

EXAMINATIONS COUNCIL OF ZAMBIA

Mathematics

Paper 2

4024/2

Wednesday

1 AUGUST 2018

Additional materials:

Answer Booklet

Silent Electronic Calculator (non programmable)

Geometrical instruments

Graph paper (3 sheets)

Plain paper (1 sheet)

Time: 2 hours 30 minutes

Instructions to Candidates

Write your name, centre number and candidate number in the spaces provided on the Answer Booklet.

Write your answers and working in the Answer Booklet provided.

If you use more than one Answer Booklet, fasten the Answer Booklets together.

Omission of essential working will result in loss of marks.

There are twelve (12) questions in this paper.

Section A

Answer all questions.

Section B

Answer any four questions.

Silent non programmable Calculators may be used.

Cell phones are not allowed in the examination room.

Information for Candidates

The number of marks is given in brackets [] at the end of each question or part question.

The total marks for this paper is 100.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

Mathematical Formulae

1 ALGEBRA

Quadratic Equation

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

2 SERIES

Geometric Progression

$$S_n = \frac{a(1-r^n)}{1-r}, (r < 1)$$

$$S_n = \frac{a(r^n - 1)}{r - 1}, (r > 1)$$

$$S_{\infty} = \frac{a}{1-r} \text{ for } |r| < 1$$

3 TRIGONOMETRY

Formula for ΔABC

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

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

$$\Delta = \frac{1}{2} bc \sin A$$

4 STATISTICS

Mean and standard deviation

Ungrouped data

$$\text{Mean } (\bar{x}) = \frac{\sum x}{n}, \text{SD} = \sqrt{\left\{ \frac{\sum (x - \bar{x})^2}{n} \right\}} = \sqrt{\left\{ \frac{\sum x^2}{n} - (\bar{x})^2 \right\}}$$

Grouped data

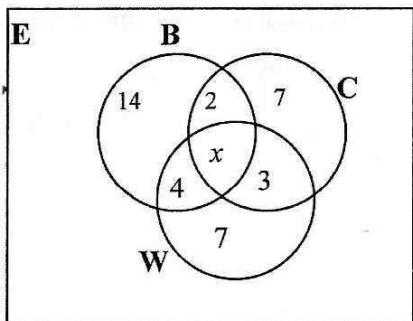
$$\text{Mean } (\bar{x}) = \frac{\sum fx}{\sum f}, \text{SD} = \sqrt{\left\{ \frac{\sum f(x - \bar{x})^2}{\sum f} \right\}} = \sqrt{\left\{ \frac{\sum fx^2}{\sum f} - (\bar{x})^2 \right\}}$$

Section A (52 Marks)**Answer all questions in this section**

- 1 (a) Given that matrix $A = \begin{pmatrix} 2x & 2 \\ 3 & x \end{pmatrix}$,
- (i) find the positive value of x for which the determinant of A is 12, [2]
 - (ii) hence or otherwise, write A^{-1} . [2]
- (b) Solve the equation $x^2 - 4x - 2 = 0$, giving your answers correct to 2 decimal places. [5]
-

- 2 (a) Simplify $\frac{7st^3}{15u^3v^2} \times \frac{5u^3v}{28s^3t^2}$.
- $$\frac{7st^3}{15u^3v^2} \times \frac{5u^3v}{28s^3t^2} = \frac{7st^3 \cdot 5u^3v}{15u^3v^2 \cdot 28s^3t^2} = \frac{35s^4t^2}{420u^3v^2} = \frac{s^4t^2}{12u^3v^2}$$
- (b) In a geometric progression, the third term is $\frac{2}{9}$ and the fourth term is $\frac{2}{27}$. Find
- (i) the first term and the common ratio, [3]
 - (ii) the sum of the first 5 terms of the geometric progression, [2]
 - (iii) the sum to infinity. [2]
-

- 3 (a) The diagram below shows how learners in a Grade 12 class at Twaenda School travel to school. The learners use either buses (B), cars (C) or walk (W) to school.



- (i) If 22 learners walk to school, find the value of x . [2]
 - (ii) How many learners use
 - (a) only one mode of transport, [1]
 - (b) two different modes of transport? [1]
 - (b) Show that the points L(-2, -10), M(2, 2) and N(5, 11) are collinear. [5]
-

- 4 Answer the whole of this question on a sheet of plain paper.**
- (a) (i) Construct triangle PQR in which $PQ = 10\text{cm}$, $QR = 8\text{cm}$ and $\hat{PQR} = 50^\circ$. [1]
- (ii) Measure and write the length of PR. [1]
- (b) On your diagram, within triangle PQR, construct the locus of points which are
- (i) equidistant from P and Q, [1]
- (ii) equidistant from PR and PQ, [2]
- (iii) 5cm from R. [1]
- (c) A point T within triangle PQR is such that it is 5cm from R and equidistant from P and Q. Label the point T. [1]
- (d) Another point X is such that it is less than or equal to 5cm from R, nearer to Q than P and nearer to PQ than PR. Indicate clearly, by shading, the region in which X must lie. [2]

-
- 5** (a) A box contains identical buttons of different colours. There are 20 black, 12 red and 4 white buttons in the box. Two buttons are picked at random one after another and not replaced in the box.

- (i) Draw a tree diagram to show all the possible outcomes. [3]
- (ii) What is the probability that both buttons are white? [2]

- (b) Study the pseudo code below.

Start

Enter a, r, n

$R = 1 - r$

If $R = 0$ THEN

Print "the value of r is not valid"

Else $S_n = \frac{a(1-r^n)}{R}$

End if

Print S_n

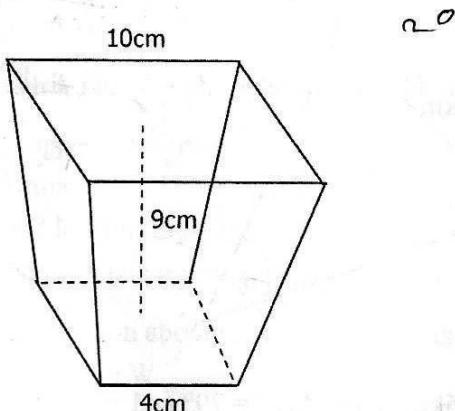
Stop

Construct a flow chart corresponding to the pseudo code above.

[5]



- 6 The diagram below shows a bin in the form of a frustum with square ends of sides 4cm and 10cm respectively. The height of the bin is 9 cm.



Find the volume of the bin.

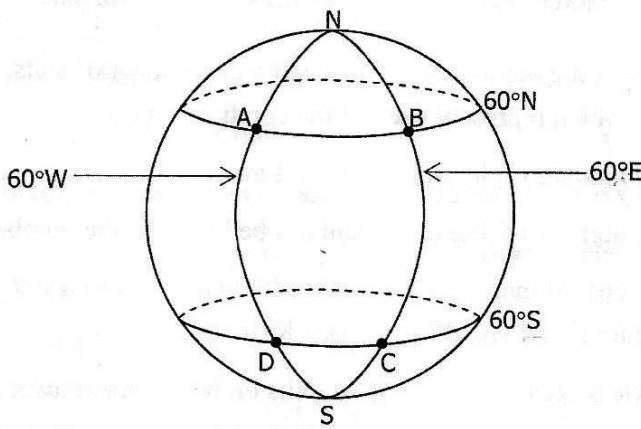
[6]

Section B [48 marks]

Answer any four questions in this section.

Each question in this section carries 12 marks.

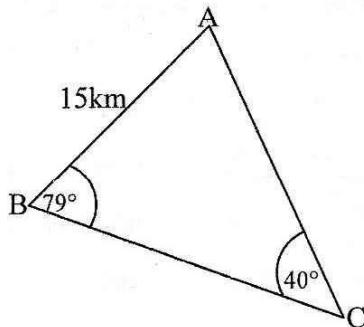
- 7 (a) In the diagram below, A and B are points on latitude 60°N while C and D are points on latitude 60°S . [$\pi = 3.142$ and $R = 3437\text{nm}$].



- (i) Calculate the distance BC along the longitude 60°E in nautical miles. [2]
(ii) A ship sails from C to D in 12 hours. Find its speed in knots. [4]
- (b) (i) Determine the equation of the normal to the curve $y = 2x^2 - 3x - 2$ that passes through the point (3, 7). [3]
(ii) Evaluate $\int_0^1 (x^2 - 2x - 3) dx$. [3]



- 8 (a) Three villages A, B and C are connected by straight paths as shown in the diagram below.



Given that $AB = 15\text{km}$, angle $\text{ABC} = 79^\circ$ and angle $\text{ACB} = 40^\circ$, calculate the

- (i) distance AC, [4]
(ii) area of triangle ABC, [2]
(iii) shortest distance from B to AC. [2]
- (b) Solve the equation $\cos \theta = 0.937$ for $0^\circ \leq \theta \leq 360^\circ$. [2]
- (c) Sketch the graph of $y = \sin \theta$ for $0^\circ \leq \theta \leq 360^\circ$. [2]

- 9 Answer the whole of this question on a sheet of graph paper.

A tailor at a certain market intends to make dresses and suits for sale.

- (a) Let x represent the number of dresses and y the number of suits. Write the inequalities which represent each of the conditions below.
- (i) The number of dresses should not exceed 50. [1]
(ii) The number of dresses should not be less than the number of suits. [1]
(iii) The cost of making a dress is K140.00 and that of a suit is K210.00.
The total cost should be at least K10 500.00. [2]
- (b) Using a scale of 2cm to represent 10 units on both axes, draw x and y axes for $0 \leq x \leq 60$ and $0 \leq y \leq 80$. Shade the unwanted region to indicate clearly the region where (x, y) must lie. [4]
- (c) (i) The profit on a dress is K160.00 and on a suit it is K270.00. Find the number of dresses and suits the tailor must make for maximum profit. [2]
(ii) Calculate this maximum profit. [2]

10 Answer the whole of this question on a sheet of graph paper.

Using a scale of 1cm to represent 1 unit on both axes, draw x and y axes for $-8 \leq x \leq 12$ and $-6 \leq y \leq 14$.

- (a) Draw and label triangle X with vertices (2, 4), (4, 4) and (4, 1). [1]
- (b) Triangle X is mapped onto triangle U with vertices (6, 12), (12, 12) and (12, 3) by a single transformation.
 - (i) Draw and label triangle U. [1]
 - (ii) Describe fully this transformation. [3]
- (c) A 90° clockwise rotation about the origin maps triangle X onto triangle W.
Draw and label triangle W. [2]
- (d) A shear with x-axis as the invariant line and shear factor -2 maps triangle X onto triangle S. Draw and label triangle S. [2]
- (e) Triangle X is mapped onto triangle M with vertices (4, 4), (8, 4) and (8, 1).
 - (i) Draw and label triangle M. [1]
 - (ii) Find the matrix which represents this transformation. [2]

11 A farmer planted 60 fruit trees. In a certain month, the number of fruits per tree was recorded and the results were as shown in the table below.

| | | | | | | | |
|-----------------|---|---|---|---|----|----|----|
| Fruits per tree | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Frequency | 1 | 5 | 4 | 6 | 10 | 16 | 18 |

- (a) Calculate the standard deviation. [6]
- (b) Answer this part of the question on a sheet of graph paper.
 - (i) Using the table above, copy and complete the relative cumulative frequency table below.

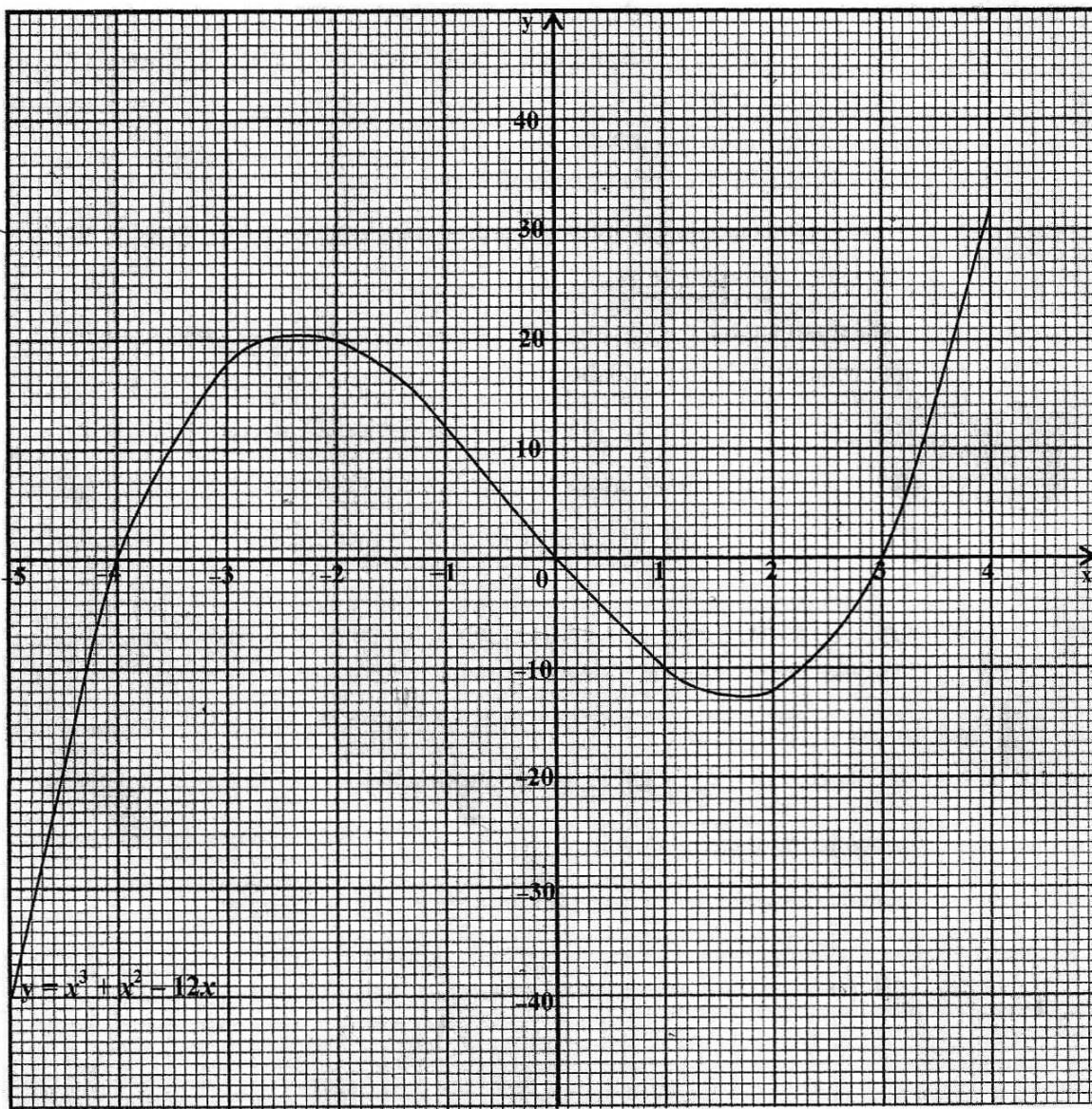
| | | | | | | | |
|-------------------------------|------|-----|------|------|----|----|----|
| Fruits per tree | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Cumulative Frequency | 1 | 6 | 10 | 16 | 26 | 42 | 60 |
| Relative cumulative frequency | 0.02 | 0.1 | 0.17 | 0.27 | | | |

[1]

 - (ii) Using a scale of 1cm to represent 1 unit on the x-axis for $0 \leq x \leq 8$ and 2cm to represent 0.1 units on the y-axis for $0 \leq y \leq 1$, draw a smooth relative cumulative frequency curve. [3]
 - (iii) Showing your method clearly, use your graph to estimate the 70th percentile. [2]

12 (a) Express $\frac{3}{2x-5} - \frac{4}{x-3}$ as a single fraction in its lowest terms. [3]

(b) The diagram below shows the graph of $y = x^3 + x^2 - 12x$.



(i) Use the graph to solve the equations

(a) $x^3 + x^2 - 12x = 0$, [2]

(b) $x^3 + x^2 - 12x = x + 10$. [3]

(ii) Calculate an estimate of the

(a) gradient of the curve at the point where $x = -3$, [2]

(b) area bounded by the curve, $x = -3$, $x = -1$ and $y = -10$. [2]



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