NAME: .STREAM:

LIGHT ACADEMY SECONDARY SCHOOL
MOCK SET II TERM 22017
TIME: 3 HOURS
S. 6 MATHEMATICS PAPER 2

P425/2
APPLIED
MATHEMATICS
Paper 2
June 2017
3 Hours Uganda Advanced Certificate of Education
MOCK II EXAMINATIONS
APPLIED MATHEMATICS

## PAPER 2

## Time 3 Hours

## INSTRUCTIONS TO CANDIDATES:

Attempt all the questions in section $A$ and any five questions from section $B$.

All necessary calculations must be done on the same page as the rest of the answers. Therefore there is no paper for rough work.

Mathematical tables with a list of formulae and squared papers are provided.
Silent, non-programmable scientific calculators may be used.
In numerical work, take $\boldsymbol{g}$ to be $9.8 \mathrm{~ms}^{-2}$.

## SECTION A: (40 MARKS)

Answer all questions in this section

1. Particles of masses $4 \mathrm{~kg}, 3 \mathrm{~kg}, 2 \mathrm{~kg}, 9 \mathrm{~kg}$ and 2 kg are placed at points with position vectors: $2 \mathbf{i}+4 \mathbf{j},-3 \mathbf{i}-2 \mathbf{j}, \mathbf{i}-4 \mathbf{j},-3 \mathbf{i}+5 \mathbf{j}$ and $4 \mathbf{i}+3 \mathbf{j}$ respectively. Find the position vector of centre of gravity of the system of particles.
(5 marks)
2. Box A contains 4 yellow and 3 green oranges while box $B$ contains 5 yellow and 7 green oranges. An orange is randomly selected from A and placed in B and then an orange is randomly selected from B and put back in A . If X is the number of yellow oranges remaining in box A after the operation,
(i) draw a probability distribution table for X and show that X is a random variable,
(ii) find the mean of X .
(5 marks)
3. A car travelling along a straight road covers consecutive distances 1 km and 2 km in equal time interval of 10 minutes. Find the
(i) acceleration of the car,
(ii) initial velocity.
(5 marks)
4. By drawing a suitable graph, determine the positive root of the equation $2 x^{2}-x-5=0$.
(5 marks)
5. Marks obtained by students in a certain test are uniformly distributed with mean 50 marks. If the least mark is 40 , calculate the probability that a student chosen at random has a mark between 47 and 53.
( 5 marks)
6. A bullet of mass 100 grams travelling at $400 \mathrm{~ms}^{-1}$ horizontally is fired into a block of mass 20 kg at rest on a horizontal table. If the coefficient of friction between the table and the block is 0.2 , calculate the
(i) acceleration of the block if the bullet is embedded in the wood,
(ii) distance moved by the block.
7. Study the flow diagram below.


Perform the dry run of the flow chart and state its purpose.
(5 marks)
8. The table below shows the height (cm) and the age (years) of a group of students.

| Height (cm) | 120 | 152 | 90 | 165 | 152 | 144 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Age (years) | 16 | 17 | 10 | 17 | 14 | 15 |

Calculate the rank correlation coefficient between height and age and comment on the relationship.

## SECTION B (60 MARKS)

Answer five questions in this section. All questions in this section carry equal marks.
9. (a) A particle performs simple harmonic motion between two points A and B which are 4 m apart with point O as center. When the particle is at point 1 m from O , its speed is $\frac{1}{\sqrt{3}} \mathrm{~ms}^{-1}$.

Calculate the
(i) acceleration when the particle is 0.4 m from A , (ii) displacement of the particle after 2 seconds.
(b) A particle of mass 2 kg is freely suspended from the end B of a light elastic string of natural length 1 m and the other end of the strong is fixed to a point A . When in equilibrium at a point $\mathrm{E}, \mathrm{AE}=1.5 \mathrm{~m}$. The particle is then pulled vertically downwards to a point $\mathrm{C}, 0.2 \mathrm{~m}$ from $E$ and released.
(i) Show that the subsequent motion is simple harmonic.
(ii) Find the time taken by the particle to reach a point 0.15 m from C for the first time.
(12 marks)
10. The probability density function of a continuous random variable $X$ is represented graphically as shown.

Find the

(i) value of k ,
(ii) equations of the p.d.f. $\mathrm{f}(\mathrm{x})$,
(iii) $\mathrm{P}(\mathrm{X}>2 / \mathrm{X}<3.5)$.
(12 marks)
11. (a) Given that the exact quantities A and B are approximated using a and b respectively with corresponding errors $\Delta \mathrm{A}$ and $\Delta \mathrm{B}$, show that the maximum possible error in $\frac{a}{b}$ is $\left\lvert\, \frac{\mathrm{a}}{\mathrm{b}}\left(\left|\frac{\Delta \mathrm{A}}{\mathrm{a}}\right|+\left|\frac{\Delta \mathrm{B}}{\mathrm{b}}\right|\right)\right.$.
(b) The quantities $\mathrm{x}=14.57, \mathrm{y}=17.9112$ and $\mathrm{z}=4.3$ are each rounded off to the given number of decimal places. If $d=\frac{x-y}{y-z}$, find
(i) range of values within which d lies correct to four decimal places,
(ii) percentage error in d correct to two significant figures.
(12 marks)
12. The ages of students attending a certain function are normally distributed with mean 18 years. If $85.1 \%$ of the students have their ages greater than 17 years, find the probability that
(a) a student selected at random has an age between 16 and 19 years.
(b) a random sample of 16 students have their mean ages between 17.5 and 18.7 years.
(12 marks)
13. The points $A, B, C$ and $D$ are the vertices of a square of side $4 m$. Forces of magnitudes 8 N , $3 \mathrm{~N}, 4 \sqrt{2} \mathrm{~N}, 6 \mathrm{~N}$ and 3 N act along the sides $\mathrm{BA}, \mathrm{CB}, \mathrm{AC}, \mathrm{DA}$ and DC respectively, the direction of the forces being indicated by the order of the letters. Find the
(a) magnitude of the resultant force.
(b) equation of line of action of the resultant force taking AB and AD as the horizontal and vertical axes respectively.
(c) distance from A where the line of action of the resultant crosses AB .
14. Derive the simplest iterative formula based on Newton Raphson method that can be used to find the cube root of a number N .
(a) By drawing a suitable graph, find the value of $\sqrt[3]{12}$.
(b) Using the value from the graph as an initial approximation, find $\sqrt[3]{12}$ correct to three decimal places.
(12 marks)
15. The table below shows the weight of seeds of a certain type of plant.

| Weight (grams) | $<0.10$ | $<0.25$ | $<0.35$ | $<0.50$ | $<0.60$ | $<0.65$ | $<0.80$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Frequency | 2 | 3 | 5 | 9 | 3 | 2 | 3 |

(a) Calculate the
(i) mean weight,
(ii) standard deviation weight.
(b) Draw a histogram and use it to estimate the modal weight.
(12 marks)
16. (a) A car of mass 1500 kg travelling along a horizontal road at a maximum power has a maximum speed of $150 \mathrm{kmh}^{-1}$. If there is a resistance of 60 N , find the
(i) maximum power,
(ii) acceleration when the car is travelling at $72 \mathrm{kmh}^{-1}$ if power remains constant.
(b) A hammer of mass 4.5 kg falls through a vertical height of 1 m and hits a nail of mass 50 grams directly without rebounding. If the nail is driven into a piece of wood a depth of 2 cm , find average resistance to penetration assuming that it is constant.
(12 marks)

## End.

