

No.	WORKING																															
1	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>No.</th> <th>Log</th> <th></th> </tr> </thead> <tbody> <tr> <td>0.52</td> <td>7.7160</td> <td></td> </tr> <tr> <td>0.312</td> <td>7.4942</td> <td></td> </tr> <tr> <td></td> <td>7.2102</td> <td>→ 7.2102</td> </tr> <tr> <td><math>2 \cdot 12^2</math></td> <td><math>(0.3263) \times 2</math></td> <td>→ 0.6526</td> </tr> <tr> <td></td> <td></td> <td><math>(2.5576) \div 2</math></td> </tr> <tr> <td></td> <td></td> <td><math>\frac{3 + 1.5576}{3}</math></td> </tr> <tr> <td></td> <td></td> <td><math>\frac{4}{3} + 0.5192</math></td> </tr> <tr> <td></td> <td></td> <td><math>10^{0.5192 - 1} \times 10 \Rightarrow 3.305 \times 10^{-1}</math></td> </tr> <tr> <td></td> <td></td> <td><math>\Rightarrow 0.3305</math></td> </tr> </tbody> </table>	No.	Log		0.52	7.7160		0.312	7.4942			7.2102	→ 7.2102	$2 \cdot 12^2$	$(0.3263) \times 2$	→ 0.6526			$(2.5576) \div 2$			$\frac{3 + 1.5576}{3}$			$\frac{4}{3} + 0.5192$			$10^{0.5192 - 1} \times 10 \Rightarrow 3.305 \times 10^{-1}$			$\Rightarrow 0.3305$	<p>M1 Log</p> <p>M1 (Add &amp; sub)</p> <p>M1 (Div)</p> <p>A1</p>
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2.	<p>Mass of acid = <math>200 \text{ cm}^3 \times 1.08 \text{ g/cm}^3</math>  <math>= 216 \text{ g}</math>.</p> <p>Mass of alcohol = <math>300 \text{ cm}^3 \times 0.8 \text{ g/cm}^3</math>  <math>= 240 \text{ g}</math>.</p> <p>Total Volume of the mixture = <math>200 + 300</math>  <math>= 500 \text{ cm}^3</math></p> <p>Density of the mixture = <math>\frac{\text{Total Mass}}{\text{Total Volume}}</math>  <math>= \frac{216 \text{ g} + 240 \text{ g}}{500 \text{ cm}^3}</math>  <math>= \frac{456 \text{ g}}{500 \text{ cm}^3}</math>  <math>= 0.912 \text{ g/cm}^3</math></p>	<p>M1</p> <p>M1</p> <p>M1</p>																														

3.

$\vec{p} = \vec{OP} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$ 
 $7\vec{OA} = \vec{d} = \begin{pmatrix} 11 \\ 4 \end{pmatrix}$

Ratio known:

$$\vec{OM} = \frac{1}{3}\vec{p} + \frac{2}{3}\vec{d}$$

$$= \frac{1}{3}\begin{pmatrix} 5 \\ 1 \end{pmatrix} + \frac{2}{3}\begin{pmatrix} 11 \\ 4 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{5}{3} \\ \frac{1}{3} \end{pmatrix} + \begin{pmatrix} \frac{22}{3} \\ \frac{8}{3} \end{pmatrix}$$

$$= \begin{pmatrix} 9 \\ 3 \end{pmatrix}$$

$|\vec{OM}| = \sqrt{9^2 + 3^2}$   
 $= \sqrt{81 + 9}$   
 $= \sqrt{90}$   
 $= 9.4868$

4. Taxable Income = Ksh. 32 500

<u>Income</u>	<u>tax (sh)</u>
---------------	-----------------

$$9680 \times \frac{10}{100} = 968 +$$

$$9120 \times \frac{15}{100} = 1368 +$$

$$9120 \times \frac{20}{100} = 1824 +$$

$$4580 \times \frac{25}{100} = 1145$$

$$\text{Total tax payable} = 5305$$

$$\text{Tax Due} = \text{Tax payable} - \text{Relief}$$

$$= \text{sh. } 5305 - 1056$$

$$= \text{sh. } \underline{4249}$$

M2

M1

M2

A1



5

$$2x = \sqrt{\frac{2w+8}{3w-5}}$$

$$(2x)^2 = \frac{2w+8}{3w-5}$$

$$4x^2(3w-5) = 2w+8$$

$$12x^2w - 20x^2 = 2w+8$$

$$12x^2w - 2w = 8 + 20x^2$$

$$w(12x^2 - 2) = 8 + 20x^2$$

$$w = \frac{8 + 20x^2}{12x^2 - 2}$$


---

6 (a)  $\frac{y-5}{x-2} = 2$

$$y-5 = 2x-4$$

$$y = 2x+1$$

(b)  $\theta = \tan^{-1}(\text{gradient})$

$$= \tan^{-1}2$$

$$= 63.43^\circ$$


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7  $P = a + bQ^3$

$$23 = a + b \quad \text{--- (i)}$$

$$-44 = a + 8b \quad \text{--- (ii)}$$

$$\hline -21 = -7b$$

$$\rightarrow b = 3$$

$$23 = a + 3 \Rightarrow a = 20$$

Eqn is

$$P = 20 + 3Q^3$$

When  $Q = 5$

$$P = 20 + 3(5)^3$$

$$= 395$$



$$8. (a) \quad T + C^t = C^t$$

$$T + \begin{pmatrix} 4 \\ 1 \end{pmatrix} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$$

$$T = \begin{pmatrix} 6 \\ -2 \end{pmatrix} - \begin{pmatrix} 4 \\ 1 \end{pmatrix} \\ = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$$

$$(b) \quad T + B = B^t$$

$$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} 3 \\ 5 \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} \Rightarrow B^t(5, 2)$$

$$T + A = A^t$$

$$\begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 3 \\ -1 \end{pmatrix} \Rightarrow A^t(3, -1)$$

$$9. \quad (1-x)^4 = 1(1)^4(-x)^0 + 4(1)^3(-x)^1 + 6(1)^2(-x)^2 + 4(1)^1(-x)^3 + 1(1)^0(-x)^4 \\ = 1 - 4x + 6x^2 - 4x^3 + x^4$$

M1

~~$$x - 1 = 0.98$$~~

$$1 - x = 0.98 \Rightarrow x = 0.02$$

$$(0.98)^4 = 1 - 4(0.02) + 6(0.02)^2 - 4(0.02)^3 + (0.02)^4 \\ = 1 - 0.08 + 0.0024 - 0.00032$$

$$= 0.922$$

$$\approx 0.92$$

$$10. \quad x^2 + y^2 - 6x + 8y - 11 = 0$$

$$x^2 - 6x + \left(-\frac{6}{2}\right)^2 + y^2 + 8y + \left(\frac{8}{2}\right)^2 = 11 + (-3)^2 + (4)^2$$

$$(x-3)^2 + (y+4)^2 = 36$$

$$(x-3)^2 + (y+4)^2 = 6^2$$

$$\text{Centre} \Rightarrow (3, -4)$$

$$\text{Radius} = 6 \text{ units}$$

Both Centre and radius



11. Let the ratio be  $x:y$  in kg respectively.

$$\text{Cost of the mixture} = \text{sh. } (42x + 47y) \checkmark$$

$$\text{Total mass of mixture} = (x+y) \text{ kg.}$$

$$\text{Cost per kg of the mixture} = \frac{\text{Total cost of the mixture}}{\text{Total mass}}$$

$$\text{sh. } 46 = \frac{42x + 47y}{x+y} \checkmark$$

$$46x + 46y = 42x + 47y.$$

$$4x = y$$

$$\frac{x}{y} = \frac{1}{4} \Rightarrow \underline{x:y = 1:4} \checkmark$$

M1

M1

A1

12. Rate of work of each pipe.

$$\left. \begin{array}{l} A = \frac{1}{3} \\ B = \frac{1}{5} \\ C = \frac{1}{15} \end{array} \right\} \text{Per hr.}$$

$$\text{Rate of work of } A \text{ \& } B = \frac{1}{3} + \frac{1}{5} = \frac{8}{15} \text{ per hr.} \checkmark$$

$$\text{Work done in 1 hr.} = \frac{8}{15} \times 1 = \frac{8}{15} \text{ of the volume.}$$

$$\begin{aligned} \text{Volume still empty} &= 1 - \frac{8}{15} \\ &= \frac{7}{15} \checkmark \end{aligned}$$

$$\begin{aligned} \text{Rate of work of } A, B \text{ \& } C &= \frac{1}{3} + \frac{1}{5} - \frac{1}{15} \\ &= \frac{7}{15} \checkmark \end{aligned}$$

$$\text{Time taken to fill} = \frac{7}{15} \div \frac{7}{15} = 1 \text{ hr.}$$

$$\text{Total time} = 1 + 1 = \underline{2 \text{ hrs}} \checkmark$$





13.

Numerator:

$$9t^2 - 25a^2 = (3t + 5a)(3t - 5a) \checkmark$$

Denominator:

$$6t^2 + 19at + 15a^2$$

$$6t^2 + 10at + 9at + 15a^2$$

$$2t(3t + 5a) + 3a(3t + 5a)$$

$$(2t + 3a)(3t + 5a) \checkmark$$

Both Combined:

$$\frac{\cancel{(3t + 5a)}(3t - 5a)}{(2t + 3a)\cancel{(3t + 5a)}} = \frac{3t - 5a}{2t + 3a} \checkmark$$

14. Buying Price = 300kg x sh 30 per kg.

$$= \text{sh. } 9000$$

After the loss  $\Rightarrow \frac{80}{100} \times 300\text{kg} = 240\text{kg}$ .

$$9000 \text{ --- } 100\%$$

$$\text{SP --- } 120\%$$

$$\text{SP} = \frac{9000 \times 120}{100} = \text{sh. } \underline{10800}$$

$$\text{SP per kg} = \frac{10800}{240}$$

$$= \text{Ksh } 45$$

15.

$$\log_c 216 + (\log 42 - \log 6) \div \log 49$$

$$\log_c 216 + \left(\log \frac{42}{6}\right) \div \log 49$$

$$\log_c 216 + \log 7 \div \log 7^2$$

$$\log_c 216 + \frac{\log 7}{2 \log 7}$$

$$\log_c 216 + \frac{1}{2}$$

$$\log_c 216 = x$$

$$216 = c^x$$

$$6 = 6^x$$

$$\Rightarrow x = 3$$

$$3 + \frac{1}{2} = 3\frac{1}{2}$$



16

$$x : y = 2 : 3$$

$$\frac{x}{2} = \frac{y}{3} = k.$$

$$\frac{x}{2} = k \Rightarrow x = 2k.$$

$$\frac{y}{3} = k \Rightarrow y = 3k.$$

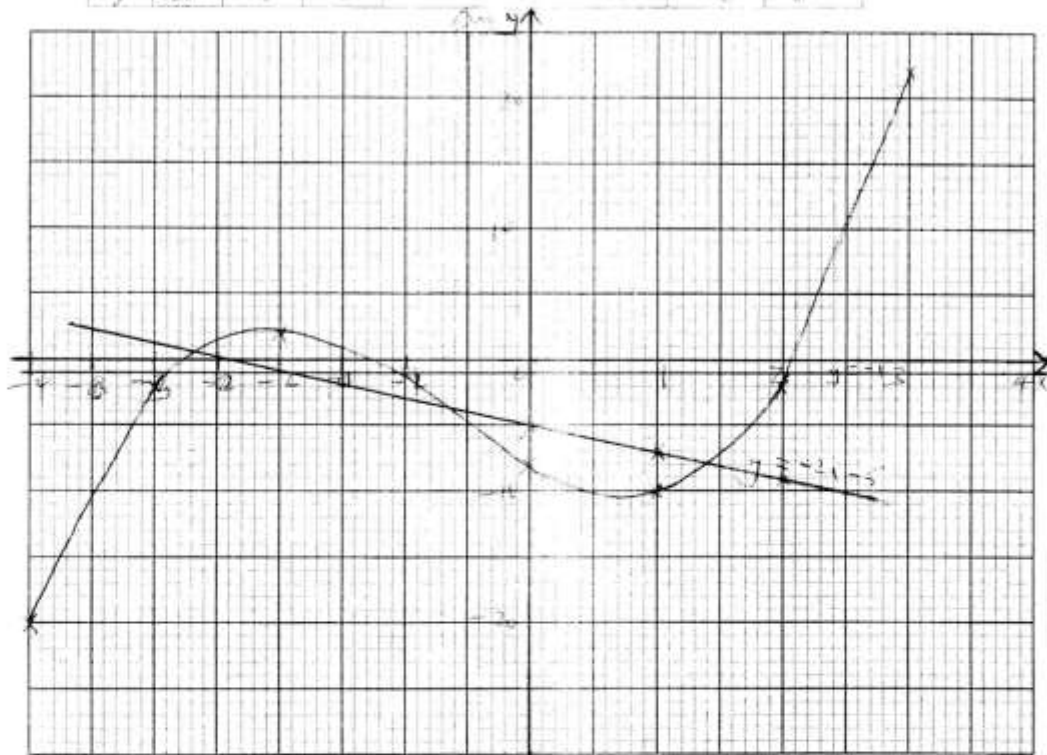
$$\begin{aligned} \frac{5x - 2y}{x + y} &= \frac{5(2k) - 2(3k)}{2k + 3k} \\ &= \frac{10k - 6k}{5k} \\ &= \frac{4k}{5k} \end{aligned}$$

$$\Rightarrow \frac{5x - 2y}{x + y} = \frac{4}{5} \Rightarrow 5x - 2y : x + y = 4 : 5$$



17

x	-4	-3	-2	-1	0	1	2	3
$x^3$	-64	-27	-8	-1	0	1	8	27
$2x^2$	32	18	8	2	0	2	8	18
$-5x$	20	15	10	5	0	-5	-10	-15
$-8$	8	8	8	8	8	8	8	8
y	-20	-2	2	2	2	-2	-2	2

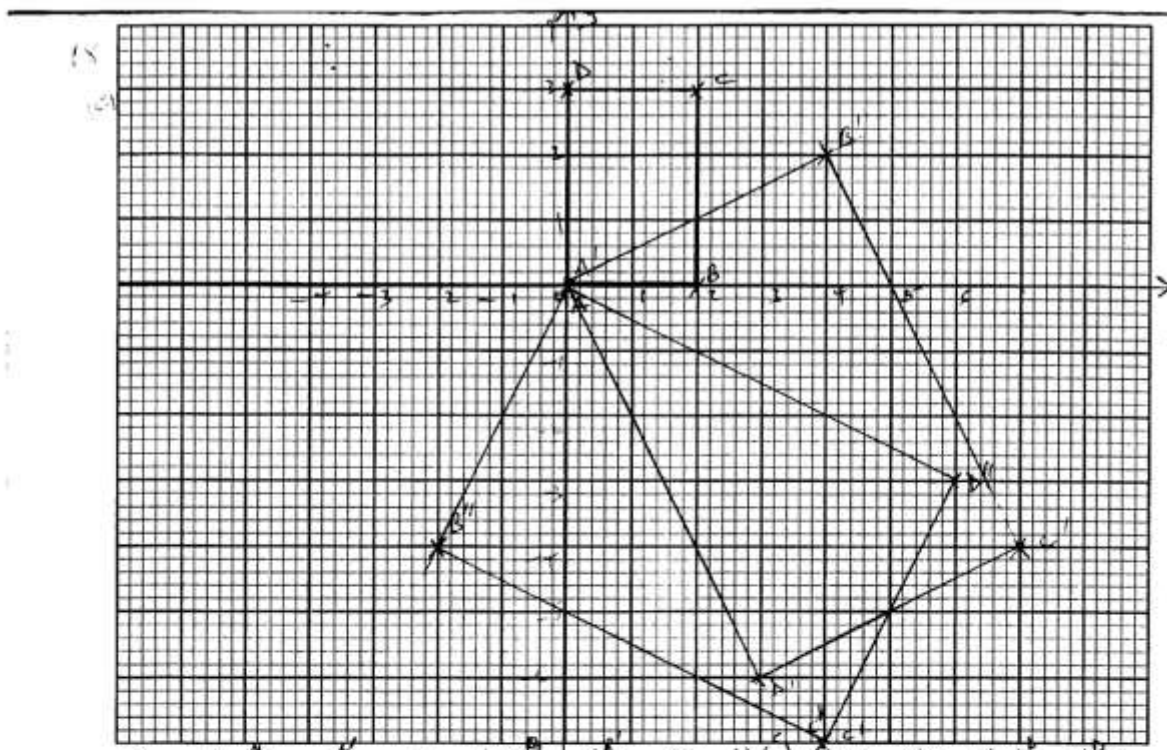


(i)  $y = x^3 + 2x^2 - 4x - 8$   
 $c = x^3 + 2x^2 - 4x - 8$   
 $y = 0 \rightarrow x^3 + 2x^2 - 4x - 8 = 0$   
 $x = -2, 1, 2$

(ii)  $y = x^3 + 2x^2 - 4x - 7$   
 $c = x^3 + 2x^2 - 4x - 7$   
 $y = -1$   
 $x = -1, 1, 2$

(iii)  $y = x^3 + 2x^2 - 4x - 1$   
 $c = x^3 + 2x^2 - 4x - 1$   
 $y = -3$   
 $x = -1, 1, 2$





$$\begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \quad \begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix} = \begin{pmatrix} 4 \\ 2 \end{pmatrix} \quad \begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 7 \\ -4 \end{pmatrix} \quad \begin{pmatrix} 2 & 1 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} 0 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \end{pmatrix}$$

$$A'(0,0) \quad B'(4,2) \quad C'(7,-1) \quad D'(3,-6)$$

6) Area of ABCD = 6 units<sup>2</sup>

$$\text{Det} = \dots$$

Area of ABCD = ...

$$(c) \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

$$A'(0,0) \quad B'(-1,-1) \quad C'(1,-1) \quad D'(0,-2)$$

(D)  $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 1 & -2 \end{pmatrix} = \begin{pmatrix} -1 & -1 \\ -1 & -2 \end{pmatrix}$

$$\text{Det} = (-1)(-2) - (-1)(-1) = 2 - 1 = 1$$

$$= \frac{1}{5} \begin{pmatrix} -1 & -2 \\ 2 & -1 \end{pmatrix}$$







$$19. (a) a^2 = b^2 + c^2 - 2bc \cos A$$

$$a^2 = 6^2 + 8^2 - 2(6)(8) \cos 50^\circ$$

$$= 36 + 64 - 96(0.6428)$$

$$a = \sqrt{100 - 61.71}$$

$$= \sqrt{38.29}$$

$$a = 6.188 \text{ cm.}$$

(b)

$$\frac{b}{\sin B} = \frac{a}{\sin A}$$

$$\frac{6}{\sin B} = \frac{6.188}{\sin 50^\circ}$$

$$\sin B = \frac{6 \sin 50^\circ}{6.188}$$

$$B = \sin^{-1}(0.7428)$$

$$= 47.97^\circ$$

$$(c) a^2 = d^2 + c^2 - 2dc \cos A$$

$$2.82^2 = 7^2 + 6^2 - 2(7)(6) \cos A$$

$$7.9524 = 85 - 84 \cos A$$

$$\Rightarrow \cos A = \frac{85 - 7.9524}{84}$$

$$A = \cos^{-1}(0.9172)$$

$$= 23.48^\circ$$

$$(d) A_{\text{rec.}} = \frac{1}{2} dc \sin A$$

$$= \frac{1}{2} \times 7 \times 6 \times \sin 23.48^\circ = 8.367 \text{ cm}^2$$



$$20. (a) P \propto \frac{Q}{R^2}$$

$$P = k \frac{Q}{R^2}$$

$$18 = k \frac{24}{4^2} \Rightarrow k = \frac{18 \times 4^2}{24}$$

$$k = 12$$

When  $Q = 30$  and  $R = 10$

$$P = 12 \frac{Q}{R^2}$$

$$= 12 \times \frac{30}{10^2}$$

$$= \underline{3.6}$$

$$(b) P = 12 \frac{Q}{R^2}$$

$$(c) P = k \frac{\frac{120}{100} Q}{\left(\frac{90}{100} R\right)^2}$$

$$P = k \frac{1.2 Q}{(0.9 R)^2} \Rightarrow P = k 1.48 \frac{Q}{R^2}$$

$$P_{\text{new}} = 1.48 P$$

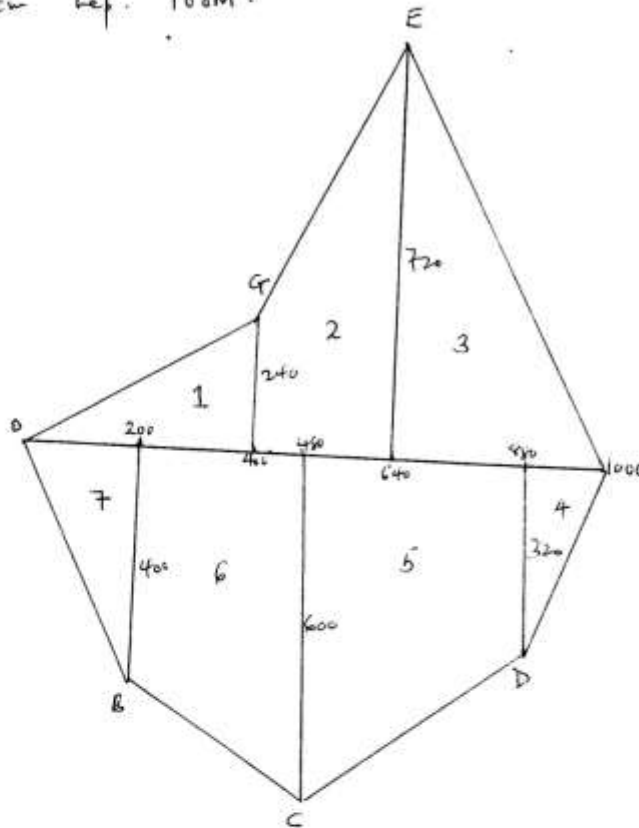
$$(d) P = 1.48 \left( k \frac{Q}{R^2} \right)$$

$$P = \frac{148}{100} \left( k \frac{Q}{R^2} \right)$$

$P$  increases by 48%.



21. (a) 1 cm rep. 100 m.



(b)

$$\begin{aligned} \text{Area 1} &= \frac{1}{2} \times 400 \times 240 = 48\,000 \text{ m}^2 \\ \text{Area 2} &= \frac{1}{2} \times 240 \times (240 + 720) = 115\,200 \text{ m}^2 \\ \text{Area 3} &= \frac{1}{2} \times 360 \times 720 = 129\,600 \text{ m}^2 \\ \text{Area 4} &= \frac{1}{2} \times 120 \times 320 = 19\,200 \text{ m}^2 \\ \text{Area 5} &= \frac{1}{2} \times 400 \times (600 + 320) = 184\,000 \text{ m}^2 \\ \text{Area 6} &= \frac{1}{2} \times 280 \times (400 + 600) = 140\,000 \text{ m}^2 \\ \text{Area 7} &= \frac{1}{2} \times 200 \times 400 = 40\,000 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Total Area} &= 48\,000 + 115\,200 + 129\,600 + 19\,200 + 184\,000 \\ &\quad + 140\,000 + 40\,000 \\ &= 676\,000 \text{ m}^2 \\ &= 67.6 \text{ ha.} \end{aligned}$$





21. (a) Gradient of L

$$M = \frac{6-3}{-1-(-2)}$$

$$= \frac{3}{1} = 3$$

$$\frac{y-3}{x+2} = 3$$

$$y-3 = 3x+6$$

$$y = 3x+9$$

(b) Gradient of P  $\times 3 = -1$

$$\text{Gradient of P} = -\frac{1}{3}$$

$$\frac{y-6}{x+1} = -\frac{1}{3}$$

$$3y-18 = -x-1$$

$$x+3y = 17$$

(c) Gradient of Q = 3

$$\frac{y-2}{x-1} = 3$$

$$y-2 = 3x-3$$

$$y = 3x-1$$

(d) Solve eq. P and Q

$$x+3y = 17$$

$$-3x+y = -1$$

$$\frac{3x+9y = 51}{-3x+y = -1}$$

$$10y = 50$$

$$y = 5$$

Simultaneously,

$$x+3(5) = 17$$

$$x = 2$$

Point of Intersection (2, 5)



$$\begin{aligned} 23 \text{ (a)} \quad AC &= \sqrt{10^2 + 10^2} \\ &= \sqrt{200} \\ &= 14.14 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad \text{Height} &= \sqrt{13^2 - 7.07^2} \\ &= \sqrt{119.0151} \\ &= 10.91 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{(c)} \quad \cos \theta &= \frac{7.07}{13} \\ \theta &= \cos^{-1}\left(\frac{7.07}{13}\right) \\ &= 57.05^\circ \end{aligned}$$

$$\begin{aligned} \text{(d)} \quad \tan x &= \left(\frac{10.91}{5}\right) \\ x &= \tan^{-1}\left(\frac{10.91}{5}\right) \\ &= 65.38^\circ \end{aligned}$$

$$\begin{aligned} \text{(e)} \quad \tan x &= \frac{5}{10.91} \\ x &= \tan^{-1}\left(\frac{5}{10.91}\right) \\ &= 24.62^\circ \\ 2x &= \underline{49.24^\circ} \end{aligned}$$

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$$24. (a) \text{ Volume of water} = \frac{1}{3} \times \frac{22}{7} \times 21^2 \times 30$$

$$= 13,860 \text{ cm}^3$$

$$(b) (i) \frac{h}{H} = \frac{r}{R}$$

$$\frac{30}{36} = \frac{21}{R} \Rightarrow R = \frac{21 \times 36}{30}$$

$$= 25.2 \text{ cm}$$

$$(ii) \text{ New Volume} = \frac{1}{3} \times \frac{22}{7} \times 25.2^2 \times 36$$

$$= 23,952.08 \text{ cm}^3$$

$$\text{V. of sphere} = 23,952.08 - 13,860$$

$$= 10,090.08 \text{ cm}^3$$

$$(iii) \frac{4}{3} \times \frac{22}{7} \times r^3 = 10,090.08$$

$$r^3 = \frac{10,090.08 \times 21}{88}$$

$$r = \sqrt[3]{\frac{10,090.08 \times 21}{88}}$$

$$= 13.40 \text{ cm}$$

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