = 11$

Expression $B = 11m^2 + {}^{26}/_N$

10. $3x = y - 1$ ……… i

$\frac{2x + 2}{y - 5} = \frac{1}{2}$

$4x + 4 = y - 5$
$4x + 9 = y \quad \ldots\ldots\ldots\ldots\ldots\ ii$
$3x = y - 1$
$\underline{4x = y - 9}$
$-x = 9 \qquad x = -9$

$-27 = y - 1$
$y = -26$

11. $P = \frac{x-1}{3 \quad x+2} \qquad \Rightarrow P^3 = \frac{x-1}{x+2}$

$P^3x - 2P^3 = x - 1$
$P^3x - x = -1 - 2p^3$
$x(P^3 - 1) = -1 - 2P^3$

$x = \frac{-1-2P^3}{P^3-1} \quad -1$
$x = \frac{1+2p^3}{1-p^3}$

12. $a^4 = \frac{1+d^2}{b^2} + \frac{b}{3}$
$3d^2 = 3a^4b^2 - b^2 - 3$

$d = \frac{3a^4b^2 - b^2 - 3}{3}$

13. (a) $Z = \frac{KX^2}{y^2}$
$Z = \frac{100k}{16} = 15$
$K = \frac{12}{5}$
$Z = \frac{12x^2}{5^{y2}}$

(b) $Z = 21.90$

14. $R = kn + t\sqrt{n}$
$9k + 3t = 42$
$25k + 5t = 100$
$45k + 15t = 210$
$\underline{75k + 15t = 300}$

$-30k = -90$
$k = 3$
$t = 5$

$R = 3(16) + S(4) = 68$

15. $a^2 = \frac{b^2 d^2}{b^2 + d}$
$a^2 b^2 + a^2 d = b^2 d^2$
$b^2 d^2 - a^2 b^2 = a^2 d^2$
$b^2 (d^2 - a^2) = a^2 d^2$

$b^2 = \frac{a^2 d^2}{d^2 - a^2}$
$b = \mp \frac{a^2 d^2}{d^2 - a^2}$

16. $P = KQ + m\sqrt{Q}$
$22 = K(4) + m(2)$……………(1)
$42 = K(g) + n(3)$……………(2)
$22 = 4K + 2m$
$42 = 9K + 3m$
$3(22) = 3(4K) + 3(2m)$
$2(42) = 2(9K) + 2(3)$
$66 = 12k + 6m$
$84 = 18K + 6m$
$18 = 6k = k = 3$
$22 = 4(3) + 2m$
$22 - 12 = 2m$
$20 = 2m$
$M = 10$
$= 3(25) + 10(5)$
$= 75 + 50$
$= 125$

17. $b = \sqrt{k} - ac$
$b^2 = k - ac$
$b^2 - k = -ac$
$\frac{b^2 - k}{-9} = c$
$C = \frac{b^2 - k}{-9}$ or $c = \frac{k - b^2}{9}$
$C = \frac{1 - 2^2}{4}$
$= {}^{-3}/_4 = -0.75$

18. $V = 30, r = 2$
$K = Ur^2$

$= 30 \times 22 = 120$

When $r = 4$

$V = {}^{120}/_{42} = 7.5m/s$

19. $P = {}_{3}\frac{X\,Y}{z + X}$

$P^3 = \frac{XY}{z + X}$

$Xy = P^3Z + P^3X$

$Xy - P^3X = P^3 z$

$X(y-P^3) = P^3 z$

$\therefore X = \frac{P^3z}{Y - P^3}$

20. $X \alpha y + {}^1/_{z,2}, x = Ky + M$

$X = 6, y = 3, z = 2 - 6 = 3k + M$

$X = 8 , y = 5, z = 1 - \ 8 = 5k + M$

$X4 \ \ 24 = 12k + M$

$-16 = -7k , k = 1$

When $y = 10$,

$z = \frac{16}{7}(10) - \frac{24}{7(64)} = \frac{160}{7} - \frac{24}{448} = \frac{10216}{448} = 22.8$

21. $T_{11} = a + 10d$

$T_2 = a + d$

$a + 10d = 4a + 4d$ ....(i)

$3a - 6d = 0$

$S7 = {}^7/_2\{2a + 6d\} = 175$ ...(ii)

$2a + 6d = 50$

$+$

$\underline{3a - 6d \ = \ 0}$

$5a \qquad = 50$

$a = 10$

$d \ = 5$

22. (i) $R = m + nI$

$55 = M + 20n$……(i)

$\underline{58 = m + 28n\text{……..(ii)}}$

$-3 \ = \qquad -8n$

$n \quad = {}^3/_8 = 0.375$

$55 \ = m + {}^{60}/_8$

$m = 55 - 7.5 \quad \Rightarrow \ m = 47.5$

$R = 47.\,5 + 60 X\, {}^3/_8$

$R = 70$ ohms

23.

$1 - \underline{1\,})^5 \quad = 1 - 2x \ \ ^5$

$(2x)$

$= 1^5 (-2x)^o + 5.1^4 (-2x)^1 + 10.1^3 (-2x)^2 + 101^2 (-2x)^3$

$= 1 - 10x + 40x^2 - 80x^3$

$(1 - 2x)^5 = (0.98)^5 = (1 - 0.02)^5$

$\therefore 2x = 0.02$

$x = 0.01$

Thus $(0.98)^5 = 1 - 10(0.01) + 40 (0.01)^2 - 80(0.01)^3$

$= 1 - 0.1 + 0.004 - 0.00008 = 0.9039$

50. Sequence and series

1. $P \quad 1 + \frac{R}{100}$

3

$= 40,000 \quad 1 + \frac{2}{100}$

3

$= 40, 000 \text{ x } (1.02) = 42,448.32 \text{ km}^2$

Encrouched area

$= 42\ 448.32 - 40\ 000 = 2448.32 \text{ km}^2$

2. (a) $\frac{9^x}{3^{2x+1}} = \frac{81}{9^x}$

$9^{2x} = 3^4(3^{2x+1})$

$3^{4x} = 3^{4+2x+1}$

$3^{4x} = 3^{2x+5}$

$4x = 2x + 5$

$2x = 5$

$x = 2.5$

(b) Common ratio $= \frac{81}{92.5}$

$= \frac{1}{3}$

(c) $a = 3^{(2 \text{ x } 2.5 + 1)}$

$= 3^6$

$= 729$

For both the 5th and 7th term

$S_{10} = 729 \quad 1 - \frac{1}{3} \quad {}^{10}$

$1 - \frac{2}{3}$

$= 1093.5 \times 0.99998 \quad = 1093.5$

(d) 5^{th} term $= 729 \times (^1/_3)^4$

$= 9$

7^{th} term $= 729 \times (^1/_3)^6$

$= 1$

$a = 9 \quad d = 1 - 9 = -8$

$$S_{20} = \frac{20}{2} \quad 2 \times 9 + (20 - 1)\ (-8)$$

$= 10\ (18 - 152) = -1340$

3. $-12 \underline{+} -10 + -8 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..$

$a = -12 \qquad d = z$

$$S_n = \frac{n}{2} \quad 2a + (n - 1)d$$

$$338 = \frac{n}{2} \quad 2(-12) + (n - 1)2$$

$676 = \quad n \quad -24 + 2n - 2$

$$\frac{2n^2}{2} - \frac{26n}{2} - \frac{676}{2} = \frac{0}{2}$$

$n^2 - 13n - 338 = 0$

$(n - 26)(n + 13) = 0$

$n = 26$ or $n = -13$ reject

$\therefore n = 26$ terms

3. $-12 \underline{+} -10 + -8 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..$

$a = -12 \qquad d = z$

$$S_n = \frac{n}{2} \quad 2a + (n - 1)d$$

$$338 = \frac{n}{2} \quad 2(-12) + (n - 1)2$$

$676 = \quad n \quad -24 + 2n - 2$

$$\frac{2n^2}{2} - \frac{26n}{2} - \frac{676}{2} = \frac{0}{2}$$

n^2 - 13n – 338 = 0
(n – 26) (n + 13) = 0
n = 26 or n = -13 reject
$\therefore$ n = 26 terms

4. 32 = 2 + (n-l)d……(i)
357 = $\frac{n}{2}$ 2.2 + (n-l)d …… (ii)
N 4 + (n-l) d = 714
2 + (n-l)d = 32
N(4 + nd – d) = 714
$\underline{\text{-d + nd} \quad = 30}$
4n + n^2d – d = 744
nd – d = 30
d(n-l) = 30

5. a) OC = OB + BC = a + b

b) OM = OA + AM = a + ½ b
Given OX = rOM
= r(a + ½ b)
From ΔOBX
Ox = OB + BX
= OB + BC + CX
= b + a + sa
= (1+s) a +b
$\therefore$ r(a + ½ b) = (1 + s) a + b
Comparing coefficients of a and b
r = 1 + S
and ½ r = 1$\Rightarrow$r = 2
Substitute for r = 2 $\Rightarrow$2 = 1 + s $\Rightarrow$s = 1

c) Now BX = BC + Cx
= a + a = 2a

$\therefore$ BC:BX = 1:2

6. (a) -91 = 29 + (n-1) x -6
-120 = -6n + 6
6n = 126
n = 21

(b) S_{21} = $^{21}/_2$ [(2 x 2a) + (20 x -6)]
= $\frac{21 \text{ x } -62}{2}$
= -651

7. $d = p-5$.....(i)
$d = q – p$ ………(ii)
$0 = 2p - q – 5$
$0 = 7 – 2q + p$
$- p + 2q = 7$
$2p – q = 5$

$-2p + 4q = 14$
$2p – q = 5$
$3q = 19$
$q = {}^{19}/2$
$p=2q – 7$ $\quad {}^{38}/_{3} – 7$
$p={}^{17}/_{8}$
$S = \underline{n}\ [2a + (n-1)d\}$
2
$= {}^{12}/_{2}\ (10+11 \times {}^{2}/_{3})$
$= 6\ (10+{}^{22}/_{3}) = 104$
$S_n = a(r^n-1) = S(1.5-6)$
$r-1 \quad 1.5 – 1$
$= 5 \times (1.5 – 1) = 103.90$
$0.65 = 10.4$

8. $a + a + d = 10$………………(i)

$\underline{10} \quad 2a + 9d \quad = 210$……………..(ii)
2
$2a+ \quad d =10$
$\underline{2a + 9d = 42}$
$8d = 32$
$d= 4$
$T1 = 3 +6(4)$
$= 3 + 24$
$= 27$

9. $S_6 = \underline{15\ (1-0.56)}$
$1- 0.5$
$= 29.5314$metres

10. $Sn = \underline{n} \quad 2a + (n-1)L$
2
$S51 = \underline{51}\ (2x -22) + (51 -1)3$
2
$= 2703$

11. $100 + 200 + 400 + 800 + 1600 + 3200 + 6400 + 12800 + 25600 + 51200$

$\frac{200}{100} = \frac{400}{200} = \frac{800}{400}$

= 51200	99600	108200	110,600
25600	6400	1600	700
76800	105,000	109,800	111,300
12800	3,200	800	
99,600	108,200	110,600	

= 111300

12.. a) Let n be the initial members

Each to contribute $\frac{720000}{n}$

New membership $n + 20$

Contributions: $\frac{720000}{n + 20}$

$\frac{720000}{n} - \frac{720000}{n + 20} = 3000$

$720000(n + 20) - 720000n = 3000n(n + 20)$

$4800 = n(n + 20)$

$n^2 + 20 - 4800 = 0$

$n^2 + 80n - 60n - 4800 = 0$

$n(n + 80) - 60(n + 80) = 0$

$(n-60)(n + 80) = 0$

$n = 60$

Original members = 60

b) Contributions required before recruitment

$= \frac{720000}{60} = 120000$

After requirement = $\underline{720000}$

13. n^{th} term is ar^{n-1}

$a = 8, r = ½$

n^{th} term $= {}^{1}/_{512}$

$8(½)^{n-1} = {}^{1}/_{512}$

$8(½)^{n-1} = 2^{-9}$

$(½)^{n-1} = 2^{-9} \div 2^{3}$

$(½)^{n-1} = 2\text{-}^{12} = (½)^{12}$

$n^{-1} = 12$

$n = 13$

14. 3rd $a + 2d$

$9^{th}\ a + 8d$
$25^{th}\ a + 24d$

(i) $\underline{a + 2d} = \underline{a + 8d}$
$a + 8d\ a = 24d$
$(a + 2d)(a + 2d) = (a + 8d)(a + 8d)$
$a^2 + 26da + 48d^2 = a^2 + 16da + 64d^2$
$\underline{10da} = \underline{16d^2}$
$10d \qquad 10d$
$a = 1.6d$…………(i)
$(a + 6b) + 2(a+5d) = 78$
$3a + 16d = 78$…………………(ii)
But $a = 1.6d$
$\therefore (3x1.6d) + 16d = 78$
$4.8d + 16d = 78$
$4.8d + 16d = 78$
$\underline{20.8} = \underline{78}$
$20.8 \quad 20.8$
Common distance $d = 3.75$
$a = 1.6 \times 3.75$
first term $a = 6$

(ii) $S_n = {}^n/_2\,(2a + (n-1)d)$
$S_a = {}^9/_2\,((2x6) + (9-1)3.75)$
$= {}^9/_2\,(12 + 30)$
${}^9/_2 \times 42 = 189$

15. $T_4 = a + 3d$
$T_7 = a + bd$
$(a + 6d) – (a + 3d) = 12$
$3d = 12$
$d = 4$
But $a = 9$
$S5 = \underline{5}\ 2(9) + 4(4)$
2
$= \underline{5}\ 18 + 16$
2
$= \underline{5} \times 34$
2
$= 85$

51. Vectors 2

1. a) (i) $AN = OA + ON$
$= -\underset{\sim}{a} + \underline{2}\ \underset{\sim}{b}$
7
$= \underline{2}\ \underset{\sim}{b} - \underset{\sim}{a}$
7

(ii) $AT = \frac{7}{13} AN$

$\frac{7}{13} \quad -\underset{\sim}{a} + \frac{2}{7}\underset{\sim}{b}$

$\frac{2}{13}\underset{\sim}{b} \quad -\frac{7}{13}\underset{\sim}{a}$

(iii) $AM = \frac{1}{4} AB$

$= \frac{1}{4}(AO + OB)$

$= \frac{1}{4}(\underset{\sim}{b} - \underset{\sim}{a})$

(b) $OT = OA + AT$

$= \underset{\sim}{a} \quad \frac{2}{13}\underset{\sim}{b} - \frac{7}{13}\underset{\sim}{a}$

$= \frac{2}{13} \quad 3\underset{\sim}{a} + \underset{\sim}{b}$

$OM = OA + AM$

$= \tilde{a} + -\frac{1}{4}\underset{\sim}{a} + \frac{1}{4}\underset{\sim}{b}$

$\frac{3}{4}\underset{\sim}{a} + \frac{1}{4}\underset{\sim}{b}$

$\frac{1}{4} \quad 3\underset{\sim}{a} + \underset{\sim}{b}$

$\frac{OT}{OM} = \frac{\frac{2}{13}(3a + b)}{\frac{1}{4}(3a + b)}$

$OT = \frac{8}{13} OM$

Or $OM = \frac{13}{8} OT$

Since $OT = \frac{8}{13} OM$

√√Construction of ∠60° and ∠90°

Bisect ∠btw 90° and 60° to obtain ∠75°

√ Construction of the given sides

Construction of Δ XYZ

Then $OT : TM = \frac{8}{13} : \frac{5}{13}$

$= 8 : 5$

2. 3 5

(X,Y) T(-3,4) B(6,-5)

$TB = {}^5/_8\, AB$

$$\begin{pmatrix}6\\-5\end{pmatrix} - \begin{pmatrix}-3\\4\end{pmatrix} = \frac{5}{8} AB$$

$$\begin{pmatrix}9\\-9\end{pmatrix} = \frac{5}{8}\left[\begin{pmatrix}6\\-5\end{pmatrix} - \begin{pmatrix}x\\y\end{pmatrix}\right]$$

$$\begin{pmatrix}9\\-9\end{pmatrix} = \begin{pmatrix}{}^5/_8\,(6-x)\\ {}^5/_8\,(-5-y)\end{pmatrix}$$

$\frac{30}{8} - \frac{5}{8} X = 9$

$-\frac{25}{8} - {}^5/_8\, y = -9$

$30 - 5x = 72$ $-5x = 42$

$-25 - 5y = -72$ $-5y = -47$

$X = - 8.4$ $y = 9.4$

3. $OX = \frac{2}{3}(3i + 2j - 4k) + \frac{1}{3}(6i + 11j + 2k)$

$= 2i + 4j - \frac{8}{3}k + 2i + \frac{11}{3}j + \frac{2}{3}$

$= 4i + 5j - 2k$

$|OX| = 16 + 25 + 4$

$= 6.71$units

4. a) $2^5 - 5(2^4)({}^1/_5) + 10(2^3)({}^1/_5\, x)^2 - 10(2^2)({}^1/_5\, x)^3 + 5(2)({}^1/_5 x)^4 - ({}^1/_5 x)^5$

$32 - 16x + {}^{16}/_5 x^2 - {}^8/_{25} x^3 + {}^2/_{125} x^4 - {}^1/_{3125} x^5$

$- {}^1/_5 x = -0.04$

$x = 0.2$

b) $32 - 16(0.2) + {}^{16}/_5 (0.2)^2 - {}^8/_{25} (0.2)^3 + \ldots\ldots\ldots$

$= 32 - 3.2 + 0.128 - 0.00256$

$= 28.92544$

$= 29.925$

5. $AS = AO + OS$

$= - a + 2(3c)$

$= 2c - a$…………

$BC = BA + AC$

$= a - b + AC$

But $AC = AO + OC = -a + 3c$

$= 3c - a$………

$AB + \frac{2}{3} OC = \frac{2}{3} 3c = 2c$

$BA = 2c$…….

$BC = -12c + 3c - a = c - a.$

b) (i) $AT = \eta AS = \eta (2c - a)$

$= 2\eta c - \eta a$

$AT = AB + BT = 2c + K(c - a)$

$= 2c + Kc - Ka$

$= (2 + k)c - Ka$

(ii) $2 + K = 2\eta$ (i) $K = \eta$ (ii)

$2 + \eta = 2\eta$

$2 = 2\eta - \eta$

$2 = \eta, K = 2$

(c) $BT : BC$

$BT = 2BC$

6. (a) (i) $\underset{\sim}{PQ} = \underset{\sim}{PO} + \underset{\sim}{OQ}$

$= \underset{\sim}{P} + q$ or $\underset{\sim}{q} - \underset{\sim}{p}$

(ii) $\underset{\sim}{QR} = \underset{\sim}{OP} + \underset{\sim}{PR}$

$= \underset{\sim}{P} + \frac{2}{3} \underset{\sim}{PQ}$

$= \underset{\sim}{P} + \frac{2}{3} (q - \underset{\sim}{p})$

$= \underset{\sim}{P} + \frac{2}{3} \underset{\sim}{q} - \frac{2}{3} p$

$= \frac{1}{3} \underset{\sim}{p} + \frac{2}{3} \underset{\sim}{q}$

(iii) $\underset{\sim}{SQ} = \underset{\sim}{SO} + \underset{\sim}{OQ}$

$= -\frac{3}{4} \underset{\sim}{OP} + \underset{\sim}{OQ}$

$= -\frac{3}{4} p + \underset{\sim}{q}$ or $\underset{\sim}{q} - \frac{3}{4} \underset{\sim}{p}$

For √PQ or P and q

For √exp. Of OR

For √OR in p & q

For √ SQ in P & Q

For √OT or p & q Multiply this by 12

For √OT in p,q

For √eq. both expr.Multiply these by 12

For √equations both express.

For √ elimisn. of m

Both ans.

(b) Express $\underset{\sim}{OT}$ in two different ways:

Given $\underset{\sim}{OT} = n \underset{\sim}{QR}$

$= n \left(\frac{1}{3}\underset{\sim}{P} + \frac{2}{3} \underset{\sim}{q}\right)$

$= \frac{n}{3}\underset{\sim}{p} + \frac{2n}{3}\underset{\sim}{q}$

3 3

From ΔOST,

$$OT = \underset{\sim}{OS} + \underset{\sim}{ST}$$

$$= \frac{3}{4}OP + \underset{\sim}{M}\,\underset{\sim}{SQ}$$

$$= \frac{3}{4}\underset{\sim}{P} + M\left(-\frac{3}{4}\underset{\sim}{P} + \underset{\sim}{q}\right)$$

$$= \left(\frac{3}{4} - \frac{3m}{4}\right)\underset{\sim}{p} + m\underset{\sim}{q}$$

$$\therefore \frac{n}{3}\underset{\sim}{p} + \frac{2n}{3}\underset{\sim}{q} = \left(\frac{3}{4} - \frac{3m}{4}\right)\underset{\sim}{p} + m\underset{\sim}{q}$$

Compare the coefficients of $\underset{\sim}{p}$ and $\underset{\sim}{q}$

$$\frac{n}{3} = \frac{3}{4} - \frac{3}{4}m$$

$4n = 9 - 9m$

$4n + 9m = 9$ ………………..eq (1)

$$\frac{2n}{3} = m$$

$$m = \frac{2n}{3} \quad \text{……………eq. (2)}$$

Substitutes form in equation (1)

$$4n + 9\left(\frac{2n}{3}\right) = 9$$

$4n + 6n = 9$

$10n = 9$

$$n = \frac{9}{10}$$

Substitute for n in equation (2)

$$m = \frac{2}{3} \times \frac{9}{10} = \frac{3}{5}$$

52. Binominial expansion

1. a) $1^5 + 5(-3x)^1 + 10(-3x)^2 + 10(-3x)^3 + 5(-3x)^4 + (3x)^5$

$1 - 15x + 90x^2 - 270x^3 + 405x^4 - 243x^5$

$1 - 15x + 90x^2 - 270x^3 + 405x^4 - 243x^5$

b) $3x = 1 - 0.997$

$x = 0.001$

$= 1 - 15(0.001) + 90(0.001)^2 - 270(0.001)^3 + 405(0.001)^4$

$= 1 - 0.015 + 0.00009 - 0.00000027 +$ ……………..

$= 1 + 0.00009 - 0.015 - 0.00000027$

$= 1.00009 - 0.01500027 = 0.98508973$

$= -0.9851$ (4 d.p)

2. (i) $5 + \frac{x}{2}^{6} = 15625 + \frac{3125}{3} X + \frac{9375}{4} X^2 + \frac{625}{2} X^3 + \ldots\ldots$

(ii) $X = 1$

$\frac{11}{2}^{6} = 15625 + \frac{3125}{3} + \frac{9375}{4} + \frac{625}{2}$

$= 15625 + 1041.667 + 2343.75 + 312.5$

3.

$(3 + 2x)^6 = (3)^6 + 6(\ 3)^5\ \ 2x + 15(3)^4(2x)^2 + 20(3)^3(2x)^3$

$= 27 + 108x\ \ 3 + 270x^2 + 480x^3\ \ 3$

$3 + 2x = 3\ \ 3$

$2x + 2\ \ 3$

$x = \ \ 3$

$27 + 108\ \ 3\ \ 3 + 270\ \ 3^2 + 480\ 3(\ 3)^3$

$= 27 + 324 + 810 + 4320 = 5481$

4.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

P(Sum odd) = $^{18}/_{36}$ = ½

5. $\angle PQR = 180 - (35o + 75)$

$= 70^o$

$PR^2 = 12^2 + 8.4^2 - 2(12)(8.4)\ \text{Cos}\ 70^o$

$PR = 145.61\ \ \ = 12.07$

6. (a) Terms; $2^5, 2^4(^3/_x), 23(^s/_x)^2, 2^2(^3/_x)^3, 2^3(^3/_x)^4$

Co eff 1, 5, 10, 10, 5

$(2 + ^3/_x)^5 = 25 + 5(2)^4(^3/_x) + (2)^3(^3/_x)^2 + 10(22)\ ^3/_x)^2 + 5(2)(^3/_x)$

$= 32 + 2140x\text{-}1 + 720x\text{-}2 + 1080x^3 + 820x\ \text{-}4$

(b) $9.5 = 2 + ^3/_x$

$^3/_x = 7.5$

$x = ^3/_{7.5} = 0.4$

$(9.5)^5 = 32 + \frac{240}{0.4} + \frac{720}{(0.4)^2} + \frac{1086}{(0.4)^3} + \frac{810}{(0.4)^4}$

$= 53647.625$(3d.p)

7. $X^5 - 5x^4(0.2) + 10x3(0.20 - 10x2(0.2)^3 + 5x(0.2)^4 - (0.2)^5$

$X^5 – 5x^4 (^2/10) + 10x^3\ ^2/10^2 – 10x^2 (^2/10)^3 + 5x (^2/10)^4 – (^2/10)^5 + x^5 – (^4/10) x^3 – (^8/100)x^2 + 5 \text{ x } 16 – 2^5/10^5$

$X^5 – x^4x^3 – {}_{8/}100x^2 + 80x – {}_2{}^5/10^5$

90, 392, 079

8. Log (x +24) = log(x(9-2x)
X + 24 = 81-18x
X =3

9. $$1 + \frac{x}{12} = 1 + \frac{x}{2} + \frac{5x^2}{48} + \frac{5x^3}{432}$$
6

$$1 + \frac{x}{12} = 1\tfrac{1}{4}$$

$$\frac{x}{12} = \tfrac{1}{4}$$

$$x = 3$$

6

$$\frac{5}{4} = 1 + \frac{3}{2} + \frac{9}{48} + \frac{27}{432}$$

= 2.7500

10. (a) $(1 + ½)^8 = 1 + 8(½) + 28(½ x)^2 + 56(½ x)^3 + 70(½ x)^4 + 567(½ x)^5 + 2(½ x)^6 + 8(½ x)^7 + (½ x)^8$

$= 1 + 4x + 7x^2 + 7x^3 + 4.375x^4 + 1.75x^5 + 0.4375x^6 + 0.0625x^7 + {}^1/_{256}x^8$

(b) (1.05)8 = 1 + 4(0.1) + 7(0.1)2 + 7(0.1)3
=1+ 0.4 + 0.07 + 0.0074…
= 1.48

11. $81 + 27x + 9x^2 + 3x^3 + x^y$
$81 + 108x + 54x^3 + x4$
$81 + 108 (0.02) + 54 (0.02)^3$
= 83.182

53. Probability

1. (a) (i) Total balls = 3 + 6 = 9

= P(BW) or P(WB)

$= \frac{\overset{1}{\cancel{3}}}{\cancel{9}\,3} \times \frac{\overset{2}{\cancel{6}}}{8} + \frac{6}{9} \times \frac{3}{8}$

$= \frac{18}{72} + \frac{18}{72} = \frac{36}{72}$

$= ½$

(ii) = P(BW) or P(WB)

$= \frac{3}{9} \times \frac{6}{9} + \frac{6}{9} \times \frac{3}{9}$

$= \frac{18}{81} + \frac{18}{81}$

$= \frac{36}{81} = \frac{4}{9}$

(b) (i) P(WW) $= \frac{6}{9} \times \frac{5}{8}$

$= \frac{30}{72} = \frac{5}{12}$

(ii) P(WW) $= \frac{6}{9} \times \frac{6}{9}$

$= \frac{4}{9}$

2. P(W) = ${}^{7}/_{12}$ P (B) = ${}^{5}/_{12}$

(2 white and one brown)

=(WWB or WBW or BWW

$= ({}^{7}/_{12} \times {}^{6}/_{11} \times {}^{5}/_{10}) + ({}^{7}/_{12} \times {}^{5}/_{11} \times {}^{6}/_{10}) + ({}^{7}/_{12} \times {}^{7}/_{11} \times {}^{6}/_{10})$

$= {}^{22}/_{44}$

(ii) P(BBW or BWB or WBB)

$= (5/_{12} \times {}^{4}/_{11} \times {}^{7}/_{10}) + ({}^{5}/_{12} \times {}^{7}/_{11} \times {}^{4}/_{10}) + ({}^{7}/_{12} \times {}^{5}/_{11} \times 4/_{10})$

$= {}^{7}/_{22}$

(iii) P (at least one white cup)

$= (1\text{-}P(BBB) = 1\text{-}({}^{5}/_{12} \times {}^{4}/_{11} \times {}^{3}/_{10})$

$= {}^{21}/_{22}$

(iv) P (same colour) = P(BBB or WWW)

$= ({}^{7}/_{12} \times {}^{6}/_{11} \times {}^{5}/_{10}) + ({}^{5}/_{12} \times {}^{4}/_{11} \times 3/_{10})$

$= {}^{9}/_{44}$

3. a)

2	3	5	7
2	32	52	72
3	23	53	73
5	25	35	75
7	27	37	57

b) $P(E) = \frac{4}{16}$

$= \frac{1}{4}$

4.

(a) $P(late) = (^1/_3 \text{ x } ^1/_5) + (\frac{1}{2} \text{ x } ^3/_{10}) + (^1/_6 \text{ x } ^1/_{20})$

$= ^1/_{15} + ^3/_{20} + ^1/_{120}$

$= ^9/_{40}$

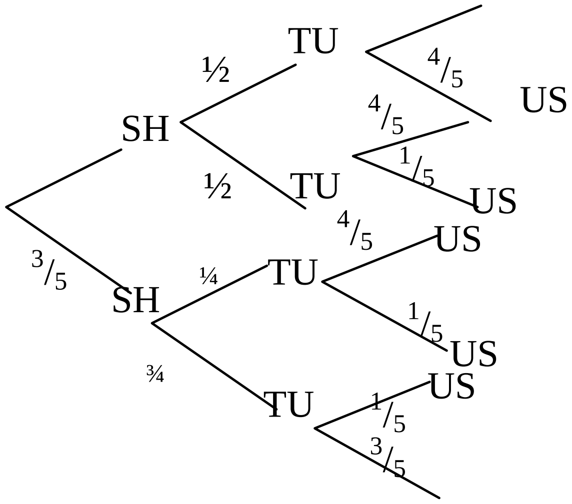
(b) $P = ^1/_3 \text{ x } ^1/_5) + (^1/_6 \text{ x } 1/_{20})$

$= ^1/_{15} + 1/_{20}$

$= ^3/_{40}$

(c) $P= (not\ late) = (1- ^9/_{40})$

5. *a)*

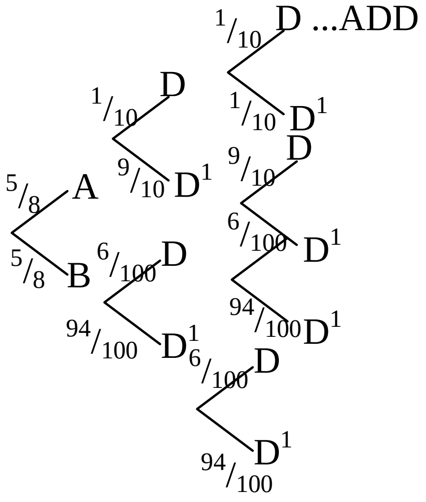


b) i) $P(all\ faults) = P(SH\ and\ TU\ and\ US)$

$= ^2/_5 \text{ x } \frac{1}{2} \text{ x } ^4/_5 = ^4/_{25}$

ii) $P(exactly\ two) = ^2/_5 \text{ x } \frac{1}{2} \text{ x } ^1/_5 + ^2/_5 \text{ x } \frac{1}{2} \text{ x } ^1/_5 + ^3/_5 \text{ x } \frac{3}{4} \text{ x } ^1/_5$

6.



Both defective

$= \frac{3}{8} \times \frac{1}{10} \times \frac{1}{10} + \frac{5}{8} \times \frac{6}{100} \times \frac{6}{100}$

$= \frac{3}{800} + \frac{180}{80000}$

$= \frac{24}{4000}$

$= \frac{3}{500}$

7. a)

R

b) i) P (BL or GL) $= {}^2/_3 \text{ X } {}^1/_{10} + {}^1/_3 \text{ X } {}^1/_{10}$

$= {}^2/_{15} + {}^1/_{30} = {}^5/_{30}$

ii) P(BL break or GR break)

$= {}^2/_3 \text{ X } {}^1/_5 \text{ X } {}^3/_10 + {}^1/_3 \text{ X } {}^1/_{10} \text{ X } {}^3/_{10}$

$= {}^2/_{50} + {}^1/_{100} = {}^{4+1}/_{100} = {}^5/_{100}$

iii) P(BR break or GR break)

$= {}^{2}/_{3}$ X ${}^{4}/_{5}$ X ${}^{1}/_{10}$ + ${}^{1}/_{3}$ X ${}^{9}/_{10}$ X ${}^{1}/_{10}$

$= {}^{8}/_{150} + {}^{9}/_{300} = {}^{16+9}/_{300} = {}^{25}/_{300}$

iv) $1 - ({}^{5}/_{100} + {}^{25}/_{300}) = 1 - {}^{15+25}/_{300}$

$= {}^{260}/_{300}$

8.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

P(a two days outing) $= {}^{10}/_{36} = {}^{5}/_{18}$

(b)	1	2	3	4	5	6
H	H1	H2	H3	H4	H5	H6
T	T1	T2	T3	T4	T5	T6

P(2days and one day pocket money)

$= \frac{5}{18}$ x $\frac{10}{12}$

$= \frac{25}{108}$

(c) (i) ${}^{5}/_{18}$ x ${}^{2}/_{12}$

$= {}^{5}/_{108}$

(ii)

P(get pocket money)

$= {}^{5}/_{18}$ x ${}^{2}/_{12}$ + ${}^{5}/_{18}$ x ${}^{10}/_{12}$ + $1^{3}/_{18}$ x ${}^{2}/_{6}$

9. (a) (i) P(W W) = $\frac{4}{10}$ x $\frac{3}{9}$

$= \frac{2}{15}$

(ii) P (W W) or (R R) = $\frac{4}{10}$ x $\frac{3}{9}$ + $\frac{6}{10}$ x $\frac{5}{9}$

$= \frac{2}{15} + \frac{1}{3} = \frac{7}{15}$

(iii) P (at least Red) $= 1 - P(WW)$

$$= 1 - \frac{2}{15}$$

$$\frac{13}{15}$$

(iv) P(WR) or P(RW) $= \frac{3}{5} \times \frac{4}{9} + \frac{2}{5} \times \frac{2}{3}$

$$= \frac{8}{15}$$

10. a) i) ${}^{8}/_{15}$

ii) ${}^{2}/_{15} + {}^{5}/_{15} = {}^{7}/_{15}$

b) i)

Gh $= {}^{2}/_{15} \times {}^{1}/_{14} = {}^{2/}{}_{21}0 = {}^{1}/_{105}$

ii) RG or RB

$${}^{3}/_{21} + {}^{7}/_{45} = \frac{45 + 147}{945}$$

$$= \frac{192}{945}$$

(c)(i)

	H	T
1	1H	1T
2	2H	2T
3	3H	3T
4	4H	4T
5	5H	5T
6	6H	6T

11. (a)

(b) (i) same colour = $^{5}/_{9} \times ^{4}/_{2} \times ^{3}/_{7} + ^{4}/_{9} \times ^{3}/_{8} \times ^{2}/_{7}$

$= ^{5}/_{42} + ^{1}/_{7}$

$= ^{11}/_{42}$

(ii) more red balls $= ^{5}/_{89} \times \frac{1}{2} \times ^{3}/_{7} + ^{5}/_{9} \times \frac{1}{2} \times ^{4}/_{7} + ^{5}/_{9} \times \frac{1}{2} \times ^{4/}7$

$= ^{5}/_{42} + ^{10}/_{63} = ^{10}/_{63}$

$= ^{5}/_{42} + ^{20}/_{63} = \frac{15 + 40}{126} = \frac{55}{126}$

(iii) at least black ball was picked

$= 1 - ^{5}/_{9} \times \frac{1}{2} \times ^{3}/_{7}$

$= 1 – ^{5}/_{21}$

$= ^{16}/_{21}$

(iv) Atmost 1 red ball picked

$= ^{5}/_{9} \times ^{4}/_{2} \times ^{3}/_{7} + ^{4}/_{9} \times ^{5}/_{8} \times ^{3}/_{7} + ^{4}/_{9} \times ^{3}/_{8} \times ^{2}/_{7}$

$= ^{5}/_{42} + 5/_{92} + ^{1}/_{21}$

$= \frac{5 + 5 + 2}{42}$

$= ^{12}/_{42}$

$= ^{2}/_{7}$

$^{3}/_{10}$

12.

A **$^{5}/_{10}$** **½** **W** **$^{2}/_{10}$**

½ **G**

B **R** **$^{4}/_{12}$**

$^{3}/_{12}$

$^{5}/_{12}$ **W**

G

P (Red) = (½ x $^{3}/_{10}$) + (½ x $^{4}/_{12}$)= 19 60

13. (a) **$^{1}/_{10}$** **Break**

Break^{1} **B1** **$^{9}/_{10}$**

$^{4}/_{5}$ **R**

$^{3}/_{10}$

$^{2}/_{3}$

B **$^{1}/_{5}$**

$^{7}/_{10}$ **R** **Break^{1}** **$^{9}/_{10}$** **Break**

G **R**

Break

L

B1

$^{9}/_{10}$ **Break^1**

Break^1

Break^1 **B1**

bi) P (left handed)

$= {}^{2}/_{3} \times {}^{1}/_{5} + {}^{1}/_{3} \times {}^{1}/_{10}$

$= {}^{2}/_{15} + {}^{1}/_{3}$

$= {}^{5}/_{30} = {}^{1}/_{6}$

ii) P (Right handed and will break)

$= {}^{2}/_{3} \times {}^{4}/_{5} \times {}^{1}/_{10} + {}^{1}/_{3} \times {}^{1}/_{9} \times {}^{1}/_{10}$

$= {}^{8}/_{150} + {}^{9}/_{300}$

$= {}^{25}/_{300} = {}^{1}/_{18}$

c) P (= $^{2}/_{3} \times {}^{4}/_{5} \times {}^{1}/_{10} + {}^{2}/_{3} \times {}^{1}/_{5} \times {}^{3}/_{10} + {}^{1}/_{3} \times {}^{9}/_{10} \times {}^{1}/_{10} + {}^{1}/_{3} \times {}^{1}/_{10} \times {}^{3}/_{10}$

14. (i) P (RRR) = $\frac{5}{15} \text{ X } \frac{5}{15} \text{ X } \frac{5}{15}$

$= \frac{125}{3375}$

$= \frac{1}{27}$

(ii) $\frac{125}{3375} + \frac{64}{3375} + \frac{216}{3375}$

$= \frac{405}{3375}$

$= \frac{3}{25}$

(iii) P (RBG) + P (GRB) + P(BGR)

$\frac{5}{15} \text{ X } \frac{4}{15} \text{ X } \frac{6}{15} + \frac{6}{15} \text{ X } \frac{5}{15} \text{ X } \frac{4}{15} + \frac{4}{15} \text{ X } \frac{6}{15} \text{ X } \frac{5}{15}$

$= \frac{120}{3375} + \frac{120}{3375} + \frac{120}{3375}$

$= \underline{24}$

(iv) P(BBB) + P(GGG) + P(BBG) + P (GGB)

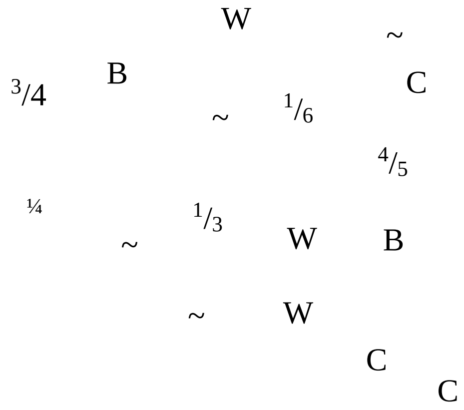
$$= \frac{4}{15} X \frac{4}{15} X \frac{4}{15} + \frac{6}{15} X \frac{6}{15} X \frac{6}{15} + \frac{4}{15} X \frac{4}{15} X \frac{6}{15} + \frac{6}{15} X \frac{6}{15} X \frac{4}{15}$$

$$= \frac{64}{3375} + \frac{216}{3375} + \frac{96}{3375} + \frac{144}{3375}$$

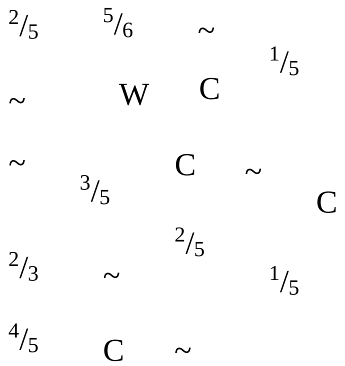
$$= \frac{520}{3375} + \frac{104}{3375}$$

B- To bed on time
B- To bed late
W- Waking upon time
W- waking up late
C- Getting to class on time
C- Getting to class late

15.



B- To bed on time
B- To bed late
W- Waking upon time
W- waking up late
C- Getting to class on time
C- Getting to class late



(a) (i) P(Bnw) = $\frac{3}{4} x \frac{5}{6}$

$= \frac{5}{8}$

ii) P(Waking up late)

1
$\frac{3}{4} x \frac{1}{6} + \frac{1}{4} x \frac{2}{3}$
3 2

$$= \frac{1}{8} + \frac{1}{6} = \frac{3 + 4}{24}$$

$$= \frac{7}{24}$$

√tree diagram.
√Addition of probability
√Addition of prob.
√Addition of prob.

b) (i) P (BW~C) or P(B~W~C)

1
$\frac{3}{4} x \frac{1}{6} x \frac{4}{5} + \frac{3}{4} x \frac{5}{6} x \frac{2}{5}$
2 2 1

$$\frac{1}{10} + \frac{1}{4} = \frac{4 + 10}{40}$$

$$= \frac{7}{20}$$

ii) $P(\sim B \sim C) = \frac{1}{4} x \frac{1}{3} x \frac{3}{5} + \frac{1}{4} x \frac{2}{3} x \frac{1}{5}$

$$= \frac{1}{20} + \frac{1}{30} = \frac{3 + 2}{60} = \frac{5}{60}$$

$= \frac{1}{12}$

54.Compound proportions, mixtures and rates of work

1. a) Deposit: Total ratio 2 + 3 + 5 = 10

Georgina: $^2/_{10}$ x 30000 = 6000

Gilbert: $^3/_{10}$ x 30000 = 9000

Akumu: $^5/_{10}$ x 30000 = 15000

b) Balance to be paid

= 510000 – 30000 = 480000

Each pays = $\frac{480000}{3}$ = 160000

c) Profit = $^{20}/_{100}$ x 510000 = 102000

Georgina received: $^1/_6$x 102000= 17000

Gilbert received: $^2/_6$x 102000 = 34000

Akumu received: $^3/_6$ x 102000 = 51000

2. Men Days

Men	Days
12	20
16	?

= $(\frac{12}{16}$ x 20) days = 15 days

3 t cost

+09.00 81.50

Cost of mixture

Sh 112.8 x $\frac{100}{120}$ = 94 per kg

Ratio A : B

(81.50 – 94) : (109 – 94)

12.5 : 15

2.5 : 3

5 : 6

Alt. At selling Price

130.50 97.80

- 112.80

15 18

A sales at $\frac{109}{100}$ x 120

= 130.50/=

B sales at $\frac{81.50}{100} \times 120$

= 97.80/=

A & B mixed sells at

$\frac{94 \times 120}{100} =$

sh 112.80 per kg

Ratio A : B

(112.80 – 97.8) :

(130 – 112.8)

15: 18

5 : 6

4 *Let Onacha take x days.*

Mogutu takes x + 5 days.

$\frac{1}{x} + \frac{1}{x + 5} = \frac{1}{6}$

$x^2 (x + 5) + 6x = x(x – 5)$

$x^2 – x – 30 = 0$

$(x – 10) (x + 3)$

$x = 10, 3$ *Onacha takes 10 days.*

5 $^{dy}/_{dx} = 6x2 + x – 4$

When x = 1,

$^{dy}/_{dx} = 6+1 -4 = 3$

Grad of normal $= {}^{-1}/_3$

$y + ½ = -1/_3 (X -1)$

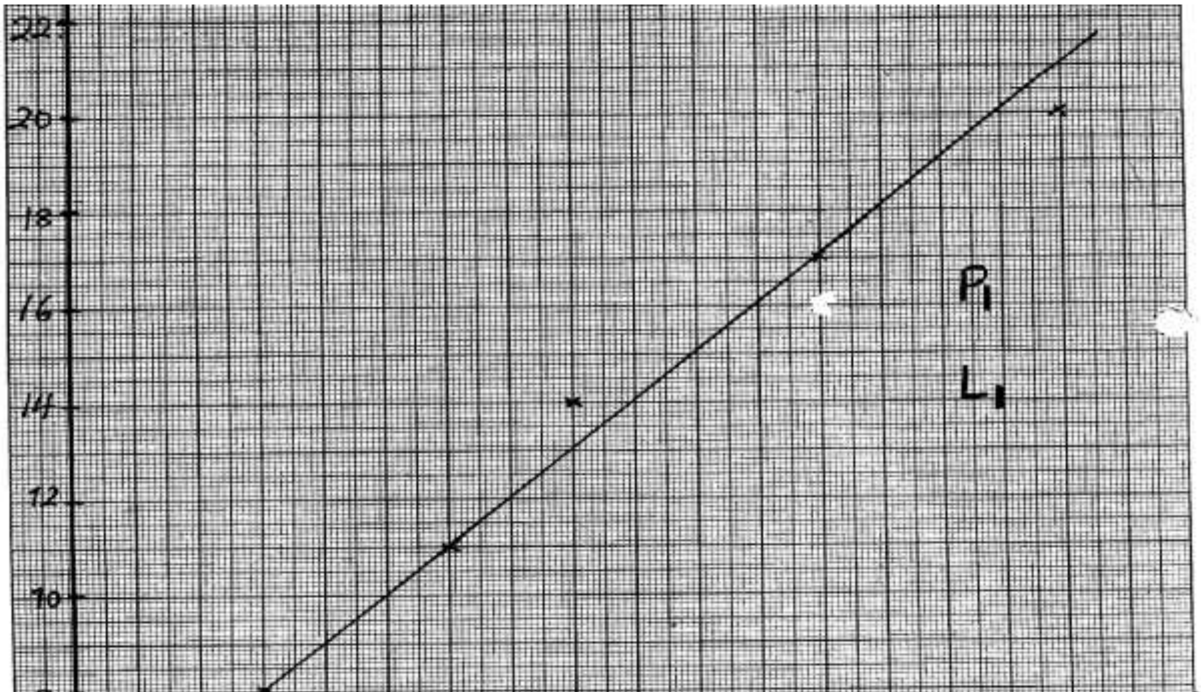
$y= {}^{-1}/3\, x – {}^1/_6$

6 *Gradient =* $\frac{11 – 8}{3 – 1.5}$

$= 2$

K = 2, M = 5 *B = 2A + 5*

D



7 (70 – 25 x 60 = 2700
2700 Cos 47
= 2700 x 0.68 = 1841.4nm

8 $\frac{6x\ 72 + 66 x 4}{10}$ = 69.6
100% = 69.6
∴ 105 = 73.10

9 (a) (i) A B Mixture
150 160 156
1 n 1+n
150 160n (n+1)156
150 + 160n = 156(n+1)
N = $^6/_4$ = $^3/_2$
= $\frac{112}{100}$ x 156 = shs. 174.72

(b) At 11.45 a.m
Depth filled by P in 2hrs = 2.1m
3hrs = $\frac{3hr}{2hr}$ x 2.1m
= 3.15m
Depth filled by q in 7hrs = 2.1m
3hrs = $\frac{3hrs}{7hrs}$ x 2.1m

= 0.9m

Depth emptied by R in 6hrs = 2.1m

$\frac{2hrs}{6hrs} = 2hr \text{ x } 2.1$

∴Depth at 11.45a.m = (3.15 + 0.9) – 0.7 = 3.35m

10 Let the amount to be mixed be x kg of the lower, priced grade and y kg for higher price grade

X kg of the lower priced grade cost Sh. 420x

Y kg of the higher priced grade cost Sh.470y

Total cost of (x+y0 kg of mixture

= Shs.$\frac{420x + 470y}{x + y}$

equating $\frac{420x + 470y}{x + y} = 455$

420 x + 470y = 455x + 455y

470y – 455y = 455x – 420y

15y = 35x

X: y = 3:7

11. Cross sectional area = r^2

$= (\frac{22}{7} \text{ x } 35 \text{ x } 35)cm^2$

Flow per second = $(\frac{22}{7} \text{ x } 35 \text{ x } 35 \text{ x } 45)cm^2$

After 2¼ hrs = $(\frac{22}{7} \text{ x } 35 \text{ x } 35 \text{ x } 45 \text{ x } 3 \text{ x } 60 \text{ x } 69)$liters

= 233887.5litres

12 a) In 2000, Costs

		Shs
Material = $^8/_{25}$ x 1250	=	400
Labour = $^{14}/_{25}$ x 1250	=	700
Transport = $^3/_{25}$ x 1250	=	150

In 2003

Material = 400 x 2	=	800
Labour = $^{130}/_{100}$ x 700	=	910
Transport =$^{120}/_{100}$ x 150	=	180

b) In 2004 Costs

Material = 800

Transport = 180

∴ labour = 1981 – (800 + 180)= Shs.1001

∴ Increase in labour = 1001 – 910 = 91

% increase = $^{91}/_{910}$ x 100

= 10%

13. $\text{Cost price} = \frac{100 \times 114}{120} = \text{shs. } 95$

Let A: B = n :1

$\frac{95}{1} = \frac{80n + 100}{n + 1}$

$95n + 95 = 80n + 100$

$15 n = 5$

$n = {}^{1}/_{3}$

n:1 =1:3

A:B = 1:3

14. Let the ratio be x: y

$76x + 84y = 81(x + y)$

$84y - 81y = 81x - 76x$

$3y = 5x$

$\frac{3}{5} = \frac{x}{y}$

$x : y = 3 : 5$

15. a) Cost of 8kg = $5 \times 25 + 2 \times 30 + 1 \times 45 = 230$

Cost of 1 kg= ${}^{230}/_{8} = 28.75$

Profit/ kg= $28.75 \times {}^{20}/_{100}$

$= 5.75$

b) i) Selling price

$= 28.75 \times {}^{112}/_{100} = 32.20$

$32.20 \times {}^{120}/_{100} = 38.64$

38.64

ii) New cost/ kg

$= 1.12 \times 28.75 = 32.20$

$\% \text{ Profit} = \frac{40.25 - 32.20}{32.20} \times 100$

$= 25\%$

16. $= \frac{3(5.60) + 11y}{14} = 6.70$

$= 16.8 + 11y = 93.8$

$11y = 77$

$y = 7$

1Kg costs Shs. 7.00

55. Graphical methods

1. $x^2 + 4x + y^2 = 5$

   $x^2 + 4x + (\frac{1}{2} \text{ x } 4)^2 + y^2 = 5 + (\frac{1}{2} \text{ x } 4)^2$

   $(x + 2)^2 + (y + 0)^2 = 5 + 4$

   $(x + 2)^2 + (y + 0)^2 = 9$

   Centre (-2,0)

   Radius $\sqrt{9}$

   $r = 3$ units

2. $x^2 + 6x + (3)^2 + y^2 - 10y + ({}^-5) = 2 + 9 + 25$

   $(x + 3)^2 + (y - 5)^2 = 36$

   $(x - {}^-3)^2 + (y - +5)^2 = 6^2$

   ∴ centre (-3, 5)

   Radius 6 units

Completing of sq. for expression in x and y.
√Expression.
√Centre
√Radius

3. CBE = 40^0 (alt.segiment theoren)

   ∠BCE = 120^0 (Suppl. To BCD = 60^0alt. seg.)

   ∴(40 + 120 + E) = 180^0 (Angle sum of Δ)

   ∠BEC = 20^0

4. $X^2 + Y^2 - 10Y + 25 = 25 - 16$

   $(X - 0)^2 + (Y - 5)^2 = 9$

   $(X - 0)^2 + (Y - 5)^2 = 3^2$

   Centre (0, 5)

   Radius = 3

5.

x	-5	-4	-3	-2	-1	0	1
x^3	-125	-64	-27	-8	-1	0	1
$6x^2$	150	96	54	24	6	0	6
$8x$	-40	-32	-24	-16	-8	0	8
y	-15	0	3	0	-3	0	15

   $x^3 + 6x^2 + 8x > 1$

   Between

   (i) $x = -3.85\ 0.1$ and $x\ -2.15\ 0.1$

   (ii) $x > 0.5 \pm 0.1$

6. $y = x^3 - 3x + 2$

   $x = 0, y = 2$

   (0, 2) ⇒ y – intercept.

$\frac{dy}{dx} = 3x^2 - 3 = 0$

$x^2 = 1$

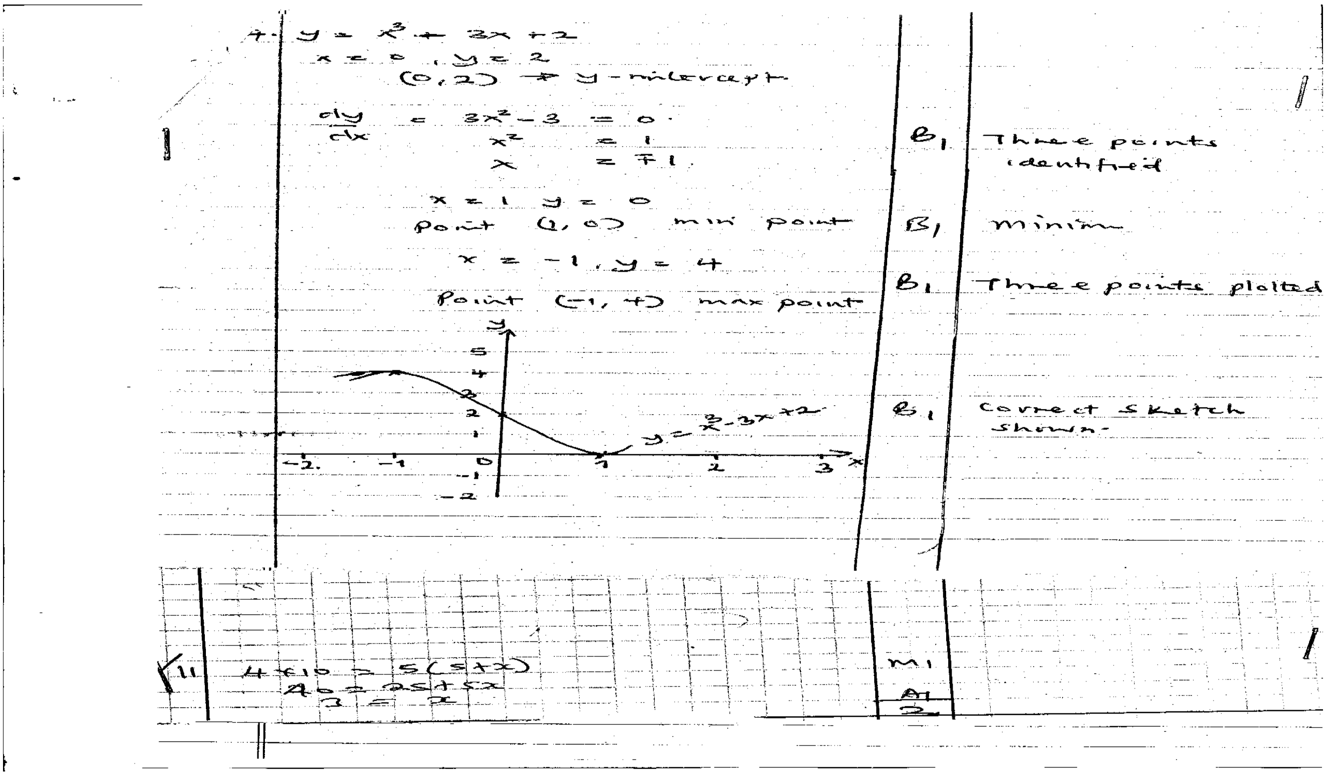
$x = \mp 1$

$x = 1 \quad y = 0$

Point (1, 0) min point

$x = -1, \; y = 4$

Point (-1, 4) max point.



4. $y = x^3 - 3x + 2$

$x = 0, y = 2$

(0,2) → y-intercept

$\frac{dy}{dx} = 3x^2 - 3 = 0$

$x^2 = 1$

$x = \mp 1$ — B1 Three points identified

$x = 1 \quad y = 0$

Point (1, 0) min point — B1 Minimum

$x = -1, y = 4$

Point (−1, 4) max point — B1 Three points plotted

B1 Correct sketch shown.

11. $4 \times 10 = 5(5 + x)$ — M1

$40 = 25 + 5x$

$3 = x$ — A1

2

7. $4x_2 - 12x + 4y^2 + 12y = 7$

$x^2 - 3x + y^2 + 3y = {}^7/_4$

$x^2 - 3x + ({}^3/_2)^2 + y^2 + 3y + ({}^3/_2)^2 = {}^7/_4 + {}^9/_4 + {}^9/_4 = {}^{25}/_4$

$(x - {}^3/_2)^2 + (y + 3/2)2 = 25/4$

$\therefore$ Centre (1,5, -1.5) Radius 2.5units

8. Log R =nlog p + log K

Log P	0.48	0.54	0.60	0.65	0.70
Log R	1.56	1.69	1.81	1.91	2.00

$$\text{Gradient} = \frac{2 - 0.6}{0.7}$$

$$= \frac{1.4}{0.7} = 2$$

Log R intercepts = 0.6 = logk

K= 4

The law connecting R and P is $R=4P^2$

$900 = 4P^2$

$$P^2 = \frac{900}{4}$$

$225 = P^2$

9. $(x + 2)^2 (y-3)^2 = 3^2$

$X^2 + 4x + 4 + y^2 - 6y + 9 = 3^2$

$X^2 + y^2 + 4x - 6y + 4 = 0$

10.

V	0	2	4	6	8	10
$\frac{1}{T}$	2.04	3.33	4.17	5	6.25	7.30

$T = \frac{a}{b + V}$

$\frac{I}{T} = \frac{b + V}{a}$

$\frac{I}{T} = \frac{1}{a}V + \frac{b}{a}$

$y = mx + C$

b) (i) $\frac{1}{a} = \text{Grad} \Rightarrow \frac{\Delta y}{\Delta x} = \frac{7.3 - 5}{10 - 6} = \frac{2.3}{4} = 0.575$

$a = 1.739$

$\frac{b}{a} = y - \text{Intercept} \Rightarrow 2.04$

$\frac{b}{1.739} = 2.04$ $\quad b = 2.04 \times 1.739$

$= 3.547556$

$b \simeq 3.548$

(ii) $T = 0.38$

$\frac{I}{T} = 2.63$ shown on graph

$V = 1$

-1

(iii) $\frac{I}{T} = 4.45$

$T = (4.45)$

$= 0.2247$

$\simeq 0.22$

11. $y = 2x^3 + x^2 + 3x - 1$

$\frac{dy}{dx} = 6x^2 + 2x + 3$

gradeindent at (1, -5)

$= 6 + 2 + 3 = 11$

$\frac{y-(-5)}{x - 1} = 11$

$y + 5 = 11x - 11$

$y = 11x - 16$

12. $3^5 = 3^{-4} x\ 3^{-x}$
$3^5 = 3^{-4-x}$
$-4 – x = 5$
$-x = 9$
$x = -9$

13. $x^2 + 2x + 1 + y^2 – 4y + 4 = 4 + 1 + 1$
$(x+1)^2 + (y-2)^2 = 9$
Centre (-1, 2)
Radius 3units

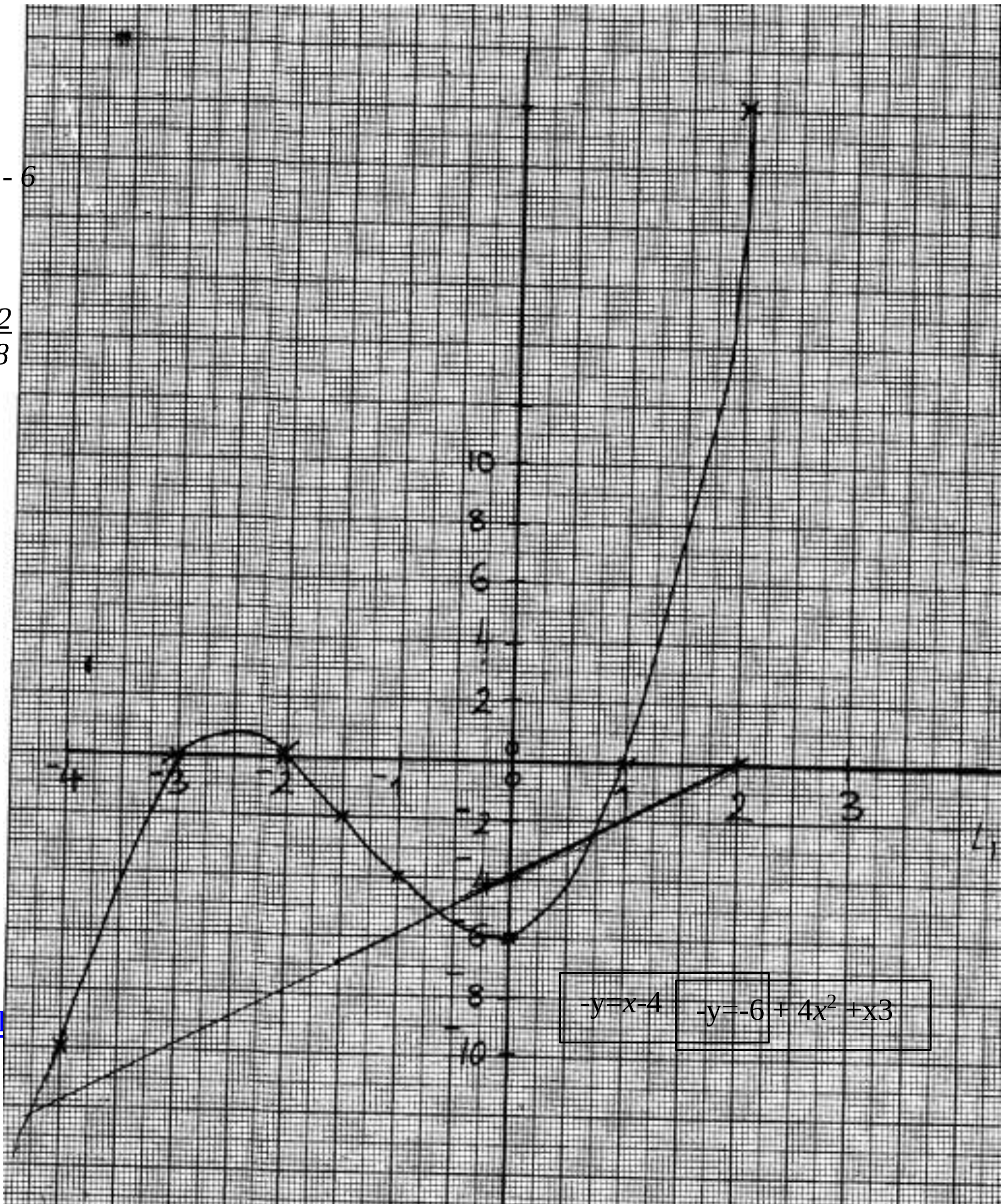
14. c)

X	-4	-3	-2	-1	0	1	2
-6	-6	-6	-6	-6	-6	-6	-6
X	-4	-3	-2	-1	0	1	2
$4x^2$	64	36	16	4	0	4	16
X^3	-64	-27	-8	-1	0	1	8
$Y=-6+x+4x^2+x^2$	-10	0	0	-4	-6	0	20

$y = x^3 + 4x^2 + x -6$
$\underline{0 = x^3 + 4x^2 + x -4}$
$y = -2$

(iii) $y = x^3 + 4x^2 + x - 6$
$\underline{0 = x^3 + 4x^2 + 0 – 2}$
$y = x – 4$

x	1	0	-2
y	-3	-4	-8



c (i) solution 0.8
-1.5
And -3.2
(c) 1, -2, -3

15.

Perimeter p(cm)

35

30

25

20

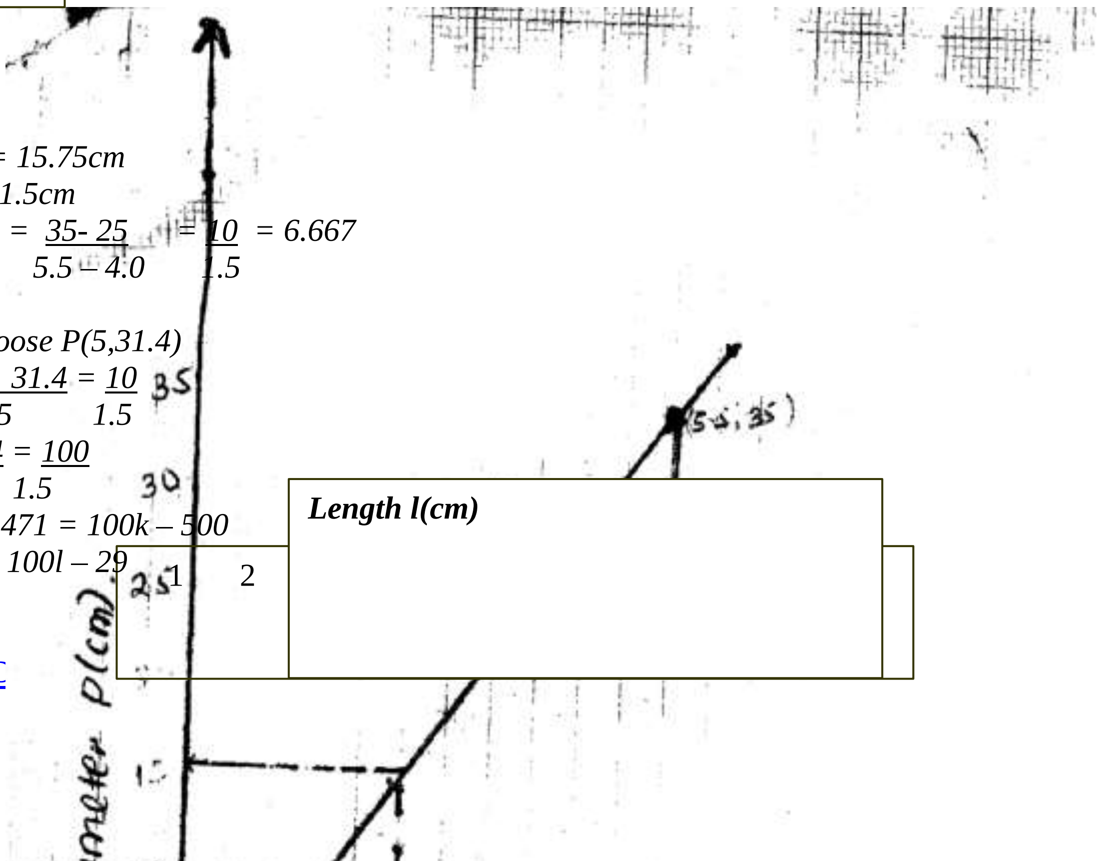
15

10

5

(5.5, 35)

(4, 25) (5.5, 25)



(i) P = 15.75cm

(ii) l=1.5cm

(iii) $m = \frac{35-25}{5.5-4.0} = \frac{10}{1.5} = 6.667$

(c) choose P(5,31.4)

$\frac{p - 31.4}{l-5} = \frac{10}{1.5}$

$\frac{p-31.4}{l-5} = \frac{100}{1.5}$

15p – 471 = 100k – 500

15p = 100l – 29

15 15

Length l(cm)

1 2

$2k = \frac{100}{15}$

$k = \frac{100}{2 \times 15} = 3.33$

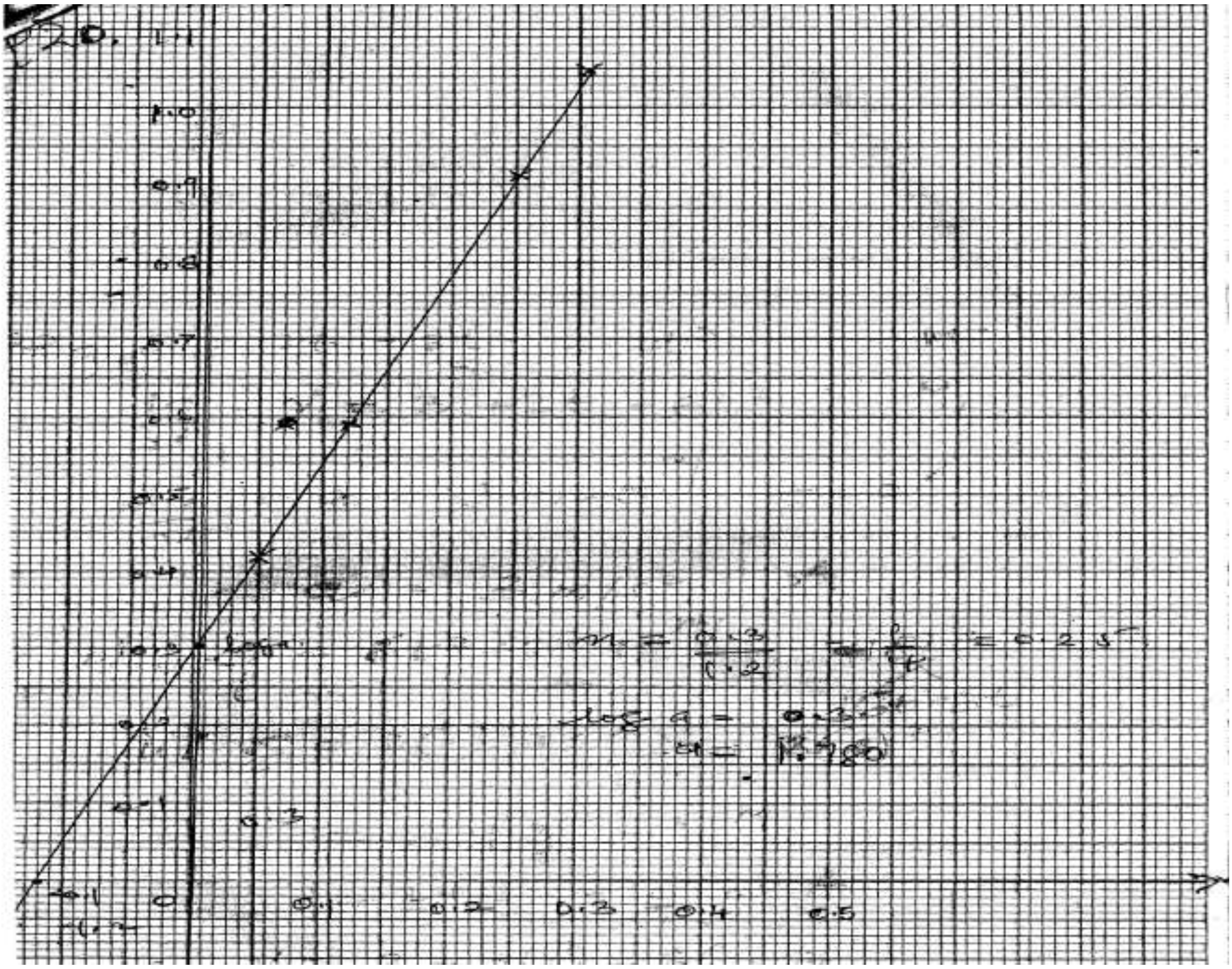
$c = 1.93$

$P + 0.6 = ar^h$

$\text{Log}\,(P + 0.6) = \log a + n \log R$

$= n \log R + \log 9$

P + 0.6	1.33	2.65	3.85	8.04	11.22
Log (P + 0.6)	-0.13	0.42	0.59	0.91	1.05
Log R	-0.05	0.05	0.12	0.25	0.30



Log 0.3 = ¼ = 0.25

Log a = 0.3

17. $x^2 + y^2 - 6x = 3 - 4y$

$x^2 - 6x + (^{-6}/_2)^2 + y^2 + 4y + (^4/_2)^2 = 3 + (^{-6}/_2)^2 + (^4/_2)^2$

$(x - 3)^2 (y + 2)^2 = 3 + 9 = 4$

$(x - 3)^2 (y + 2)^2 = 16$

C (3, -2)

$$\text{Gradient } \frac{\Delta y}{\Delta x} = \frac{7 - -2}{6 - 3} = 3$$

18.

x	-3	-2	-1	0	1	2	3	4
$-x^3$	27	8	1	0	-1	-8	-27	-64
$2x^2$	18	8	2	0	2	8	18	32
$-4x$	12	8	4	0	-4	-8	-12	-16
2	2	2	2	2	2	2	2	2
y	59	26	9	2	-1	-6	-19	-46

b) Check on the graph paper.

c) $x = 0.5 \underline{+} 0.1$

d) $-x^3 + 2x^2 - 5x + 3 = 0$

Line to allow: $y = x - 1$

x	0	1
y	-1	0

$x = 0.65$

19. $^{Dy}/_{dx} = 12x^2 - 12$

$12x^2 - 12 = 0$

$12(x^2 - 1) = 0$

$x = 1$

$x = -1$

At $x = 1$ At $x = -1$

0	1	2	-2	-1	0
GRD = 12	0	36	36	0	-12
-	0	+	+	0	-

(1,7) (-1, 9)

Minimum maximum

20. (a) table

(b) plotting

scale

smooth curve

(c) (i) $-0.5 < x < 1$ and $x>1$

(iii) $x = 2.5 \pm 0.1$

21. $2x^2 + 2y^2 - 6x + 10y + 9 = 0$

$x^2 + y^2 - 3x + 5y + 9/2 = 0$

$x^2 + y^2 - 3x + 5y = -9/2$

$x^2 - 3x + \frac{9}{4} + y^2 + 5y + \frac{25}{4} = 8.5 - 4.5$

$(x - \frac{3}{2})^2 + (y + \frac{5}{2})^2 = 4$

Radius = 2 units

Centre = (1.5, -2.5)

56. *Matrices and Transformations*

1. *a) B (4,-5), C (3,6 ½)*

∆ ABC drawn

∆ ABC drawn

a) ii) Shear maps

1

I (1, 1½)

Matrix = 1 0

1 ½

b) i) 1 1 1

A B C

-1 0 -6 -4 3

$^3/_2$ *-1 -4 -5 6 ½*

=

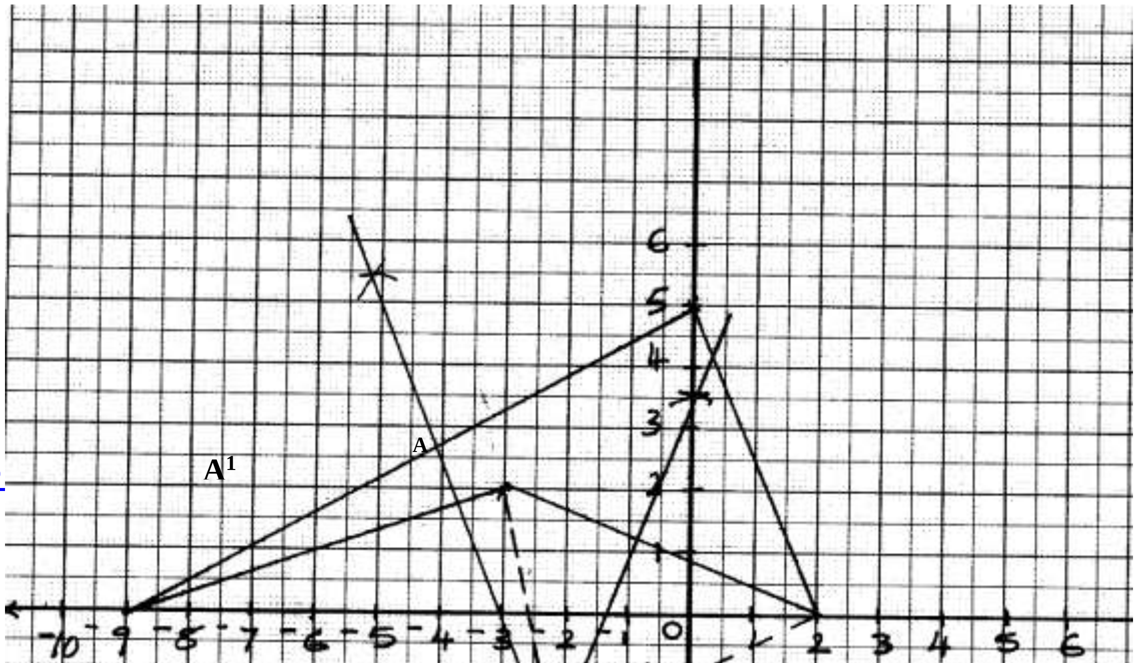
A^{11}	B^{11}	C^{11}
6	4	-3
-5	-1	-2

∆ A^{11} B^{11} C^{11} D^{11} *drawn*

ii) Half turn about (0,0)

2.

B^1



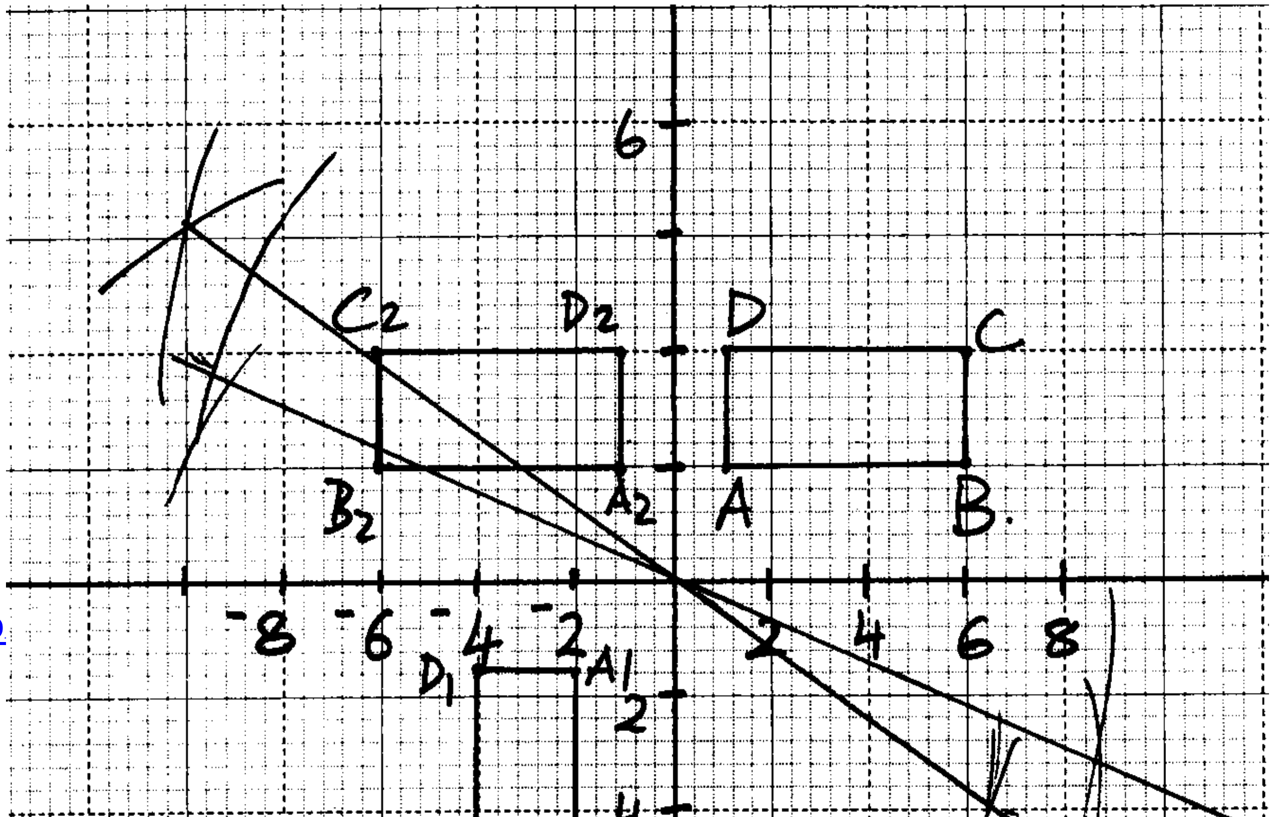
(a) Centre (-2, -2) 90^{o}

(b) A11 (-2 , -4) , B11 (0, 9)

(c) Half-turn about the centre (0, 2)

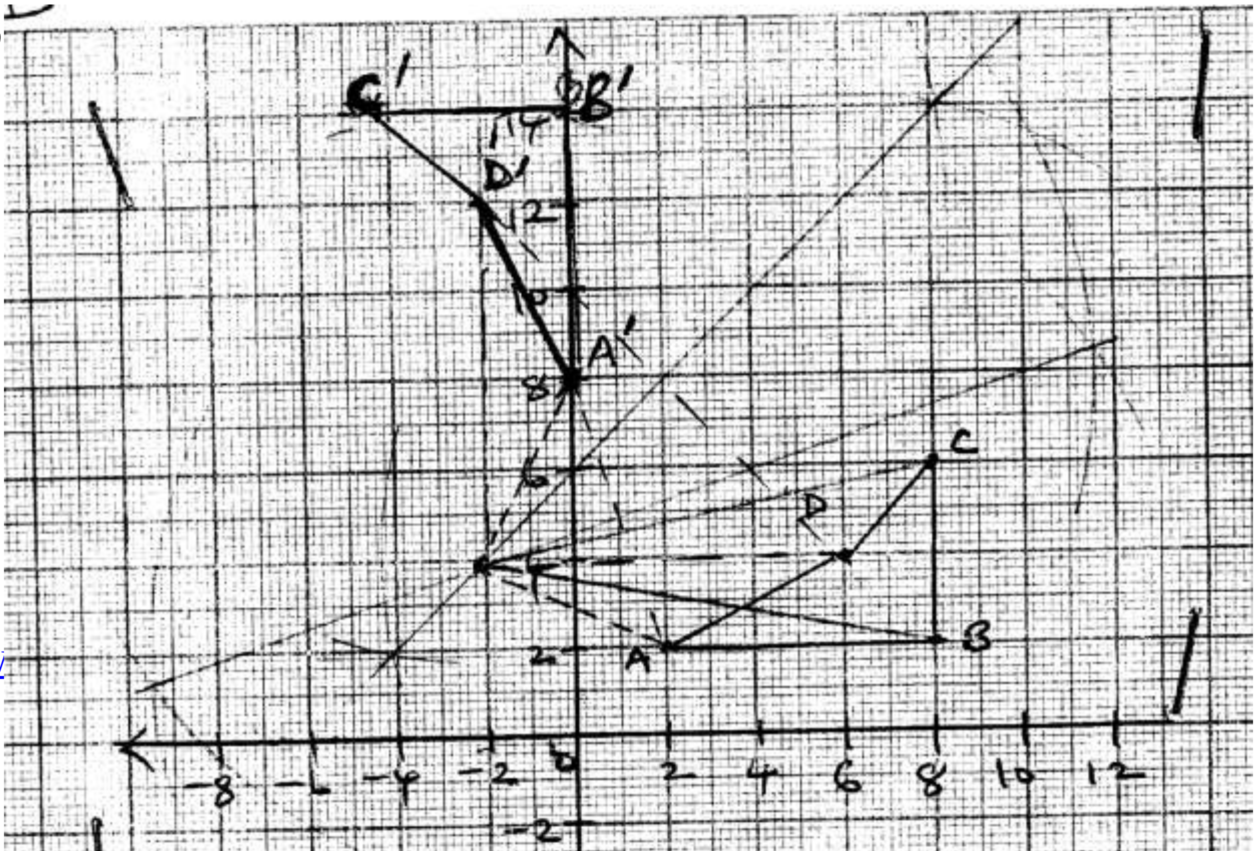
3.

(b)



(c) (i) U - - positive three-quarter turn about the origin
(ii)UT – Reflection I the line x = 0
(d) IdetI = I2.5 x -2 – 1x 0 I= 5
∴Area = 5x(5x2) = 20sq. units

4. (a)



b) Centre (-2, 4)

Angle + 90°

5. $P(5,-3)$ $P^1(2,-5)$

$$\begin{matrix}5\\-3\end{matrix} + \begin{matrix}a\\b\end{matrix} = \begin{matrix}2\\-5\end{matrix}$$

$$\begin{matrix}a\\b\end{matrix} = \begin{matrix}-3\\-2\end{matrix}$$

$$R^1 = \begin{matrix}-2\\-3\end{matrix} + \begin{matrix}-3\\-2\end{matrix}$$

$$= \begin{matrix}-5\\-5\end{matrix}$$

$$P^1R^1 = \begin{matrix}-5\\-5\end{matrix} - \begin{matrix}-2\\-5\end{matrix}$$

$$= \begin{matrix}-7\\0\end{matrix}$$

Mag. = 7units

6. $A^1 = (0+1, -1-2) = (1, -3)$

$B^1 = (4 + 1) , 3-2) = (4, 1)$

$C^1 = (2 +1, 2-2) = (3-0)$

Matrix $\begin{matrix}3 & 0\\0 & 3\end{matrix}$

$$\begin{matrix}3 & 0\\0 & 3\end{matrix} \quad \begin{matrix}1 & 5 & 3\\-3 & 1 & 0\end{matrix} = \begin{matrix}3 & 15 & 9\\-9 & 3 & 0\end{matrix}$$

A^{11} (3, -9) B^{11}(15, 3) C^{11}(9,0)

Determinant (0-9) =-9

Area = 9x24 = 216cm^2

$\begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{matrix} 3 & 15 \\ -9 & 3 \end{matrix} = \begin{matrix} 1 & 5 \\ -3 & 1 \end{matrix}$

$5(31 -9b =1 \qquad 5(3c-9d=-3$

$\underline{-15a+3b =5} \qquad \underline{15c +3d=1}$

$-48b =0 \qquad -48d = -16$

$b = 0 \qquad d = {}^1/_3$

$a = {}^1/_3 \qquad c=0$

matrix $\begin{matrix} {}^1/_3 & 0 \\ 0 & {}^1/_3 \end{matrix}$

7. Scale used S_1

ΔABC drawn B_1

$\Delta A_1B_1C_1$ drawn B_1

A, (6, -1), B(7, 2) C, (4, 4) B1

Line x = 4 L_1

$\Delta A_2 B_2 C_2$ drawn B_1

Two seen B_1

Centre of rotation

Angle of centre of rotation B_1

$A_3B_3C_3$ drawn B_1

Scale used S_1

ΔABC drawn B_1

$\Delta A_1B_1C_1$ drawn B_1

A, (6, -1), B(7, 2) C, (4, 4) B1

Line x = 4 L_1

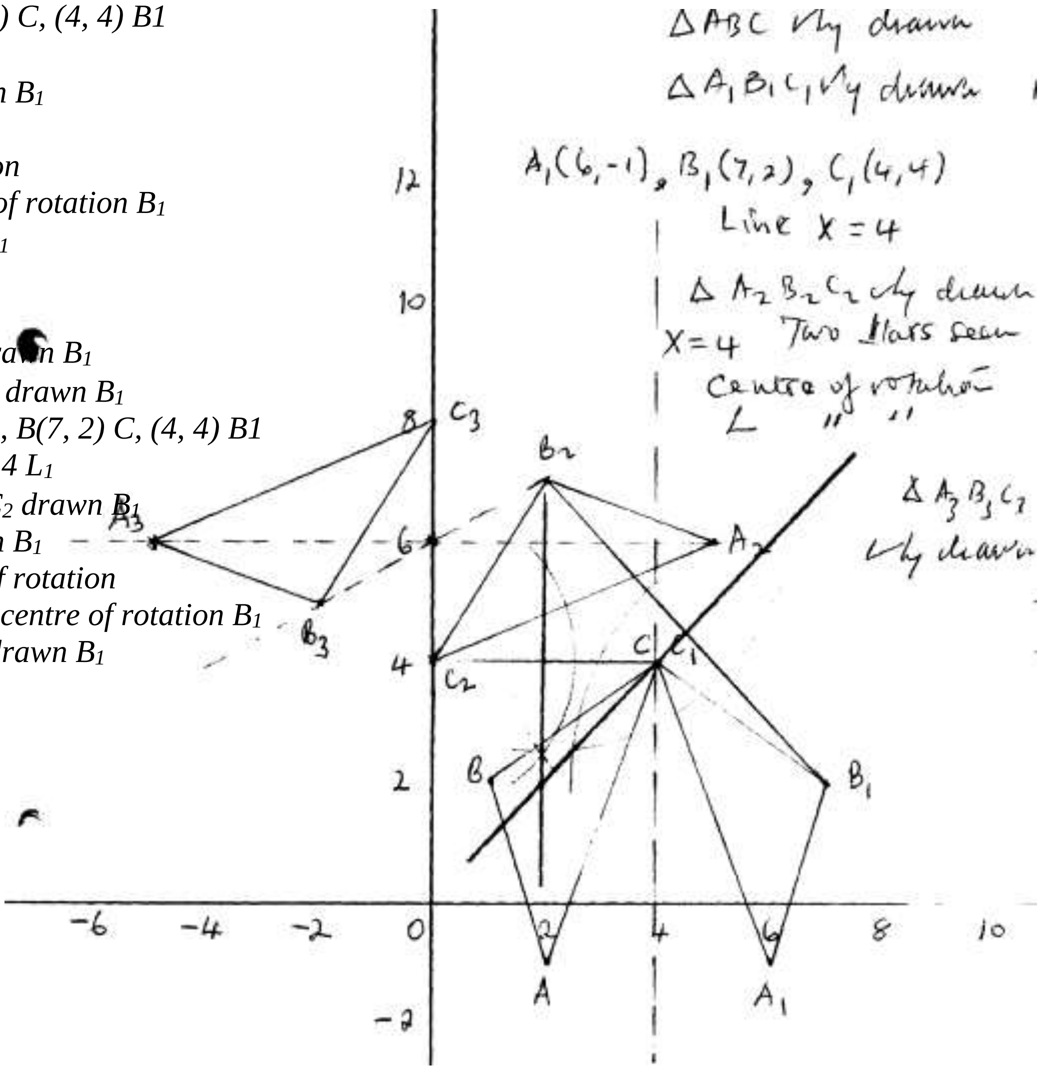
$\Delta A_2 B_2 C_2$ drawn B_1

Two seen B_1

Centre of rotation

Angle of centre of rotation B_1

$A_3B_3C_3$ drawn B_1



8. (a) $P(6, -2)$

$X^1 = 6 -3 (-2) = 12$

$Y^1 = 2(6) = 12$

$(X^1, Y^1) = (12, 12)$

(b) (i) $A^1(3, 4)$

(ii) $B^1 (3, 2)$

$C^1 (1, 4)$

$D^1(4, 3)$

(c) (i)

=

$A^{11} (-5, 4)$, $B^{11}(-1, 2)$, $C^{11}(-7, 4)$ and $D^{11}(-6, 5)$

(ii) A stretch with y-axis invariant and a sketch factor (3)

$2h = 6$

$h = 3$

$-5a + 4b = 4$	$-5c + 4d = -3$
$\underline{- a + 2b = 2}$	$\underline{-c + 2d = 3}$
$-5a + 4b = 4$	$-5c + 4d = -3$
$\underline{-a + 4b = 4}$	$\underline{-c + 4d = -6}$
$-4a = 0$	$- 4c \quad = 3$
$a = 0$	$c = - ¾$
$b = 1$	$d = {}^{15}/_{8}$

9. (a) $X1(5, -1)$ $y_1(7, -1)$ $Z_1 (-2, 2)$

xyz & $x_1y_1z_1$ well drawn

(b) 1-3 xyz x1y1z1

$X_2(2, 10)$ $y_2(2, 14)$

$X_2y_2Z_2$ well drawn

(c)

(d)) Area of $\Delta X_2y_2Z_2$

$= 4x15 = 60cm^2$

10. $\begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{matrix} 2 & 4 & 4 & 2 \\ 1 & 1 & 4 & 4 \end{matrix} = \begin{matrix} 7 & 14 & 14 & 8 \\ 8 & 7 & 16 & 16 \end{matrix}$

$2a + b = 8$

$\underline{4a + b = 14}$

$-2a \quad = -6$

$6 + b -= 8$

$b = 2$

$\therefore 6 + b = 8$

$b=2$

$2c + d = 7$

$\underline{4c + d = 7}$

$-2c \quad = 0$

$c = 0$

$d = 7$

$\therefore \begin{matrix}3 & 2\\ 0 & 7\end{matrix}$

- it is an enlargement with scale factor 3 with centre (-1, -2)

(c) $\begin{matrix}8\\ 7\end{matrix} + \begin{matrix}a\\ b\end{matrix} = \begin{matrix}7\\ 9\end{matrix}$

$a + 8 = 7 \qquad 7 + b = 9$

$a = -1 \qquad b = 2$

$\therefore T = \begin{matrix}-1\\ 2\end{matrix}$

11. a) ABCD drawn B_1

Name – Parallelogram B_1

b) $A^1B^1C^1D^1$ drawn B_1

Attempt to joining any two points and bisecting. B_1

Description – Rotation + 90^0. B_1 or quarter turn about (0,0)

c) $A^{11}B^{11}C^{11}D^{11}$ drawn. B_1

Description – Enlargement centre (0, 0) Scale factor –Z. B_1

d) $A^{111}B^{111}C^{111}D^{111}$ – drawn. B_1

Attempt to reflect. B_1

Coordinates

A^{111} = 9-2, 4) C^{111} = (-8, 4) B_1 All correct

B^{111} = (-6, 0) D^{111} (-4, 8)

12. $\begin{matrix}-1 & 1\\ 2 & -3\end{matrix} \quad \begin{matrix}4 & 0 & -2\\ 1 & -2 & 4\end{matrix}$

$\begin{matrix}-3 & -2 & 6\\ 5 & 6 & -16\end{matrix}$

$A^{|}$ (-3, 5) $B^{|}$(-2, 6) $C^{|}$(6, -16)

$\begin{matrix}2 & -1\\ 1 & 2\end{matrix} \quad \begin{matrix}-3\\ 5\end{matrix} = \begin{matrix}-2 & 6\\ 6 & -6\end{matrix}$

$A^{||}$	$B^{||}$	$C^{||}$
-11	-10	18

$$\begin{matrix}7 & 10 & -6\end{matrix}$$

$A^1(-11, 7)$ $B^1(-10, 10)$ $C''(18, -6)$

MN

$$= \begin{matrix}2 & -1\\ 1 & 2\end{matrix} \qquad \begin{matrix}-1 & 1\\ 2 & -3\end{matrix}$$

$$= \begin{matrix}-4 & 5\\ 3 & -5\end{matrix}$$

$$p\text{-}1 = \frac{1}{-12} \begin{matrix}5 & -7\\ -4 & 8\end{matrix}$$

$$\begin{matrix}-{}^{5}/_{12} & {}^{7}/_{12}\\ {}^{1}/_{3} & -{}^{2}/_{3}\end{matrix}$$

13. Det = 2 – 6

= - 4

A.S.F = 4

$\frac{25.6}{x} = 4$

$x = 6.4cm^2$

Area of $\Delta ABC = 6.4cm^2$

14. $T + \begin{pmatrix}2\\-4\end{pmatrix} = \begin{pmatrix}4\\0\end{pmatrix}$

$T = \begin{pmatrix}4 - 2\\0 + 4\end{pmatrix} = \begin{pmatrix}2\\4\end{pmatrix}$

$\therefore \begin{pmatrix}2\\4\end{pmatrix} + \begin{pmatrix}-1\\2\end{pmatrix} = \begin{pmatrix}1\\6\end{pmatrix}$

Q (1,6)

16. $5x^2 + 6 = {}^{110}/_{10}$

$5x^2 + 6 = 11$

$x^2 = 1$

$x = \pm 1$

57. Statistics II

1.

Mass	Mid term	F	d = x A	fd	d^2	fd^2

kg	x					
50 - 54	52	19	-15	-285	225	4275
55 - 59	57	23	-10	-230	100	2300
60 - 64	62	40	-5	-200	25	1000
65 - 69	67	28	0	0	0	0
70 - 74	72	17	5	85	25	425
75 - 79	77	9	10	90	100	900
80 - 84	82	4	15	60	225	900
		$\sum f =$ 140		$\sum fd$ = - 480		$\sum fd$ = 9800

Marks awarded for √table as follows:-

$\sum f = 140$ BI

Column for d B1

Column for fd B1

$\sum fd = -480$ B1

√Column for $d^2 = 9800$ B_1

$\sum fd = 9800B_1$

$x = A + \frac{\sum fd}{\sum f}$

$= 67.0 + -\frac{480}{140}$

$= 67.0 - 3.43 = 63.57$ ………… M1

$= 63.6$ kg …………… A1

Standard deviation $= \frac{\sum fd^2}{\sum f} - \frac{\sum fd}{\sum f}$

$= \frac{9800}{140} - (3.43)^2$

$= 58.24 \qquad = 7.631$

$= 7.6$

2. $= {}^{8}/_{150} + {}^{6}/_{150} + {}^{9}/_{300} + {}^{3}/_{300}$

$= {}^{40}/_{300} = {}^{2}/_{15}$

a) Construction of AB B1
Construction of BC B1
Construction of AC B1

b) Construction of bisect of AC B1
Construction of bisect BC B1
Radius 3.6 cm B1

c) Construction of bisect < CAB B1 OC B1
Construction of AD B1 AD = 12.8cm B1

3. a)

Class	f	x	d = A – x	fd	d^2	fd^2
41 – 50	20	45.5	15	300	225	4500
51 – 55	60	53	7.5	450	56.25	3375
56 – 65	60	60.5	0	0	0	0
66 – 70	50	68	-7.5	-375	56.25	2812.50
71 – 85	15	73	-12.5	187.5	156.25	2343.75
				∑fd 562.5		$\sum fd^2$ 13031.25

b) $S = \frac{\sum fd^2}{\sum f} - \frac{\sum fd}{\sum f}$

$S = \frac{13031.25}{205} - \frac{562.5}{205}$

$= 63.567 – 7.529$

$= 56.038$

$= 7.486$

4. $15 (ax)^4 (^{-2}/_{x^2}) = 4860$

$60a^4 = 4860$
$a^4 = 81$
$a = 3$

5.

Marks(x)	Freq.(f)	fx	d=x-x	d^2	Fd^2
5.5	1	5.5	-40.45	1636	1636
15.5	6	99	-30.45	927.2	5563
25.5	10	255	-20.45	418.2	4182
35.5	20	710	-10.45	109.2	2184
45.5	15	682.5	-0.45	0.2025	3038
55.5	5	277.5	9.55	91.20	456
65.6	14	917	19.55	382.2	535
75.5	5	377.5	29.55	873.2	4366
85.5	3	256.5	39.55	1564	4692

95.5	1	95.5	49.55	2455	2455
	$\sum f=80$	$\sum f99x=3676$			$\sum fx^2 33,923$

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{3676}{80}$$

$$= 45.95$$

(b) $Q1 = 30.5 + \frac{3}{14} \times 10$

$= 62.64$

S.I.R = ½ (62.64 -32)

$= 15.32$

(c) Standard deciation

$$= \frac{\sum fd^2}{\sum f} = \frac{33923}{80}$$

$= 20.59$

6. a) $x = 90 – (2 +13 + 51 + 27 + 14 + 1)$

$= 90 – 84 = 6$

b) 15 – 19

c) i)

Class	x	f	D= x-A	fd	D^2	Fd^2
5-9	7	2	-15	-30	225	450
10-14	12	13	-10	-130	100	1300
15-19	17	31	-5	-155	25	775
20-24	22	23	0	0	0	0
25-29	27	14	5	70	350	4900
30-34	32	6	10	60	600	3600
35-39	37	1	15	15	225	225

Ef = 90 Efd = 170 $Efd^2 = 11250$

$$\text{Mean} = \frac{E + d}{Ef} + A$$

$$= \frac{-170}{90} + 22$$

$= 22 – 1.888 = 20.11$

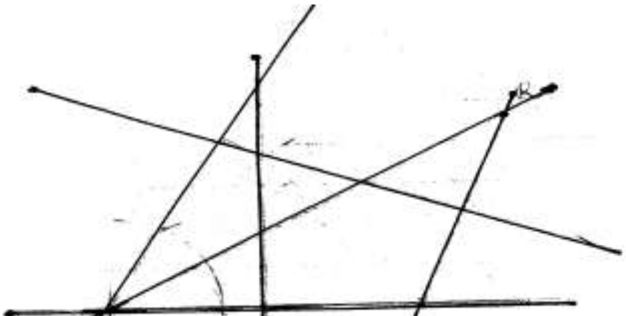
ii) $S.d = \sqrt{\frac{Efd}{Ef}} - [\frac{Efd}{Ef}]^2$

$= \sqrt{122} – (-1.888)^2$

$= \sqrt{125} – 3.566 \quad = \sqrt{121.4}$

$= 11.02$

7.



$RQ = 7.5 \pm 0.1$
$< PRQ\ 40° \pm 1$
B1 circle through P, Q and R

d) $r = 4.1 ° 0$
$A = \pi r^2$
${}^{22}/_{7} \times 4.1 \times 4.1 = 52.83$

8.

Class limits	f	cf
-0.5 – 19.5	7	7
19.5- 39.5	21	28
39.5 – 59.5	38	66
59.5 – 79.5	27	93
79.5 -= 99.5	7	100

i) from the curve – median = 52. M1 A1
(ii) Inter quartile range = 66-38 = 28.
(iii) 7th 7/10 = 62.46marks
(iv) 60th percentile – 56.34

9. $25^2 + 24^2 + 22^2 + 23^2 + x^2 + 262 + 21^2 + 23^2 + 22^2 + 27^2 = 5154$
$5.625 + 576 + 2(484) + 2(529) + 676 + 441 + 729 + x2 = 5154$
$X^2 = 81$
$X = 9$

-
(ii) $X = \frac{222}{10} = 22.2$

$^{-}\Sigma(X - x)^2 = 2.8^2 + 1.8^2 + 0.22 + 0.8^2$
$13.2^2 + 3.8^2 + 1.22 + 0.8^2 + 0.2^2 + 4.8^2$
$^{-}(x-x)^2 = 7.84 + 3.24\ 2(0.04) + 2(0.64)$
$+174.24 + 14.44 + 1.44 + 23.04$
$= \frac{225.6}{10}$
s.d 22.56
= 4.75

(b) (i) New mean = 22.2 + 3
= 25.2

(ii) s.d = 4.75

10. a) i) $x = A + \frac{\sum fd}{\sum f}$

$= 45.6 + \frac{(-74)}{40}$

$= 43.75$

Class	Mis-pt x	d = (x – A)	Frequency f	fd	Fd^2
1 – 10	5.5	-40.1	1	-40.1	1608.01
11 – 20	15.5	-30.1	3	-90.3	8154.05
21 – 30	25.5	-20.1	4	-80.4	6464.16
31 – 40	35.5	-10.1	7	-70.7	4998.49
41 – 50	45.5	-0.1	12	-1.2	1.44
51 – 60	55.5	9.9	9	89.1	7938.81
61 – 70	65.5	19.9	2	39.8	1584.04
71 – 80	75.5	29.9	1	29.9	894.01
81 – 90	85.5	39.9	0	0	0
91 – 100	95.5	49.9	1	49.9	2410.01

i) Standard Deviation

$$D = e \; \frac{\sum fd^2}{\sum f} - \left(\frac{\sum fd}{\sum f}\right)^2$$

$$= 10 \; \frac{34135.11}{40} - \left(\frac{-74}{40}\right)^2$$

$10 \times 29.1531 \qquad = 29.1531$

b) 30th student = 10th from bottom

$30.5 + \frac{10 - 8}{7}\, 10$

$= 30.5 + 2.9 \quad = \quad 33.4$ marks.

11. a) Mean $45.5 + \frac{530}{60}$

$= 54.33$

(b) Median $= 50.5 + \frac{30.5 - 23}{14}\; 10$

$= 55.86$

(c) Standard deviation = $\frac{2300}{60} - ^{2} \frac{530}{60}$

= 17.52

(d) Modal class 51 – 60

12.

x	f	d	d2	fd	fd2
24.5	4	-30	900	-120	3600
34.5	26	-20	400	-520	10400
44.5	72	-10	100	-720	7200
54.5	53	0	0	0	0
64.5	25	10	100	250	2500
74.5	9	20	400	180	3600
84.5	11	30	900	330	9900
	200			-600	37200

(a) (i) Mean = $A + \frac{\Sigma fd}{\Sigma f}$

$= 54.5 - \frac{600}{200}$

= 51.5

(ii) Standard deviation

$= \frac{\Sigma fd^2}{\Sigma f} - \frac{\Sigma fd^2}{\Sigma f}$

$= \frac{37200}{200} - (-3)^2$

= 186 – 9

= 13.30

(b) $Q_1 = 39.5 + \frac{50 - 30}{72} \times 10$

= 42.28

$Q_3 = 49.5 + \frac{150-102}{53} \times 10$

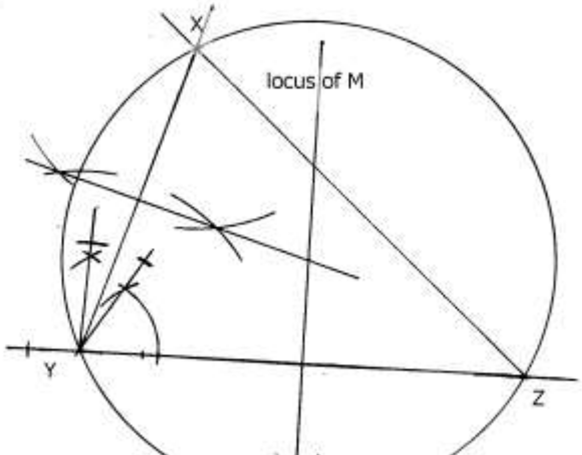
= 58.56

$Q_3 - Q1 = 58.56 - 42.28$

= 16.28

58. Loci

1.



√√Construction of ∠60° and ∠90°

Bisect ∠btw 90° and 60° to obtain ∠75°

√ Construction of the given sides

D

Construction of △ XYZ

(a)

(b) $\angle XYZ = 42^o \pm 1^o$

$XZ = 8.8 \pm 0.1$ *cm*

c) Bisecting any two sides

Drawing the circle

(d)Perpendicular bisector of YZ

Identification of locus of M

2. $AC = 8$ *cm* ± 0.1

$\angle ACB = 46^0 \pm 1^0$

3. *a)* $AC = 12.9 \pm 0.1$*cm*

b) i) Line and well shaded B2

c) $h = 7 \pm 0.1$

d) ΔABC _____ *Area* $= \frac{1}{2} \times 8 \times 7$*cm*

$= 28$*cm*

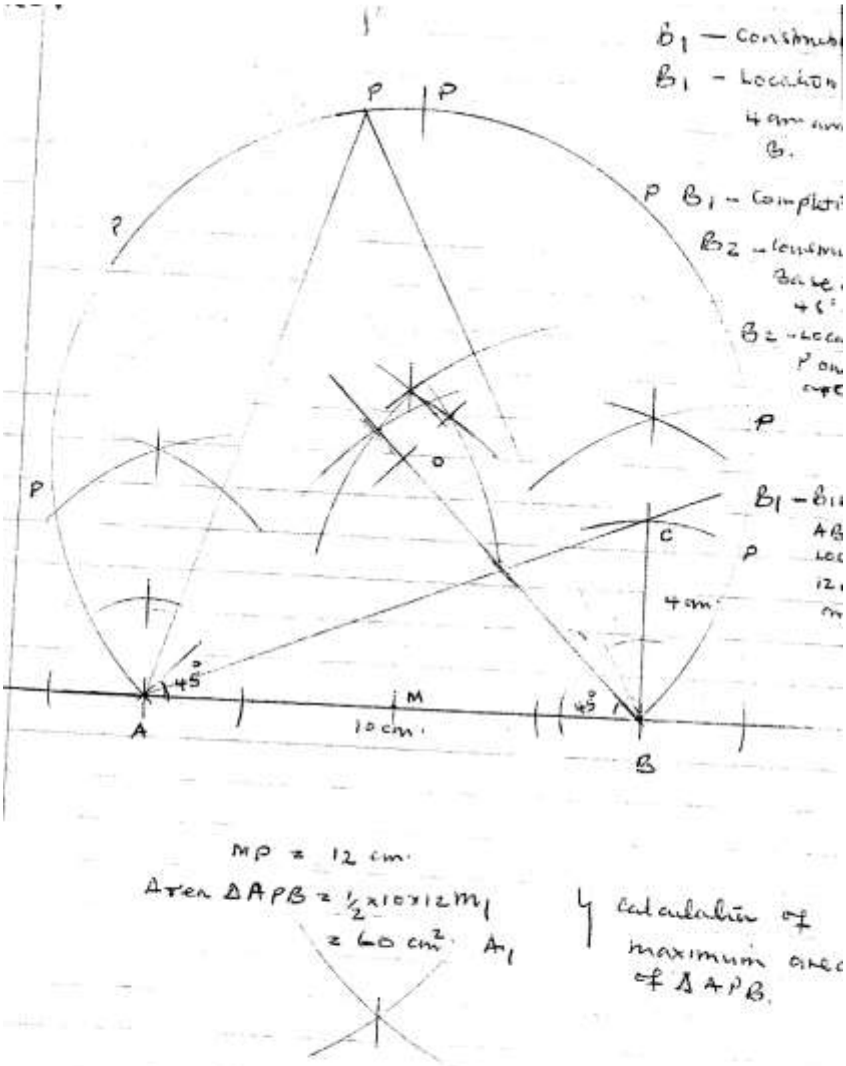
i.e. $\frac{3}{4} \times 28 =$ *Area for ARB*

$= 21$*cm*

i.e. $\frac{1}{2} \times 8 \times h = 21$

$h = 5.25$

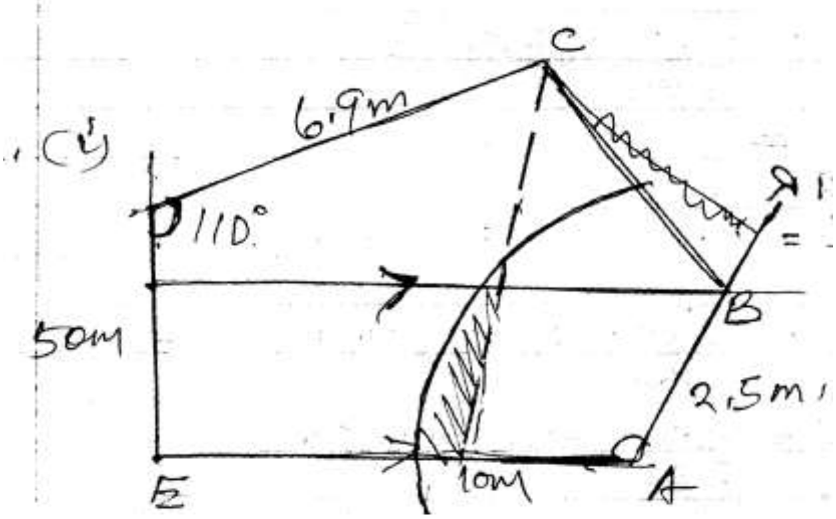
4.



- Constructing of 90^0
- Location of C 4 cm away from B.
Completing ⊿ ABC
Construction of Base angles 45^0.
Location of P on major arc APB
Bisecting AB to locate P 12 cm away
Calculation of maximum area of ⊿ AP
B. B1
B1

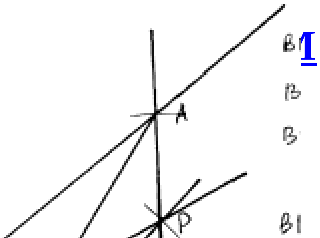
MP = 12 cm
Area ⊿ APB = ½ x 10 x 12 = 60 cm^2

5. *i)*



ii) Yes

6. *(a)*



b) < PQR = 26° + 1°
d) 4.9 + 0.1cm
e) AT = u = 8.7cm
f) <AQR = 37 + 1

7. *a) Δ ABC line AB = 7 cm and BC = 8 cm.*

Construction of ∡60^o

(b) AC = 7.6 ± 0.1 and

∡ ACB = 53 ± 1^o

(c) 2 sides bisector ⊥
Circle drawn radius 4.4. ± 0.1

(d) Bisect ∡ ACB

Bisection line to cut the circle to identify P

∡ PBC measure ≡

19

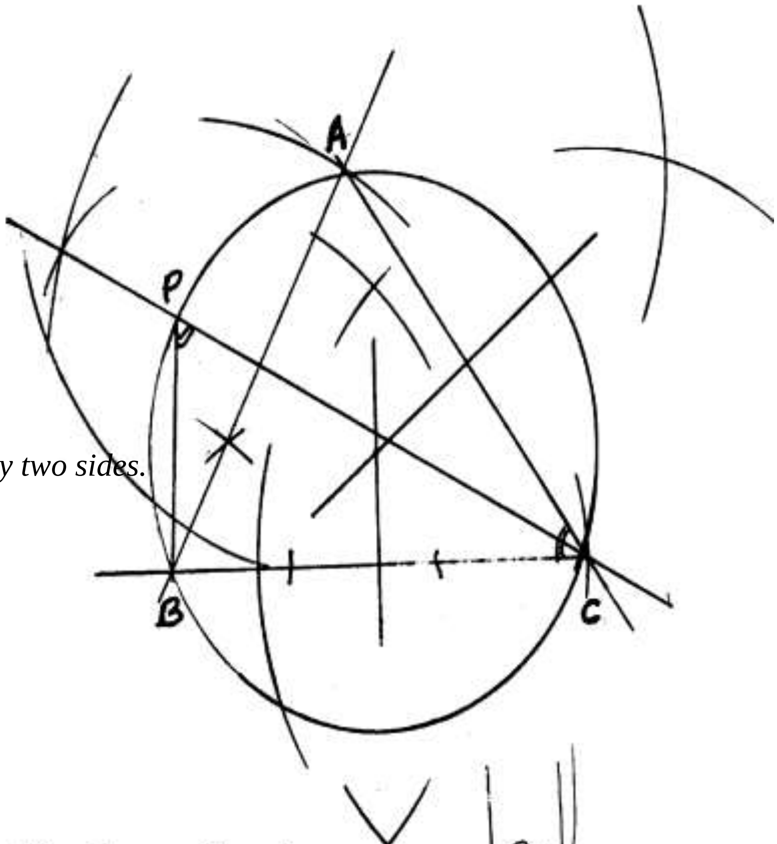
(a) AB = 7 cm, BC = 8 cm

∡ ABC = 60^o

(b) AC = 7.6 ± 0.1 cm

∡ ABC = 53^o±0.1

(c) Perpendicular bisectors of any two sides.
Circle drawn
Radius = 4.4.±0.1. cm



(d) $\measuredangle ACB$ bisected

Bisection line drawn to cut circle at P

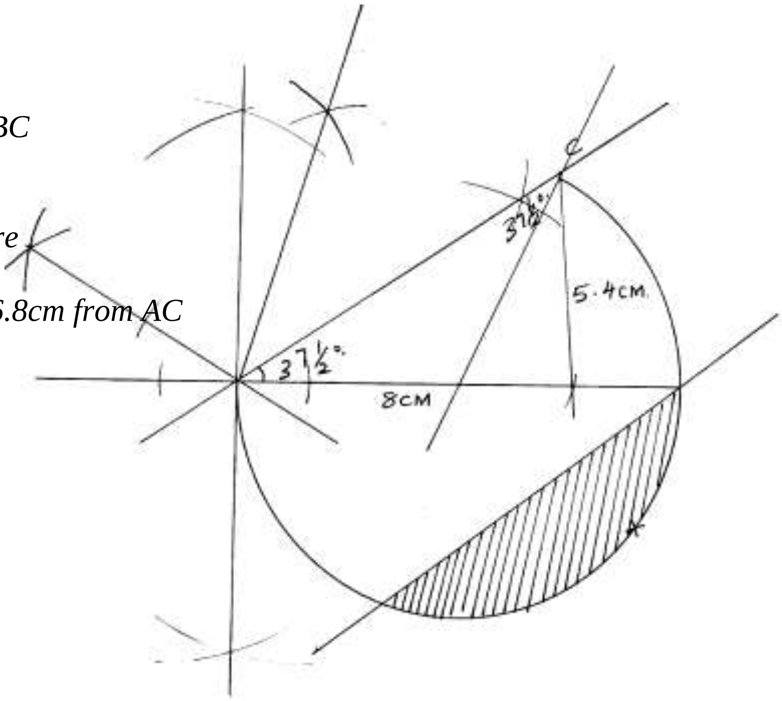
$\measuredangle BPC = \measuredangle BAC = 67^o$

$\measuredangle PBC = 88 \pm 0.1^o$

8. *B1 – Line AC*
B1Line AB
B1 AD
B3 – Drawing correct circle
B2- Tangent correctly drawn

9. a) *B1 for constructing 150°*
B1 for constructing 75°
B1 for completing triangle ABC
B1 for AC = 8.8 ± 0.1

(b) *(i) B1For locating locus centre*
B1 for locus of X
(ii) B1 for constructing arcs 6.8cm from AC
B1 for locus Y
(c)B2 for shading the locus of P

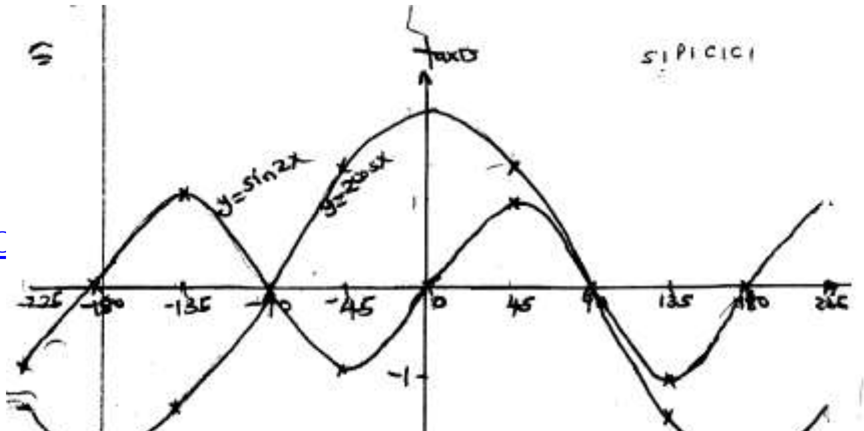


59. *Trigometric ratios 3*

1. a)

X°	*-225*	*-180*	*-135*	*-90*	*-45*	*0*	*45*	*90*	*135*	*180*	*225*
y = sin 2x		*0*		*0*	*1.0*		*1.0*	*0*		*0*	
y = 2cos x		*-2.0*		*0*	*1.4*		*1.4*	*0*		*-2.0*	

b)



(c) -90^o or 90^o

(d) (i) Highest point 1 unit

Lowest point - 1.4

2.

x	0	30	60	90	120	150	180	210
2sin(x+15^o)	0.52	1.41	1.93	1.93	1.41	0.52	-0.52	-1.41
Cos(2x -30^o)	0.87	0.87	0	-0.87	0.87	0	0.87	0.87

x	240	270	300	330	360
2sin(x+15^o)	-1.93	-1.93	-1.41	-0.52	0.52
Cos (2x -30^o)	0	-0.87	-0.87	0	0.87

B$_1$

B$_1$

B$_1$

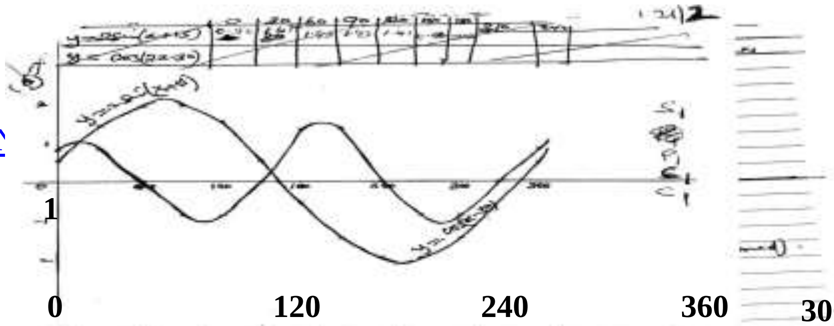
(i) Amplitudes:, y = 2 sin (x + 15)

= 2units

y = cos (2x – 30) B$_1$

=1unit B$_1$

12^o, 159^o



y =2sin(x + 15)

2

S$_1$

1

P$_1$

0 120 240 360 300 180 60 C$_1$

3. *Determine the*

i) Altitude of the frustrum

Solution

$A^1C^1 = \sqrt{4^2 + 4^2} = \sqrt{32} = 4\sqrt{2}$

$AC = \sqrt{10^2 + 10^2}$

$= \sqrt{200}$

$= 10\sqrt{2}$

$AM + XM = 10\sqrt{2} - 4\sqrt{2}$

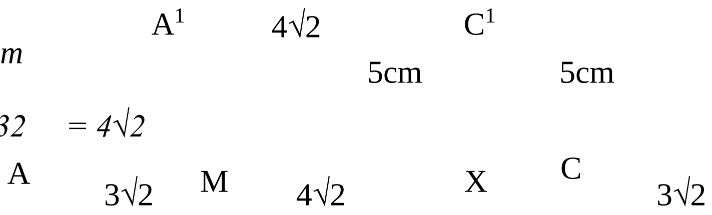
$= 6\sqrt{2}$

$AM = {}^{6\sqrt{2}}/_{2} = 3\sqrt{2}$

$Height = AM = \sqrt{5^2 - (3\sqrt{2})^2} = \sqrt{25 - 18}$

$= \sqrt{7} = 2.646$

$\therefore$ *the altitude of the frustrum = 2.646 cm*



ii) Angle between AC and the base ABCD

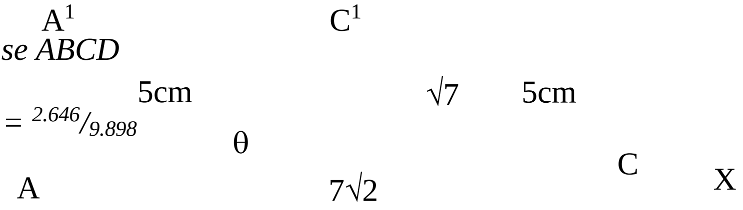
$AX = 3\sqrt{2} + 4\sqrt{2} = 7\sqrt{2}$

$Tan\ ø = {}^{CX}/_{AX} = {}^{\sqrt{7}}/_{7\sqrt{2}} = {}^{2.646}/_{9.898}$

$= 0.2673$

$\theta = tan^{-1}0.2673$

$= 14.96°$



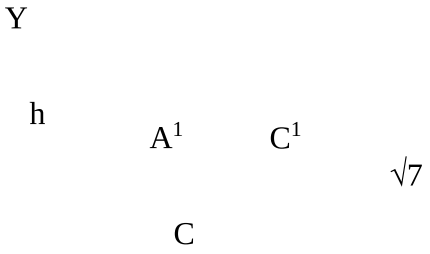
iii) Volume of pyramid = $^1/_3\,bh$

$AC = 10\sqrt{2}$

$A1C1 = 4\sqrt{2}$

$L.S.F = 10:4$

$\therefore \frac{h + 2.646}{h} = \frac{10}{4}$



$4(h + 2.646) = 10h$

$4h + 10.584 = 10h$

$6h = 10.584$

$h = 1.764$

$H = h + 2.646$

$= 1.764 + 2.646 \quad = 4.410$

$Vf = (^1/_3 \text{ x } 10 \text{ x } 10 \text{ x } 4.41) – (^1/_3 \text{ x } 4 \text{ x } 4 \text{ x } 1.76)$

$= {}^{441.0}/_3 \quad - \quad {}^{28.224}/_3$

$= {}^{413.776}/_3$

$= 137.592cm^3$

4. ✓(a) table completed

(b)

(c) (i) 3 P1 – pl✓otting

S1- ✓scale

C1 – smooth curv✓e

(ii) 180°

(iii) Line y = 1 drawn

$x = 4.5^o$ or 72.8^o ⁻ 107.2^o - 175.4^o

5. $(^A/_B)^2 = \dfrac{p + 33q}{q – 3P}$

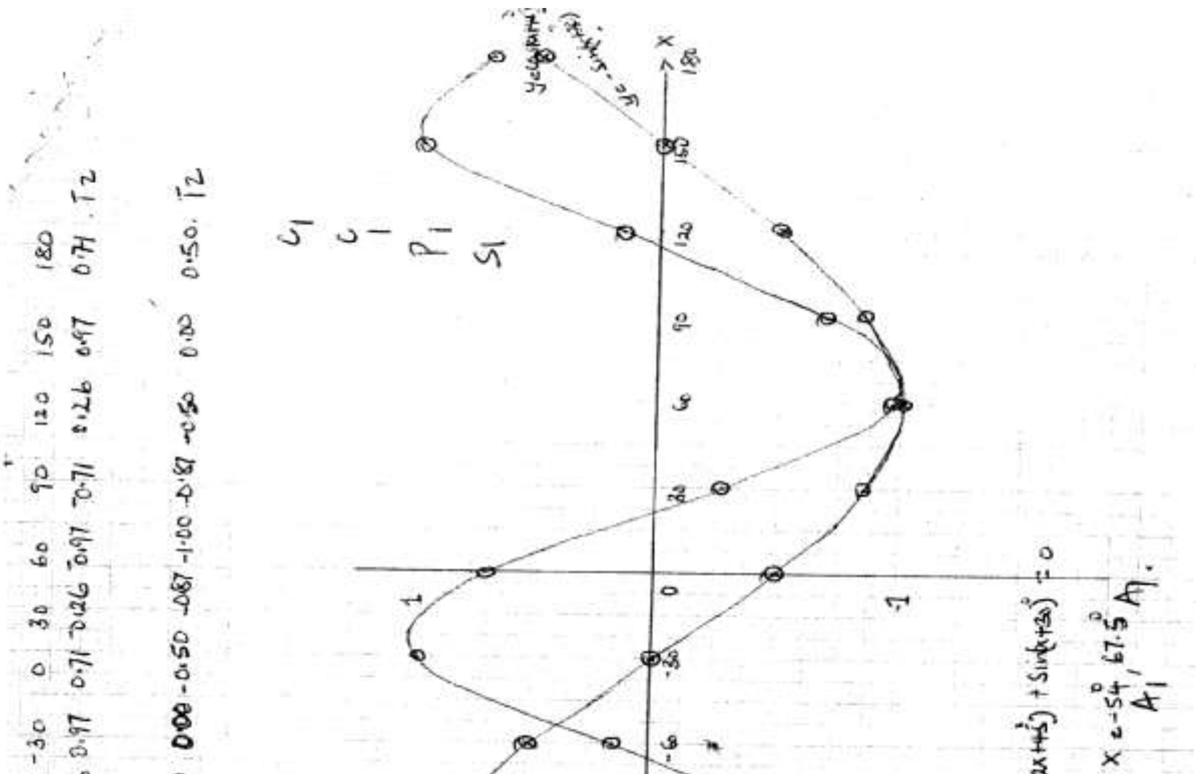
$A^2q – 3A^2P = BP + 3Bq$

$Aq^2 – 3Bq = BP + 3A^2P$

$2(A^2 – 3B) = BP + 3A^2P$

$Q = \dfrac{BP + 3A^2P}{A^2 – 3B}$

6.



-30	0	30	60	90	120	150	180	T2
0.97	0.71	-0.26	-0.97	-0.71	0.26	0.97	0.71	T2
0.00	-0.50	-0.87	-1.00	-0.87	-0.50	0.00	0.50	T2

7. 7. $\frac{\sqrt{3}}{2}$ x ½

$\frac{1}{\sqrt{3}}$ x $\frac{1}{\sqrt{2}}$

$\frac{\sqrt{3}}{4}$ x $\frac{\sqrt{6}}{1}$

$\frac{\sqrt{18}}{4}$

$\frac{3}{4}\sqrt{2}$

8. a)

x	0	30	60	90	120	150	180	210	240	270	300	330	360
3sinx		1.5			2.6	1.5					-2.6		0
2cos x	2			0	-1.0			-1.7		0			

(c) (i) Amplitude =3

(ii) $x = 36^o$

$x = 216^o$

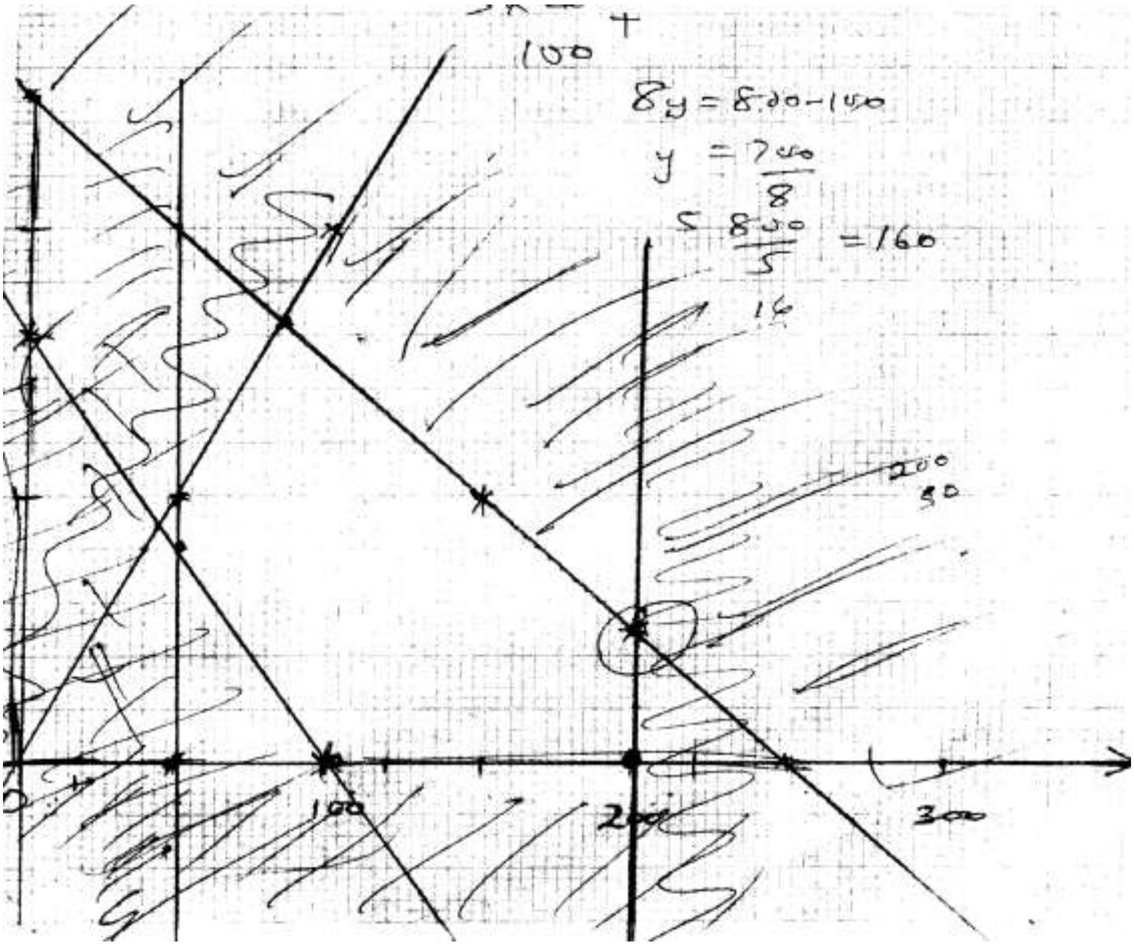
(iii) $33^o \leq x \leq 213^o$

9.

x	0	90	180	270	360	450	540	630	720	810
sin ½x	0	0.71	1	0.71	0	-0.71	-1	-0.71	0	0.71
3Sin (½x + 60)	2.6	2.9	1.5	-0.78	-2.6	2.9	-1.5	0.78	2.6	2.9

10.

x	0^o	30^o	60^o	90^o	120^o	150^o	180^o
2 sin x	0	1	1.73	2	1.73	1.00	0
1-Cos X	1	0.13	0.50	1	0.06	1.87	2



11. *Sin (x + 30) = 0.5*

x + 30 = 30°

x = 0

0, 180, 360

12. (c)$10\sin x = {}^{-1}/_{50} + 5$

$Y = {}^{-1}/_{50} + 5$

X	0	50
y	5	4

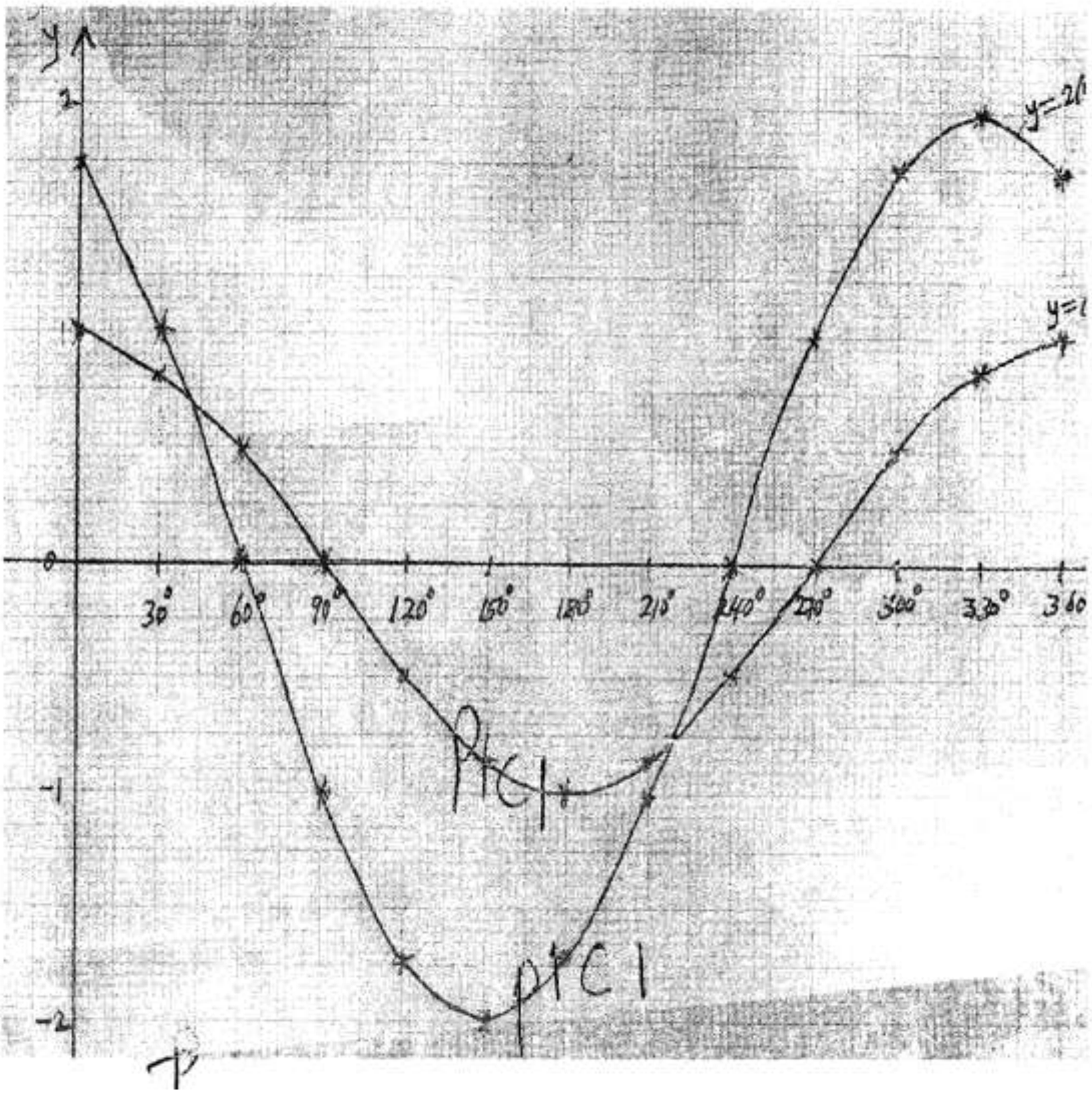
$X_1 = 28^o \pm 1$

$X_2 = 70^o \pm 1$

12.

23.

a)



b) *i) amplitude = 1*

ii) Period = 360°

iii) 45°, 219°

13. $2\theta + 10 = 210^o, 330^o, 570^o, 690^o$

$2\theta = 200, 320, 560, 680$

$= 100^o, 160^o, 280^o, 340^o$

$= \frac{5\pi^c}{90}, \frac{8\pi^c}{9}, \frac{14\pi^c}{9}, \frac{17\pi^c}{9}$

14. $4\sin 2x + 4\cos x - 5 = 0$

$4(1 - \cos 2X) + 4\cos x - 5 = 0$

$4\cos 2x - 4\cos x + 1 = 0$

$4\cos 2x - 2\cos x - 2\cos x + 1 = 0$

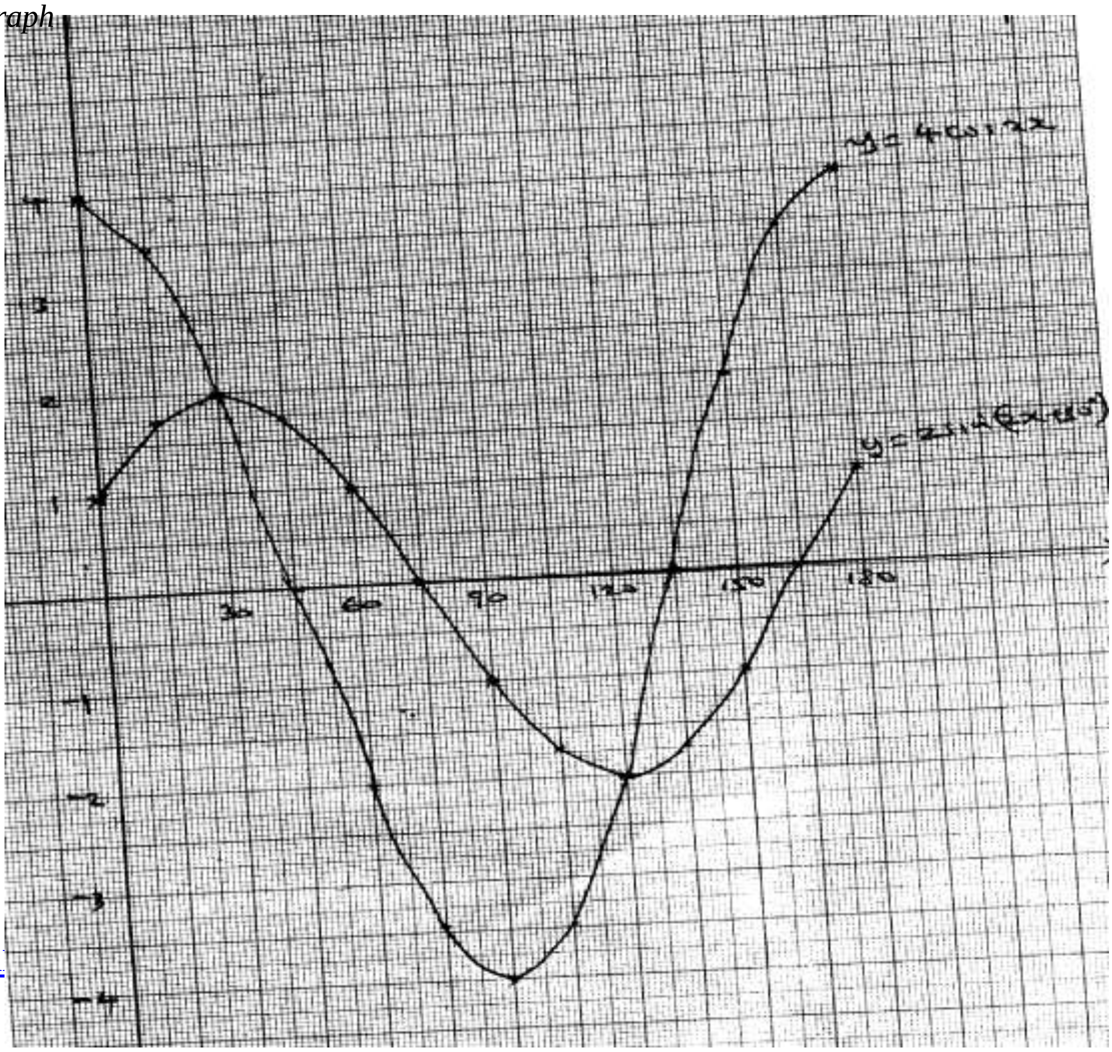
$(2\cos x - 1)2 = 0$

$X = 60°, 300°$

15.

x	15^o	60^o	150^o	165^o
4 Cos 2x	3.46			3.46
$2\sin(2x + 30^o)$		1.00	-1.00	

(b) graph



(c)(i) Amplitude = 4
(ii) period = 180^o

(d) $x = 30^o, 120^o$

60. Three dimensional geometry

1. *a)*

$QN = \sqrt{12^2 - 6^2}$
$= 10.39$

b) Q

$\sqrt{108}$

X b N

$QX = (\sqrt{108})^2 - 6^2$
$= \sqrt{72}$
$= 8.485$

c) Q

8.485

X θ T

$\tan \theta = \frac{8.485}{6}$

$\theta = 54.73^0$

d) $\tan \theta = \frac{6}{10}$

$\theta = 30.96$

$\frac{6}{10}$ obtuse $= 180^0 - 30.96$

$= 149.04^0$

2. a) $\sin 36^0 = \frac{5}{a}$

Where a is the side

$a = \frac{5}{\sin 36} = 8.507$

$h^2 = 18.2 – 8.507$

$= 258.87$

$H = 16.09$ cm

b) $\frac{1}{2} ab \sin \theta$

$\frac{1}{2} \times 8.507^2 \sin 72 \times 5$

$= 172.06 \text{ cm}^2$

c) $\tan 36^0 = \frac{5}{x}$

$x = 6.882$

$\tan \theta = \frac{16.09}{6.882}$

$\theta = 66.84^2$

d) $^1/_3 \times 172.06 \times 16.09 = 922.8\text{cm}^3$

e) S= 23.2

$23.2 (23.2 – 18.2) (23.2 - 10)$

$= 87.50\text{cm}^3$

3. (i) $\frac{1}{3} \times 4.2 \times 7.5h = 52.5$

$h = \frac{52.5 \times 3}{4.2 \times 7.5} = 5.0\text{cm}$

(ii) $AC = 4.2^2 + 7.5^2$

$= 17.64 + 56.25$

$= 73.89$

$= 8.596$

$AO = 8.596 \div 2 = 4.298$

$AV = AO^2 + OV^2$

$= 4.298^2 + 5^2$

$= 18.47 + 25$

$= 43.47$

$= 6.6\text{cm}$

(iii) $\tan\theta = \frac{4.298}{5}$

$= 0.8596$

$\theta = 40.68^o$

$\angle AVC = 40.68 \times 2$

$= 81.36$

Alternative

$\cos\theta = \frac{5}{6.6} = 0.7576$

$\theta = 40.749^o$C

$\angle AVO = 40.749^o$

$\angle AVC = 81.498^o$

(iv) $Cos\alpha = \frac{2.1}{6.6}$

$= 0.3182$

$\alpha = 71.45^o$ Acute angle

obtuse angle $= 180^o – 71.45^o$

$= 108.55^o$

4. (a)

$BD^2 = 122 + 52 = 144 + 25 = 169$

$BD = 169 = 13m$

(b) $AF^2 = 13^2 + 6.52 = 169 + 42.25$

$=211.25$ $AF= 211.25 = 14.53cm$ B1

$\tan\ \theta = \frac{6.5}{13} = 0.5$ M1

$\theta = 26.57^o$ A1

(c) $\tan\alpha^o = \frac{6.5}{5} = 1.3$ M1

$\alpha^o = 52.43$ A1

(d) $NC^2 = 2.5^2 + 12^2 = 150.25$

$NC = 150,25 = 12.26$ B1

12cm

$MC^2 = 6.52 + 150.25$

$= 42.75 + 150.25$

$= 192.5$

$MC = 192.5 = 13.87$ Ba

$\tan\ \beta^o\ \frac{6.5}{12.26} = 0.5302$

$\beta^o = 27.93^o$ B1

5.

i) Or = $16^2 - 5^2$

$= 256 – 25$

$= 15.198$ cm

ii) $\tan \theta = \frac{5.066}{4} = 1.2665$

$\therefore \theta 51.71^0$

6. a) Height

$AC = \sqrt{AB^2 + BC^2}$

$= \sqrt{10^2 + 10^2}$

$= \sqrt{200}$

$= 14.142$

θ 7.71

C

A

$\therefore OA = ½ AC = \frac{14.14^2}{2} = 7.71$

$OE = \sqrt{AE^2 - AO^2}$

5

$= \sqrt{64 - 59.44} = 4.56$

b)i) $\tan \theta = \frac{4.56}{5.00} = 0.912$

$\theta = 65.78°$

ii) $\tan \theta = \frac{4.56}{7.71} = 0.5914$

$\theta = 30.6°$

c)

8

$< AEC = 30.6 \times 2$

$= 61.2°$

7. Let length of cut off pyramid be meters

Then $\frac{7 + h}{H} = \frac{5.5}{2.1}$

$14.7 + 2.1h = 5.5$

$3.4h = 14.7$

$h = 4.3$

Slant height of big pyramid

$= \sqrt{11.3^2 + 2.75^2} = 11.6$

Slant height of the pyramid cut off

$= \sqrt{\ } 4.3^2 + 1.05^2 = 4.4m$

Area of EFCD $= ½ x11.6 \times 5.5 – ½ \times 4.4 \times 2.1$

$= 27.28\ m$

Total surface area $= 4 \times 27.28 + 2.1 \times 2.1 = 113.5$

b) ½ *litre paint* $10m^2$

4 *litres paints* $80m^2$

$\therefore 113.5m^2$ *requires 2 tins*

$2 \times 650 =$ Kshs.1300/=

8. (a) $PR = \ 12^2 + 9^2 \quad = 144 + 81 \quad = 225 \quad = 15cm$

$h = 19.52 – 7.52$

$= 380.25 – 56.25$

$= 324 \quad = 18$

(b) $\tan\theta = \frac{18}{7.5} = 2.4$

$\theta^2 \tan 2.4 \quad = 67.38^o$

(c) $\tan \alpha = \frac{6}{18} = \frac{1}{3}$

$\alpha = \tan^{-1} 0.3333$

$= 18.43^o$

$\therefore \angle x\ OY = 2 \times 18.43 = 36.86$

(d) Volume $= \underline{1} \times 12 \times 9 \times 18 \qquad 3$

$= 648cm^3$

9. a) $AC^2 = 12^2 + 12^2 = 288$

$\therefore AC = \sqrt{288} = 16.97$

$VO^2 = h^2 = 24^2 – \left(\frac{16.97}{2}\right)^2 = 504$

$h= \sqrt{504} = 22.45cm$

b) Base area $= 12x12 = 144cm$

$\therefore$Volume $= {}^1/_3 \times 144 \times 22.45$

$= 1077.6cm^3$

c) Slanting surface $= \sqrt{30(30-24)\ (30-24)\ (30-12)}$

$= 139.44cm^2$

Total curved S.A $= 139.44cm^2 \times 4 + 144cm^2$

$= 701.6cm^2$

10. (b)

D 6.4cm

O
E

A B

Vo V

72^o

6.4cm

θ 3.82cm 54^o 54^o B A A 10

$AO = \frac{4.5 x \sin 54^o}{Sin\ 72^o} = 3.82cm$

$= \cos^{-1} \frac{(3.82)}{6.4} = 53.35^o$

(c) $Vo = \sqrt{6.42 – 3.82}$

$= 5.13$

$VX = \sqrt{6.4^2 – 2.55^2}$

$= 5.99cm$

$\propto = Sin^{-1} ({}^{Vo}/_{Vx})\ Sin\text{-}1({}^{5.13}/_{5.99})$

$\propto = 58.91^o$

11. a) Longitude difference = 139 ° + 41 °

= 180 °

b) Distance along latitude = ${}^{\emptyset}/_{360} x\ 2\ \pi r \cos \theta$

$= {}^{180}/_{360}\ x\ 2\ x\ {}^{22}/_{7}\ x\ 6370 \cos 60°$

= 22 x 910 x 0.5

= 10,010 Km

Or via north pole (great circle)

Latitude difference = 60°

Distance = ${}^{60}/_{360}\ x\ 2\ x\ {}^{22}/_{7}\ x\ 6370$

= 6673.33 Km

c) Distance = ${}^{long\ diff}/_{360}\ x\ 2\pi R \cos 60°$

$420 = {}^{\emptyset}/_{360}\ x\ 2\ x\ {}^{22}/_{7}\ x\ 6370 \cos 60°$

$\theta = \frac{420\ x\ 360\ x\ 7}{2\ x\ 22\ x\ 6370 \cos 60°}$

= 7.552°

Longitude of C = 41° - 7.55° = 33.45°N

61. Longitudes and latitudes

1. $(70 – 25 \text{ x } 60 = 2700$
$2700 \text{ Cos } 47= 2700 \text{ x } 0.68 \quad = 1841.4\text{nm}$

2. (a) $\frac{22}{7} \text{ x } 6370 \text{ x } 2 \text{ x } \frac{\alpha}{360} = 1600$

$\alpha = 14.4^o$

Position $(4.4^o\text{N}, 60^o\text{E})$

(b) $72 \text{ x } 60 \cos 4.4^o$

$= 4307\text{nm}$

(c) $T = \frac{D}{S} = \frac{4307 \text{ x } 1.853}{800}$

$= 9.976 \text{ hrs}$

(d) Difference in longitude $= 72^o$

$15^o – 1\text{hr}$

$\therefore 72^o = \frac{72}{15} = 4.8\text{hrs} = 4\text{hrs } 48\text{mins behind}$

$$\begin{array}{r} 1300\text{hrs} \\ - \underline{448} \\ 8.12\text{a.m} \end{array}$$

3. a) $800x + 1600y \geq 8000$

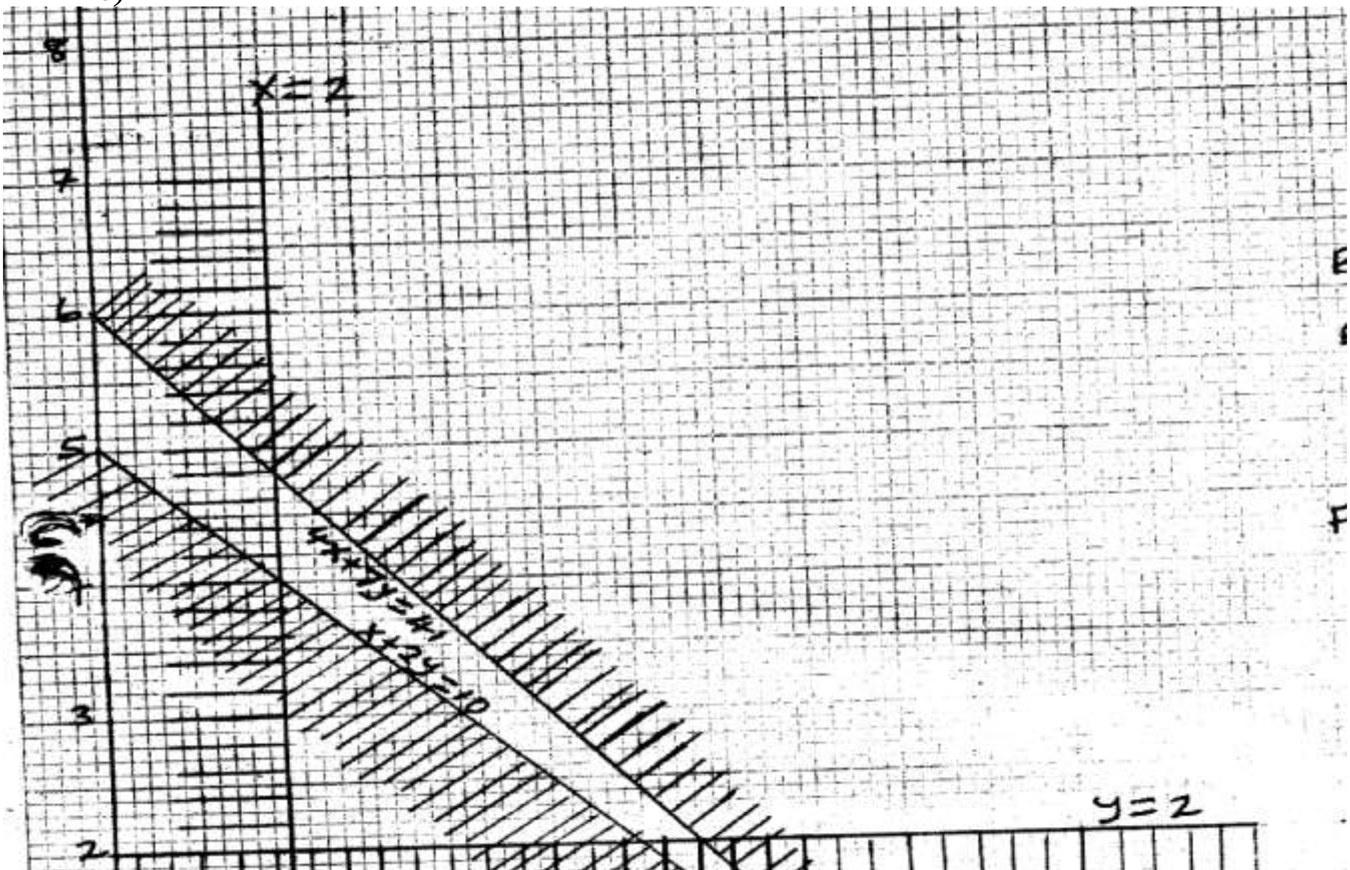
$x + 2y \geq 10$

$4x + 7y \leq 41$

$x \geq 2$

$y \geq 2$

b)



c) For type A = 3 and B = 4

No. of operators = (3x4) + (4x7)

4. a) $^{180}/_{300}$ x 2 x 22/7 x 6370 cos 48 = 13,396Km

b) Km = $\frac{(180 - 96)}{360}$ x 2 x $^{22}/_{7}$ x 6370

= $^{84}/_{360}$ x 2 x $^{22}/_{7}$ x 6370 = 9342.7 km

Time = $\frac{9342}{280}$ = 33.36 km/hr

c) θ = 180°

time = $\frac{(4 \times 180)}{60}$ = 12 hrs

(14:15 – 12:00) = 2:15a.m

d) $\frac{600}{60}$ Nm

60°

Q = (12N, 30W)

5. Long Difference = 24-12

= 12^o

12 x 60 Cos34^o = 596.9nm

S = $\frac{\text{“5.96”nm}}{1.5}$

= 397.9knots

6. (i) AB = $\frac{80}{360}$ x 2 x 3.142 x 25

= $\frac{4 \times 25}{9}$ x 3.142

= $\frac{314.2}{9}$ cm

$= 34.9111$ cm.

(ii) $\frac{\theta}{360} \times 2 \times 3.142 \times 25\cos 50^o = \frac{314.2}{9}$

$\theta = \frac{\frac{314.2}{9} \times 360}{50 \times 3.142 \times \cos 50}$

$= 93.35^o$

Longitude of BC$(93.35^o - 90^o)$E

$= 03.35^0$E.

(iii) $\frac{\theta}{360} \times 3.142 \times 50 = \frac{314.2}{9}$

$\theta = \frac{\frac{314.2}{9} \times 360}{3.142 \times 50}$

$= 80^o$

Latitude of B $(80^o - 50)$ S

$= 30^o$S

Position of B $\Rightarrow (30^o\text{S}, 03.35^o\text{E}$

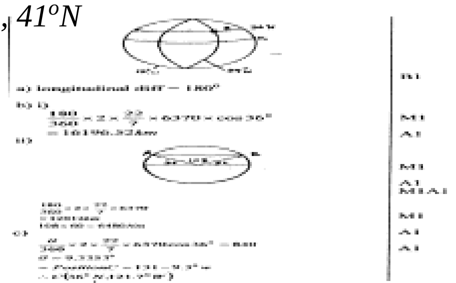
7. $2133.6 = \frac{x}{360} \times 2 \times \frac{22}{7} \times 6380 \cos 70^o$

$\propto = \frac{21.33 \times 6 \times 360 \times 7}{44 \times 6380 \times \cos 70^o}$

$\propto + 15^o = 56^o$

$= 56 - 15 = 41^o$N

$\therefore$Location of B is B$(70^o\text{S}, 41^o\text{N}$



8. (a) Longitudinal diff $= 180^o$

(b) (i) $^{180}/_{360} \times 2 \times {}^{22}/_7 \times 6370 \times \cos 360o$

$= 16196.52m$

(ii) $^{180}/_{360} \times 2 \times {}^{22}/_7 \times 6370$

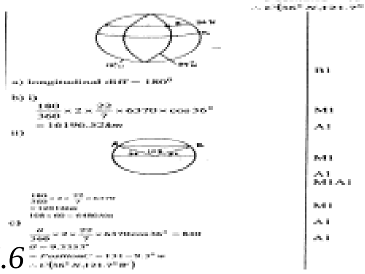
$= 12012km$

(c) $^{\theta}/_{360} \times 2\times {}^{22}/_7 \times 6370 \cos 36 = 840$

$= 9.3353^o$

$=$ position C $= 131\text{-}9.3^o$W

C$(36^o$ N, 121.7^oW)



9. a) PQ $= {}^{120}/_{360}\pi \times 6370 \times 2$

$= {}^{240}/_{360}\pi \times {}^{22}/_7 \times 6370 = 13,346.6$

b) 2PR cos 60 °

PR $= {}^{100}/_{360} \times 2\pi \times 6370 \cos 60$

$= {}^{200}/_{360} \times {}^{22}/_7 \times 6370 \cos 60 = 5561.1km$

c) $PN = {}^{30}/_{360}x2\ x\ {}^{22}/_{7}\ x\ 6370$
$= 3336.67\ km$

10. (a) (i) $60\ (z - 50) = 1200$
$Z = 20$
$Z = 70^oS$

(ii) $xy = \frac{48 \text{ x } 2 \text{ x } 6370 \cos 50}{360} = 3431.629km$

(b) (i) $XZ = \frac{3431.\ 627}{1.853} + 1200 = 3051.9km$
Time = $\frac{3051.9}{400} = 7.6hrs$

(b) (ii) tie = 7.36 + 4.28 = 12.04

11. a) A – B = 45 + 35 = 800 Lat. Diff
= 80 X 60 = 4800nm
B – C = 15 + 45 = 60 0 long. Diff
= (60 X 60 X cos 45
= 3600 X 0.7071 = 2545.56nm
Total distance = (4800 + 2525.56)nm
= 7345.56nm
≈7346nm (4.s.f)

$$b)\ \frac{\overset{2}{\cancel{80}}}{\underset{9}{\cancel{360}}} \text{ X } \frac{2}{1} \text{ X } \frac{22}{\cancel{7}} \text{ X } \underset{910}{\cancel{6370}}$$
$= \frac{88 \text{ x } 910}{9}$
$= 8897.78\ km$
≈ 8898km (to nearest km)

c) $B- C = \frac{\cancel{60}}{\cancel{360}} \text{X } 2 \text{ X } \frac{22}{\cancel{7}} \text{ X } \cancel{6370} \text{ X } \cos 45^0$
$= \frac{22 \text{ X } 910 \text{ X } 0.7071}{\cancel{6}\ \ 3}$
$= 471.8.7\ km^{3}$
A – C in Km = (8898 + 4718.70
=13616.7 KM
Time taken = $\frac{13616.7}{840}$ = 16.21 hours
= 16 hrs 13min
Arrival time$_{+}$= 08.15

$\underline{16.13}$
24.28
$= 12.28$ am followinmorning

62. Linear programming

1. $30x + 20y \leq 4800 \ldots\ldots(i)$
$30x + 40y \geq 3600 \ldots\ldots(ii)$
$10x \langle 30y \ldots\ldots\ldots(iii)$
$x \rangle 0 \quad y \rangle 0$

objective function $10x + 12y = K$

$3x + 2y = 480$ $3x + 4y = 360$ $x = 3y$

X	40	60	80		X	20	40	60		X	30	45	60
y	180	150	120		Y	75	60	45		Y	10	15	20

(ii) consider (60,40)
$10(60) + 12(40) = 600 + 480$
$= 1080$
$10x + 12y = 108\ 0$
$5x + 6y = 540$ – search line

X	20	40	60
y	73	57	40

Maximum profit at (α, 240)
No queen cake , 240 marble cakes

(iii) $240 \times 12 =$ sh. 2880

(iv) $10x + 12y \geq 600 \Rightarrow 10x + 12y = 600$
$5x + 6y = 300$

X	α	12	60
y	50	40	0

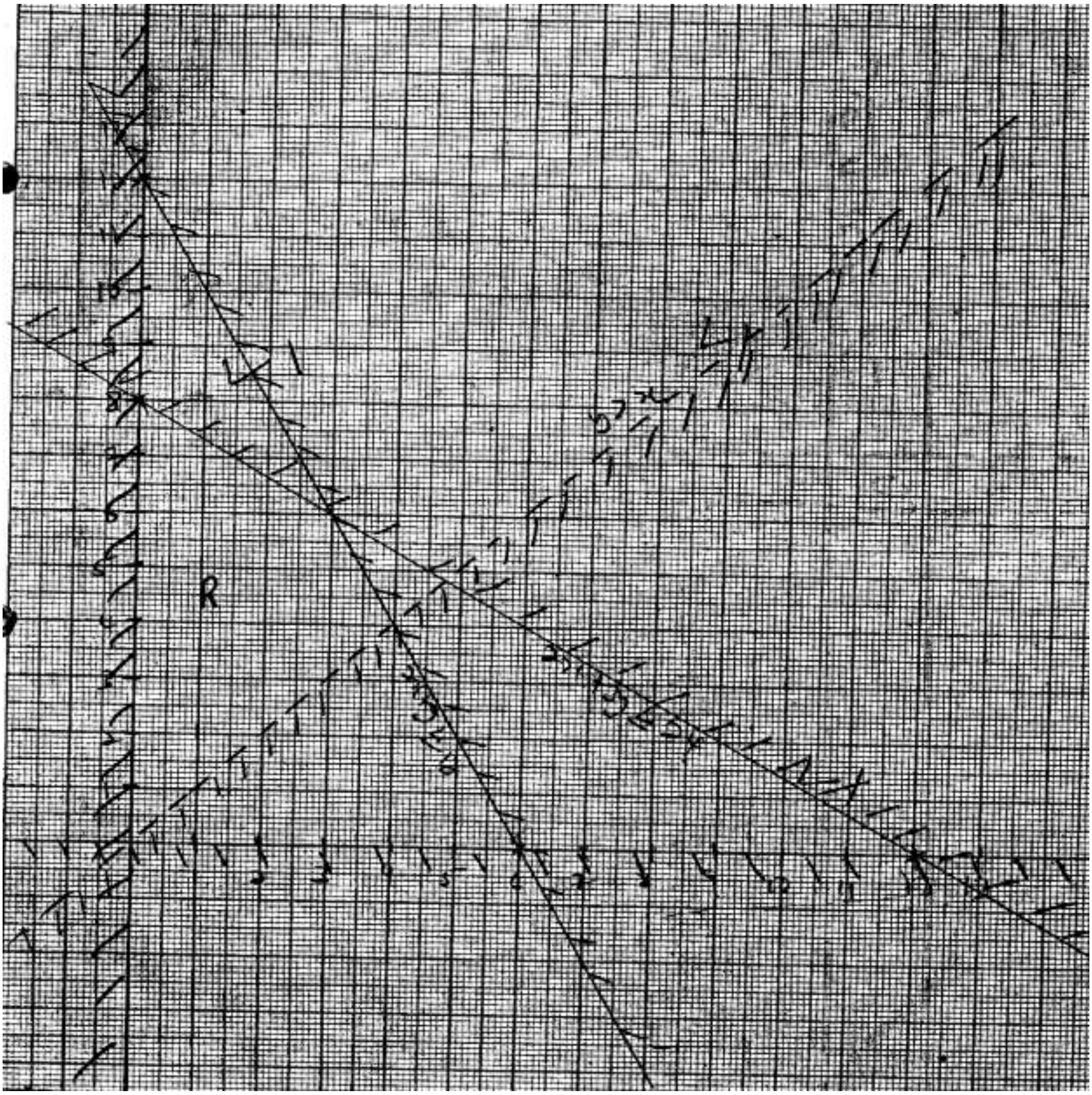
2.

Machine A		Machine B	
Shirts	Jerseys	Shirts	Jerseys
No. x	y	x	y
Hrs. @2hrs	@3hrs	@2hrs	@1hr

(i) $2x + 3y \leq 24$
(ii) $2x + y \leq 12$
(iii) $y > x$
(iv) $x > 0$
$y > 0$

Max pt(3,6)
Max profit = 22 x 3 + 200 x 6
= 600 + 1200
= Shs. 1800

(iii) y = x
(iv) y = 0
x = 0



3. (a) $3x + 7y \leq 210$

$x + y\ 20$

$x < 2y$

$x > 15$

(b) refer

(c) $120x + 140y = 120 \times 130 + 140 \times 10$

Profit = shs.5960

$x = 31$

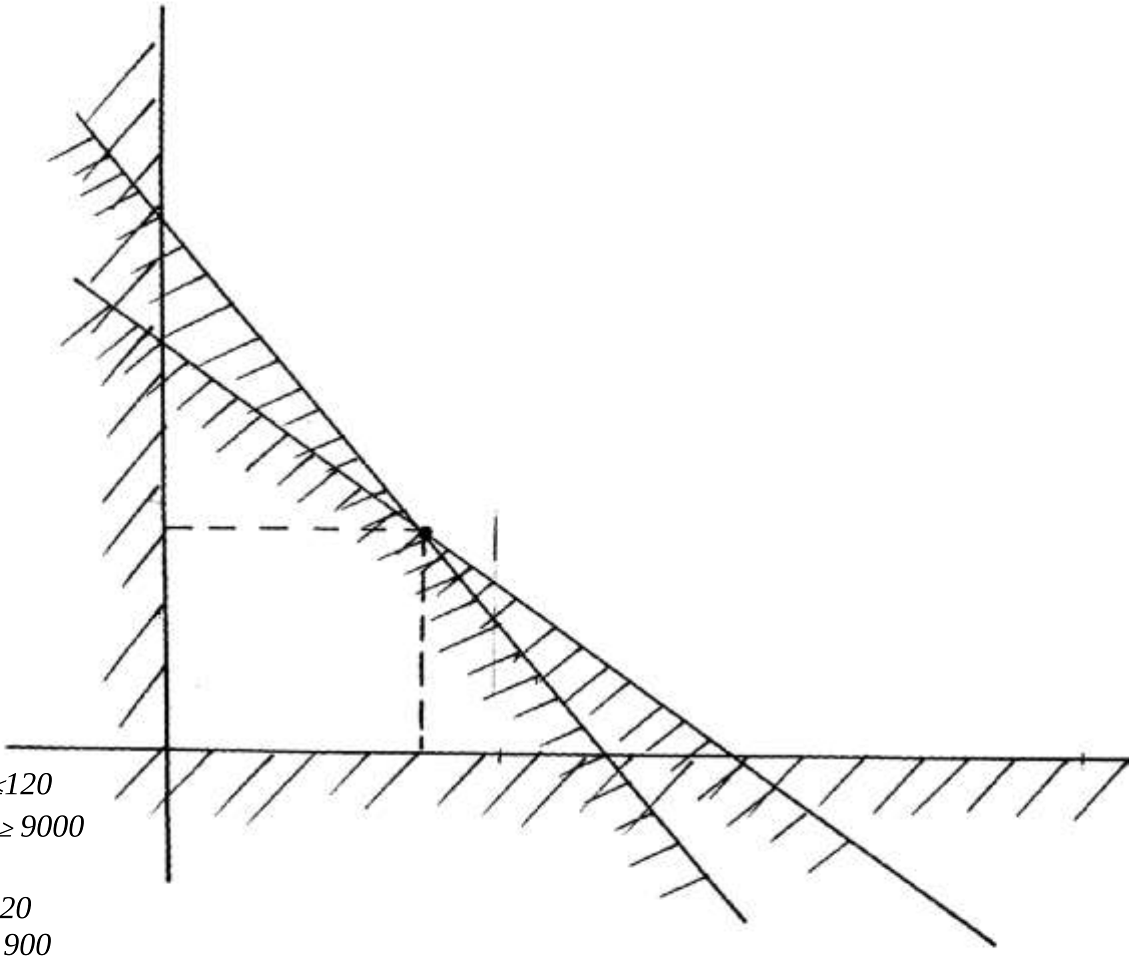
$y = 16$

4. Passengers

$64x + 48y \geq 384$ i.e. $8x + 6y \geq 48$

$x > 0$
$y > 0$
$x + y \geq 7$

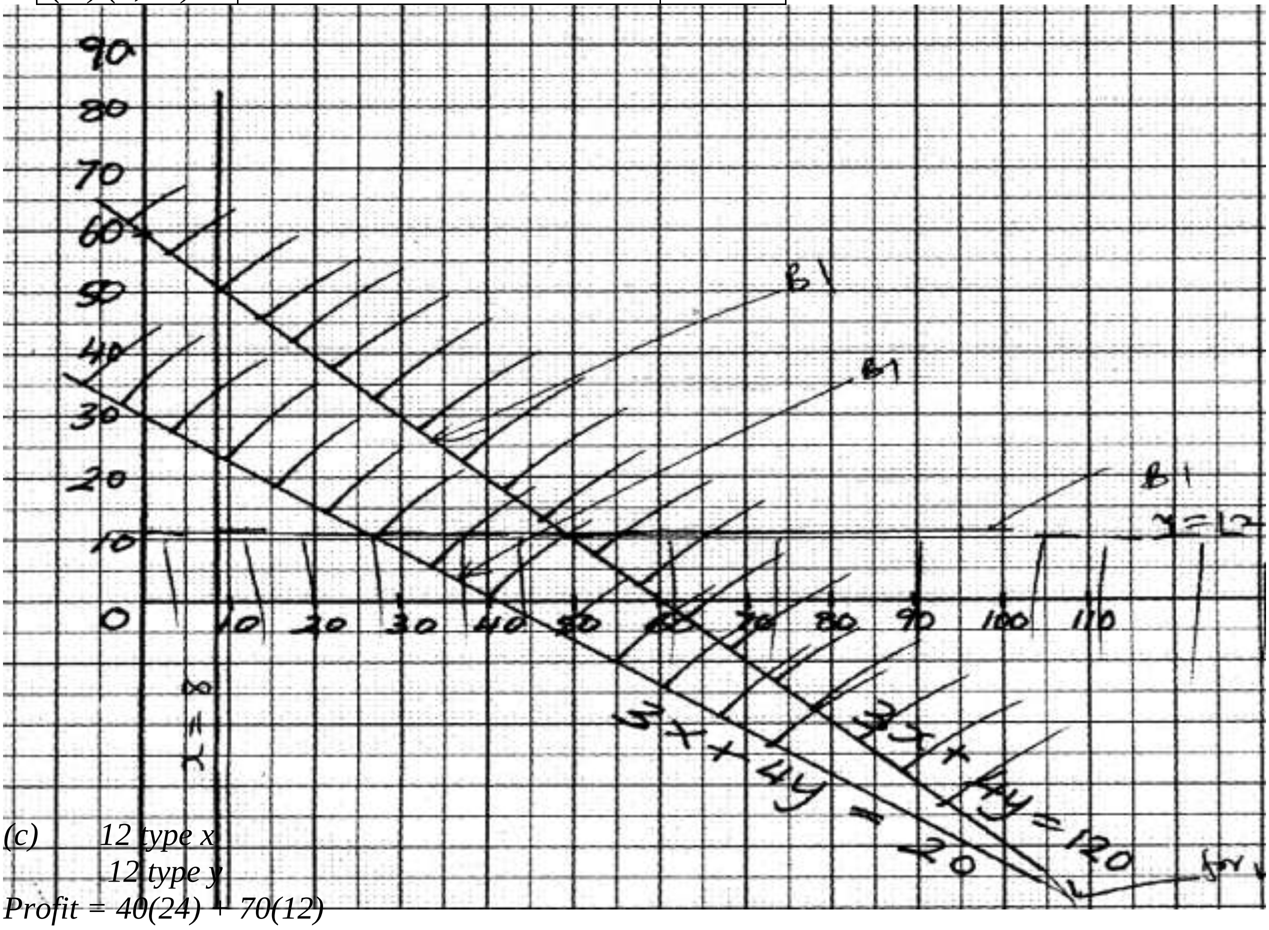
Cost equation
Total cost = $2500x + 20000y$
(3,4)
3 type x
4 type y



5. $3x + 4y \leq 120$
$400x + 150y \geq 9000$
$x \geq 8 \quad y > 12$
(b)(i) $3x + 4y\ 20$
(ii) $40x + 15y\ 900$
(iii) $x\ 8$
(iv) $y\ 12$

(table showing calculation of profit)

Points	Objective function 40x + 70y	Profit
(i) (8,24)	320 + 1680	2000
(ii) (24, 12)	960 + 840	1800
(iii) (8, 12)	320 + 840	1160



(c) 12 type x

12 type y

Profit = 40(24) + 70(12)

= 1800

6. 100 x = 160y = 16000

=100 x 200 + 160 x 50

20000 + 8000

28000/=

5 x 200 + 8 x 50

1000 + 4000

10 x 200 + 16 x 50=

10x + 16y = 1600

5x + 8y = 800

5 x 20 + 100

8y = 800 – 100

$y = \frac{\underline{700}}{8}$

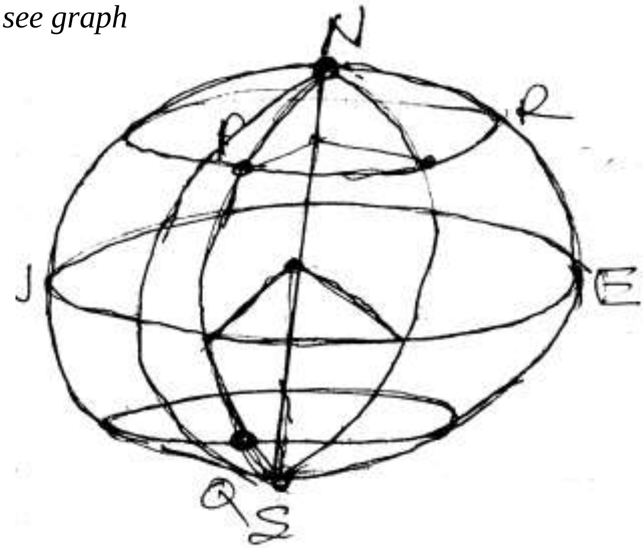
$^{800}/_{5} = 160$

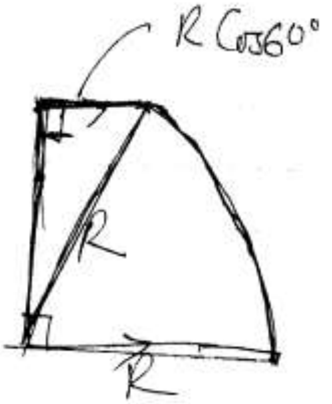
a) y<2x, 50≤x≤200 x >100

y >0, x+y ≤250, 100x + 160y ≥ 16000

b) See graph

c) see graph



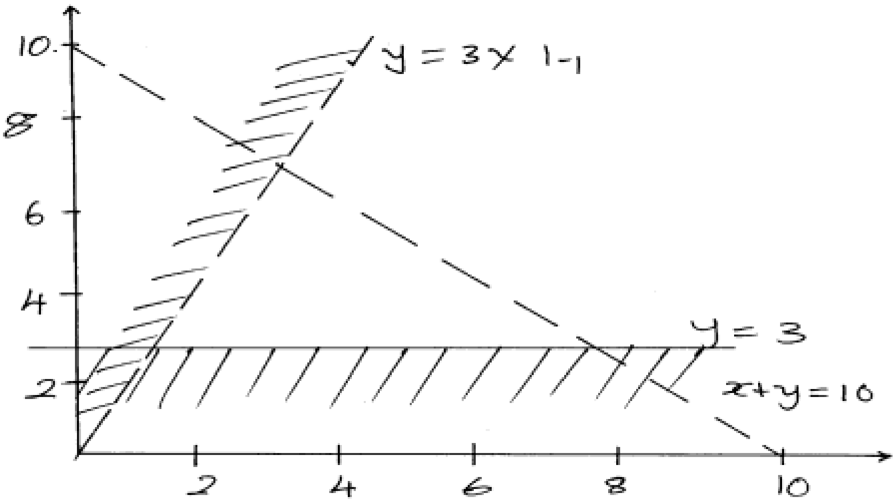


profit?

7. $x + y < 10$

$y < 3x$

$y > 3$



(c) Obejctive function 3x = 2y = I or use of serach line
5 packets of cups and 4packets of stucks

x	y	Profit
2	4	14
2	5	16
3	4	17
3	5	19
3	6	21
4	4	20
4	5	22
5	4	23

8. Panga – P, Jembe J

(a) $50P + 30J = 4260$

$50P + 15J = 1290$

$50P + 30J = 4260$

$\underline{10P + 30J = 1290}$

$40P = 1680$

$P = \frac{168}{4} = 42$

$50(42) + 30J = 4260$

$2100 + 30J = 4260$

$30J = 2160$

$J = \frac{(2160)}{30}$

$J = 72$

Wholesaler

$\frac{110}{100} \text{ x } 42 = \text{shs.}46.50 = \text{pangas}$

$\frac{85}{100} \text{ x } 72 = \text{shs } 60 = \text{jembes}$

For B

$50 \text{ x } 46.50 + 30 \text{ x } 61.2$

$2310 + 1836 = 4146$

Saving = 4260
4116
144

(b) Discount $5000 – 3500 = 1500$

% discount $= \frac{1500}{5000} \text{ x } 100$

$= 30\%$

9. a) $X \geq 0, y = \geq 0$

$10x + 20y \geq 120$

$4x + y \geq 20$

b) On the graph.

c) i) (4,4)

$4 \text{ x } 100 + 4 \text{ x } 300$

$400 + 1200 = 1600$

10. Distance Covered $= (3t^2 – 3t - 6)dt$

$= t^3 – {}^3/_2\, t^2 – 6t\ 4\ {}^4$

$$\begin{array}{c} \qquad\qquad\qquad\qquad\qquad 1 \\ 4^3 - \frac{3}{2}(4)^2 - 6(4) \quad - \quad 1^3 - 3(1)^2 - 6(1) \end{array}$$

$16 - {}^{-13}/_2 =$

63. Differentiation

1. $S = t^3 - 3t^2 + 2t$

(a) $V = \frac{ds}{dt} = 3t^2 - 6t + 2$

When $t = 2$

$V = 3(4) - 6(2) + 2$

$= 2m/s$

(b) At minimum velocity :

$\frac{dv}{dt} = 0$

$\frac{dv}{dt} = 6t - 6$

$6t - 6 = 0$

$t = 1$

Min-velocity $= 3(1)^2 - 6(1) + 2$

$= -1m/s$

(c) $3t^2 - 6t + 2 = 0$

$t = \frac{6 \pm \quad (-6) - 4(3)(2)}{6}$

$= \frac{6 \pm 5.2}{6}$

$t = 1.58$ or 0.4sec

(d) acc $= \frac{dv}{dt} = 6t - 6$

$a = 6(3) - 6 = 12m/s^2$

2. a)

X	2	5	8	10
y	5	26	65	101

b) $A = h(2 + 10 + 26 + 50 + 82)$

$= 2 \times 170$

$= 34$ square units

c) $A = (x^2 + 1)\, dx$

$= ({}^{1000}/_3 + 10) - 0$

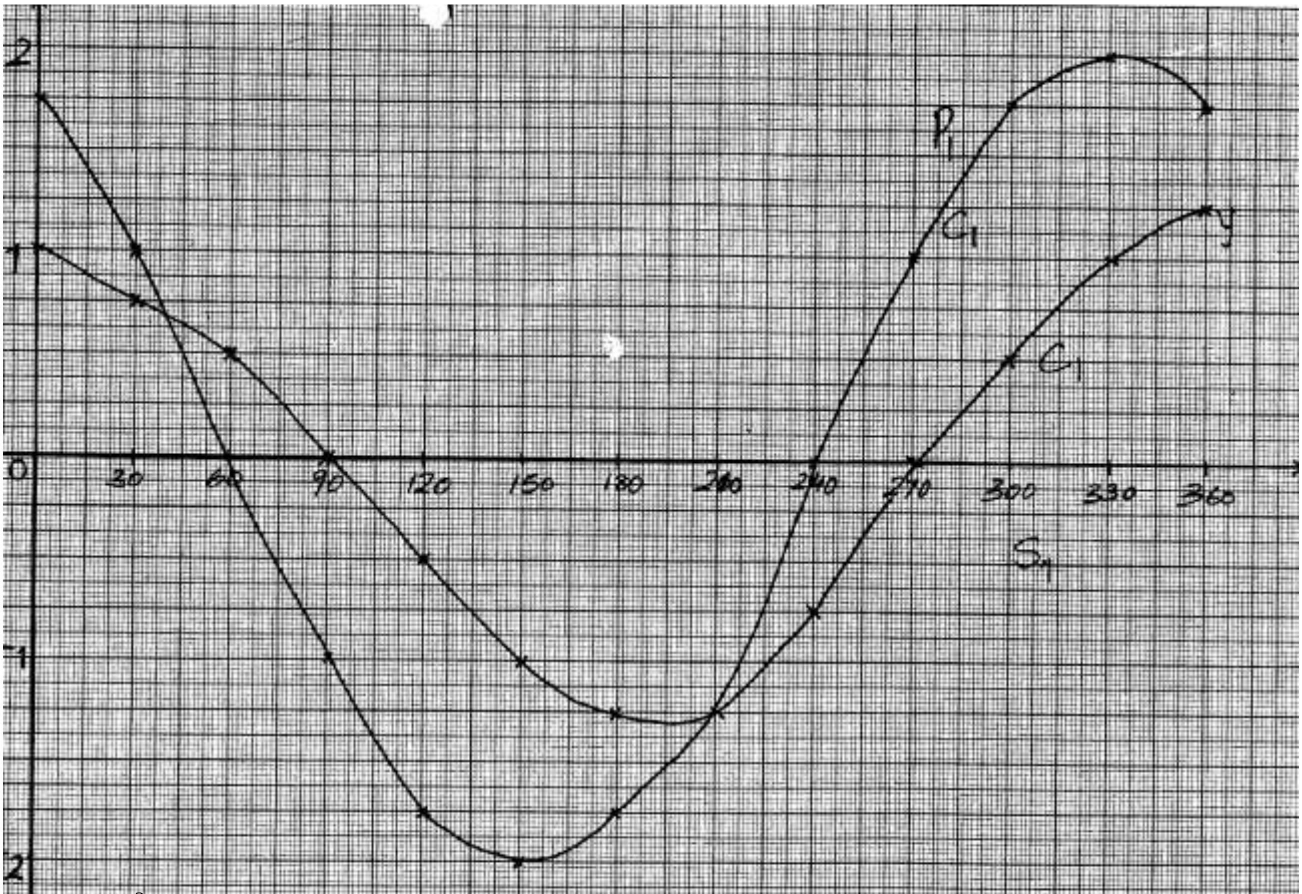
$= 333.33 + 10$

$= 343.33$

= 343.33 square units

d) Percentage error = $^{3.33}/_{343.33}$ *x 100 %*

= 0.97%



3. $y = \frac{2x^2}{2} + x + c$

$a + x = -4 , y = 6$

$6 = (-4)^2 – 4+c$

$c = -6$

$y = x^2 + x - 6$

4. a) $-2t^2 + t + 28 = 0$

$P = -56$

$S = 8, -7$

$-2t^2 + 8t – 7t + 28 = 0$

$-2t (t – 4) – 7(t – 4) = 0$

$t = 3.5$

$t = 4$

b) $AC = -4t + 1$

$- 4t + 1 = 0$

$T = ¼$

$V = -2(¼)2 + ¼ + 28$

$V = 28.125$

c) Acc = - 4t + 1
At rest t = 3.5, t = 4
Acc = -4 x 4 + 1
= $-15m/s^2$
At t = 3.5
A = $-13m/s^2$

d)(i) $D = \frac{2t^3}{3} + \frac{t^2}{2} + 28t + 5$

Distance = $-2 x 3^3/_3 + 3^2/_3 + 28 x 3 + 5 = 75.5m$

ii) $D = \frac{2t^3}{3} + \frac{t^2}{2} + 28t + 5$
$D = -2 x 3^3/_3 + 3^2/_3 + 28 x 3 + 5$
= -18 + 4.5 + 84 + 5
= 70.5 + 5 = 75.5

5. a i) $V = 15 + 4t - 3t^2$
$\frac{dv}{dt}$ = Acc = 4 – 6t

ii) $V = 15 + 4t - 3t^2$
$V = \frac{dv}{dt} = 15 + 4t - 3t^2$

∴ S = $(15 + 4t - 3t^2)$ dt

$S = 15t + \frac{4t^2}{2} - \frac{3t^2}{3} + C$

$S = 15t + 2t^2 - t^3 + C$

b) i) Acc = 0 hence $\frac{dv}{dt} = 0$
4 – 6t = 0
-6 = -4
t = $^2/_3$ sec.

ii) $S = {}^{^2/_3}_{0}\ 15t + 2t^2 - t^3 + C$

$= 15\ {}^2/_3 + 2\ {}^2/_3 - {}^2/_3\ {}^{3}\ \ {}^{2}$

$= \frac{10}{1} + \frac{8}{9} = \frac{8}{27}$

$= \frac{286}{27}$ = 10.5925 ≃ 10.59

c) Acc. $4 - 6t$

$-4 = -6t$

$t = {}^{2}/_{3}$ Acc.$= 0$

$\therefore$ Time is 0 and ${}^{2}/_{3}$

Bth. 0 and ${}^{2}/_{3}$ sec.

6. (a) $x^2 = -x2 + 8$

$2x^2 = 8$

$x = 2 \quad a = -2, \quad b = 2$

(b) Area of $\int_{-}^{2} x^2 = \left[\frac{x^3}{3}\right]_{-2}^{2}$

$= \frac{8 - {}^{-}8}{3}$

$= \frac{16}{3}$

Area $=(x^2 + 8)dx$

$= \frac{-x^3}{3} + 8x$

$= \frac{-80}{3} + 16 \quad - \frac{{}^{-}8}{3} - 16$

$\frac{80}{3} = 26\frac{2}{3}$

(c) Area $= \frac{80}{3} + \frac{16}{3} = \frac{96}{3}$

$= 32$

7. $a = \frac{d^2s}{dt^2} = \frac{d^2}{dt^2}(t^3 - \frac{5t^2}{2} + 2t + 5)$

$= \frac{d}{dt} = 3t^2 - 5t + 2$

$= 6t - 5$

If $a = 0$

$6t - 5 = 0$

$t = {}^{5}/_{6}$

$v = \frac{ds}{dt} = 3t^2 - 5t^2 = 3 \text{ x } \frac{25}{36} - 5 \text{ x } \frac{5}{6} + 2$

$= -\frac{1}{12}$ m/s

8. (a) $V = \quad 6t + 4 = 3t^2 + 4t + c$

$5 = 3(0)^2 + 4(0) + c$

$5 = c$

$V = 3t^2 + 4t + 5$

(b) $V = 3(4)^2 + 4\,(4) + 5$

$= 69\ m/s$

(c) (i) $\int 3t^2 + 4t + 5$

$= t^3 + 2t^2 + 5t + c$

When $t = 0$ $S = 0$

$S = t^3 + 2t^2 + 5t$

(ii) $S = t^3 + 2t^2 + 5t\Big|_{1}^{4}$

$= (4)^3 + 2\,(4)^2 + 5(4) - (1)^3 + 2(1)^3 + 5(1)$

$= 108\ m$

9. a) $S = 3t + \frac{3t^2}{2} - 2t^3$

$\frac{ds}{dt} = v = 3 + 3t - 6t^2$

$\frac{dv}{dt} = a = 3 - 12t \qquad t = 0$

$a = 3m/s^2$

b)i) $O = -6t^2 = 3t + 3$

$t = 1$

ii) $S = 3(1) + \frac{3\,(1)^2}{2} - 6(1)^3$

$= 3 + {}^3/_2 - 2$

$= {}^2/_2 + {}^3/_2 = {}^5/_2$

c) $V = 3 + 3(1) - 6\,(1)$

$= 3+3 - 6$

$= 0m/s$

10. $dy/dx = 12x2 - 4x - 3$ at $(2,23)$

$= 12(4) - 4(2) - 3$

$= 48 - 8 - 3$

$= 40 - 3$

$= 37$

$M = y - y$ or $y = mx + c$

$= \frac{23 - y}{2 - x}$

$23 - y = 37(2-x)$

$23 - y = 74-x$

$23 = 37\,(2) + c$

$C = 23 - 74 = -51$

Hence equation is $y = 37x - 5$

11.

(i) (180 x 30 x 2) = 10800
(60 x 30 x 2) = 3600
(180 x 60 x 1 = <u>10800</u>
Total area = 25200cm^2

(ii) Volume of the cuboid
= (180 x 60 x 30) cm^3= 324,000cm^3
Mass = (2.5 x 180 x 60x 30)
$= \frac{810000g}{1000}$
= 810kg
Volume of water = (324,000cm^3)
Mass of water $= \frac{(324{,}000 \times 1)}{1000}$
= 324kg
Mass of cuboid = 324 + 810
Full of water = 1,134kg

12. Let length of square cut off be x
Length of box = 8 – 2x
Width of box = 5 – 2x
Height of box = x

$V = (8 -2x) (5-2x)x$
$= 4x^3 - 26x^2 + 40x$
$\frac{dv}{dx} = 12x^2 - 52x + 40$
$12x^2 - 52 x + 40 = 0$
$3x^2 - 13x + 10 = 0$
$3x^2 - 10x - 3x + 10 = 0$
$X(3x -10) - 1 (3x-10) = 0$
$(x -1) (3x -10) = 0$
$x = 1$ $x = {}^{10}/_{3}$

${}^{d2}/_{dx2} = 24x - 52$

$x = 1$

$^{d2}/_{dx2} = 24x - 52 = -28$

maximum

$x = 1$cm gives maximum vol

$(8-2)\ (5-2)\ X\ 1 = 6 \times 3$

$= 18cm^3$

13. a) $\frac{dy}{dx} = 3x^2 - 2$

Gradient of the tangent is 1 so, gradient of the normal is -1

$\frac{y - ^-2}{x - 1} = \frac{-1}{1}$

$\frac{y + 2}{x - 1} = \frac{-1}{1}$

$y = -x - 1$

(b) $dy = 3x^2 - 3 = 0$

$3x^2 - 1) = 0$

$(x-1) = 0$

$x = 1, y = 0$ & $x = -1, y = 4$

Coordinates of turning points

(1,0) and (-1, 4)

For (1,0) $x < 1$, $\frac{dy}{dx}$ is –ve

$x > 1$, $\frac{dy}{dx}$ is +ve

(1,0) is a minimum point for (-1, 4) $x < -1$, $\frac{dy}{dx}$ is +ve

(1, 0) is a minimum point for (-1, 4) $x < -1$, $\frac{dy}{dx}$ is +ve

$x > -1$, $\frac{dy}{dx}$ is –ve

⇒ (-1, 4) is a maximum point

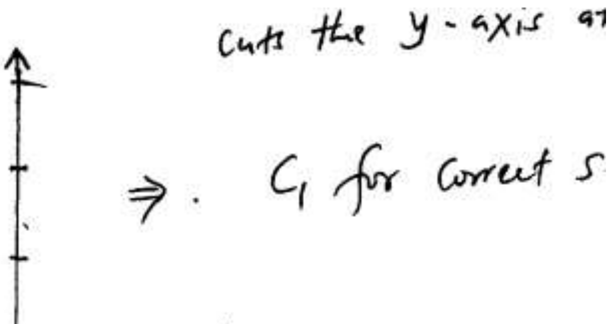
To sketch the curve we

(i) Its turning points and their nature

(ii) The points the graph cuts the x and y axis i.e the x and y-intercepts

(b) ⇒Indicating that the curve turns at (-1, 4) (1, 0) and cuts the y-axis at (0, 2) B_1

⇒C_1 for correct sketch



14. a) $-2t^2 + t + 28 = 0$
$t^2 - t - 28 = 0$
$2t^2 - 8t) + (7t - 28) = 0$
$+ (t-4) + 7(t-4) = 0$
$t + 7) (t-4) = 0$
$t = -3.5$ or 4
p.B at rest at $t = 4$seconds

(b) $a = 1-4t$
$1 - 4t = 0$
$0.25s = t$
$V = 28 + 25 - 2\,(0.25)^2$
$= 28.25 - 0.125$
$V = 28.125m/s$

(c) (i) $S = 28t + \frac{t^2}{2} - \frac{2t^3}{3} + C$
when $t = 0, s = 0$
$\therefore S = 28t + t2 - 2t$

PB at rest after 4s
$\therefore S = 28 \text{ x } 4 \text{ x } 42 - \frac{2}{3} \text{ x } 4^3$
$= 112 + 8 - 42.667$
$= 120 - 42.6667 = 77.33m$

15. $S = t^3 - 3t^2 + 2t$
(a) $V = \frac{ds}{dt} = 3t^2 - 6t + 2$
When $t = 2$
$V = 3(4) - 6(2) + 2$
$= 2m/s$

(b) At minimum velocity :
$\frac{dv}{dt} = 0$

$\frac{dv}{dt} = 6t - 6$

$6t - 6 = 0$

$t = 1$

Min-velocity $= 3(1)^2 - 6(1) + 2$

$= -1m/s$

(c) $3t^2 - 6t + 2 = 0$

$t = \frac{6\pm \quad (-6) - 4\,(3)\,(2)}{6}$

$= \frac{6 \pm 5.2}{6}$

$t = 1.58$ or $0.4sec$

(d) acc $= \frac{dv}{dt} = 6t - 6$

$a = 6(3) - 6 = 12m/s^2$

60. Approximation of area

1 $h = \frac{3 - -1}{5} = \frac{4}{5} = 0.8$

x	-1	-0.2	0.6	1.4	2.2	3
y	5	7.56	8.84	8.84	7.56	5

$A = 0.8\ (5 + 5\ ) + 2\ (\ 7.56 + 8.84 + 8.84 + 7.56)$

$= 0.4 \quad 10 + 2\ (32.8)$

$= 0.4 \text{ x } 75.6$

$= 30.24$ sq. units

2. $y_o = 0$

$y_1 = 2.5$

$y_2 = 6$

$y_3 = 10.5$

$y_4 = 16$

$y_5 = 22.5$

$y_6 = 30$

$A = ½ \text{ x } 1(0+30) + 2(2.5 + 6 + 10.5 + 16 + 22.5)$

$= ½ \text{ x } 145 = 72.5$

(b) $½\, x^2 - 2 = \frac{x^3}{6} - x$

$= \frac{8^3}{6} - 8 - \quad \frac{2^3}{6} - 2$

$= 77.33 - -0.67$

$= 78$ square units

(c) % error $= \frac{72.5 - 78}{78} \times 100$

$= -7.05\%$

3 $y_o = 0$
$y_1 = 2.5$
$y_2 = 6$
$y_3 = 10.5$
$y_4 = 16$
$y_5 = 22.5$
$y_6 = 30$
$A = \frac{1}{2} \times 1(0+30) + 2(2.5 + 6 + 10.5 + 16 + 22.5)$
$= \frac{1}{2} \times 145$
$= 72.5$

(b) $\frac{1}{2}x^2 - 2 = \frac{x^3}{6} - x$

$= \frac{8^3}{6} - 8 - \frac{2^3}{6} - 2$

$= 77.33 - -0.67$
$= 78$ square units

(c) % error $= \frac{72.5 - 78}{78} \times 100$

$= -7.05\%$

4 a) $-2x^2 + 3x + 4 = 2x + 3$
$-2x^2 + x + 1 = 0$
$-2x^2 + 2x - x + 1 = 0$
$(x-1)(-2x-) = 0$
$x = 1$ or $x = -\frac{1}{2}$
when $x = 1$ $y = 2 \times 1 + 3 = 5$
$Q(1, 5)$
(b) $-2x^2 + 3x + 4)dx - (2x+3)dx$

5. a)

X	-5.5	-5	-4.25	-3.75
y	16.25	12	6.56	3.56

b) $A = 0.5\,(18.56 + 14.06 + 10.06 + 6.56 + 3.56 + 1.06)$
$= 0.5 \times 53.86 = 26.93$

c) i) $\int x^1 + 2x - 3$

$[x^3 + x^2 - 3x]^{-3}$

3
= [$\underline{(-3)}^{3}$ + $(-3)^{2}$ – 3(-3)]
3
= 9 + 18= 27 square units
ii) $\underline{27 – 26.93}$ X 100
27
= 0.25925 % = 0.2593 %

6

x	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
y	18	28.25	41	56.25	74	94.25	117	142.25	170	200.25	233

∴ Area = ½ n (y$_0$ + y$_n$) + 2(y$_1$ + ………… y$_n$ - 1

= ½ (1) (18 + 233) + 2(41 + 74 + 55 + 170)

= ½ 251 + 2(340)
= ½ (251 + 680)
= ½ (831)
= 415.5 sq. units.

65. Integration

1. $S_{10} = 100$
$\int_2^5 \underline{(x-1)\ (x-2)}\ dx$
x – 2
= $\int_2^5 x – 1dx$
= [$^{x2}/_2$ - x $]_2^5$

2.
$\int(x^2 + 1)\ dx = 2a$

a
$\underline{x^3}$ + $\underline{x}$ = 2a
3 1

$\underline{a}^3$+ $\underline{a}$ – 0 =2a
3 1
a^3 + 3a= 6a
a^3 = 3a

$(a^3 - 3a) = 0$
$a(a^2 - 3) = 0$
$a = 0$
$or\ 3 = \pm 1.732$