EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

80126700

Mathematics 4024/2

Paper 2

Friday **15 NOVEMBER 2019**

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.

This question paper consists of 10 printed pages

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 Δ ABC

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

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

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

4 STATISTICS

Mean and standard deviation

Ungrouped data

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

Grouped data

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

Section A (52 Marks)

Answer all questions in this section

1 **(a)** Given that matrix $A = \begin{pmatrix} 6 & x \\ 2 & 3 \end{pmatrix}$,

(i) find the value of x for which the determinant of A is 36, [2]

(ii) hence, find the inverse of A. [2]

(b) A box contains 4 red pens and 5 green pens. A pen is picked at random from the box without replacement and a second pen is then picked.

(i) Draw a tree diagram to illustrate the outcomes. [3]

(ii) What is the probability of picking one red pen and one green pen? [2]

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2 **(a)** Simplify $\frac{6x^2 - 24}{x - 2}$. [2]

(b) Given the geometric progression 4, 8, 16, …,
find

(i) the geometric mean of 256 and 1 024, [2]

(ii) the 11^{th} term, [2]

(iii) the sum of the first 11 terms. [3]

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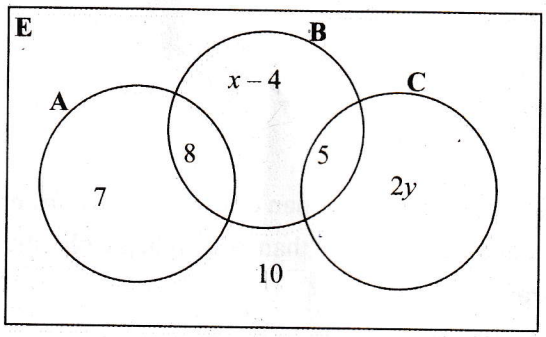
3 **(a)** Solve the equation $p^2 - p = 4$, giving your answers correct to 2 decimal places. [5]

(b) The Venn diagram below shows the number of elements in sets A, B and C.



Find

(i) x, such that $n(B) = n(B \cup C)'$, [2]

(ii) y, such that $n(C) = n(A)$, [1]

(iii) $n(E)$, [1]

(iv) $n(B')$. [1]

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4 **(a)** Express $\frac{5}{2x-4} - \frac{4}{3x+5}$ as a single fraction in its simplest form. [3]

(b) The program below is given in the form of a pseudocode.

Begin
Enter length
If length < 0
Then display "error message and re-enter positive length
Else enter height
If height < 0
Then display "error message" and re-enter positive height
Else volume = $\frac{1}{3} * l * l * h$
End if
Display volume
End

Draw the corresponding flowchart for the information given above. [5]

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5 **(a)** **(i)** Construct triangle ABC in which AB = 8cm, $B\hat{A}C = 110°$ and $A\hat{B}C = 35°$. [1]

(ii) Measure and write the length of BC. [1]

(b) Within the triangle ABC, construct the locus of points which are

(i) 3cm from AB, [1]

(ii) equidistant from AC and BC, [2]

(iii) 4cm from A. [1]

(c) A point Q inside triangle ABC is greater than or equal to 3cm from AB, less than or equal to 4cm from A and nearer to AC than BC. Indicate clearly, by shading, the region in which Q must lie. [2]

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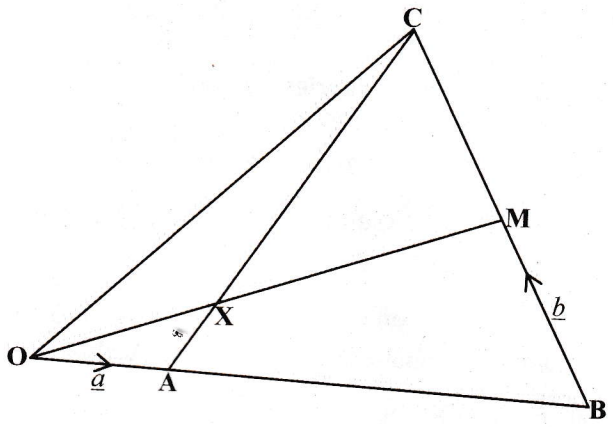
6 **(a)** In the diagram below, $\overrightarrow{OB} = 4\overrightarrow{OA}$ and $\overrightarrow{AC} = 5\overrightarrow{AX}$. M is the midpoint of BC, $\overrightarrow{OA} = \underline{a}$ and $\overrightarrow{BM} = \underline{b}$.



(i) Express in terms of $\underline{a}$ and/or $\underline{b}$.

(a) $\overrightarrow{AB}$, [1]

(b) $\overrightarrow{AC}$, [1]

(c) $\overrightarrow{OM}$. [1]

(ii) Show that $\overrightarrow{OX} = \frac{2}{5}(4\underline{a} + \underline{b})$. [2]

(b) Find the equation of the normal to the curve $y = 5x^3 - 6x^2 + 2x + 5$ at the point (1, 2). [3]

Section B [48 marks]

Answer any four questions in this section.

Each question in this section carries 12 marks.

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

The vertices of triangle ABC are A(1, 1), B(1, 3) and C(3, 3). The vertices of triangle $A_1B_1C_1$ are $A_1(-1, 1)$, $B_1(-3, 1)$ and $C_1(-3, 3)$.

(a) Using a scale of 1cm to represent 1 unit on each axis, draw the x and y axes for $-6 \leq x \leq 6$ and $-6 \leq y \leq 6$. Draw and label triangles ABC and $A_1B_1C_1$. [2]

(b) Describe fully a single transformation that maps triangle ABC onto triangle $A_1B_1C_1$. [2]

(c) An enlargement maps triangle ABC onto triangle $A_2B_2C_2$ with vertices $A_2(-2, -2)$, $B_2(-2, -6)$ and $C_2(-6, -6)$.

(i) Draw and label triangle $A_2B_2C_2$. [1]

(ii) Find the scale factor. [1]

(d) The transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ maps triangle ABC onto triangle $A_3B_3C_3$.

(i) Find the coordinates of the vertices A_3, B_3 and C_3. [2]

(ii) Draw and label triangle $A_3B_3C_3$. [1]

(e) Triangle ABC is mapped onto triangle $A_4B_4C_4$ with vertices $A_4(1, -2)$, $B_4(1, 0)$ and $C_4(3, -6)$.

(i) Draw and label triangle $A_4B_4C_4$. [1]

(ii) Find the matrix representing this transformation. [2]

8 The table below shows the expenditure of 90 farmers in a particular farming season.

Amount (K)	$0 < x \leq 100$	$100 < x \leq 200$	$200 < x \leq 300$	$300 < x \leq 400$	$400 < x \leq 500$	$500 < x \leq 600$	$600 < x \leq 700$	$700 < x \leq 800$
No. of farmers	5	16	17	17	14	12	7	2

(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 cumulative frequency table below.

Amount (K)	≤ 0	≤ 100	≤ 200	≤ 300	≤ 400	≤ 500	≤ 600	≤ 700	≤ 800
Frequency	0	5	21	38	55	69			

[1]

(ii) Using a scale of 2cm to represent 100 units on the horizontal axis and 2cm to represent 10 units on the vertical axis, draw a smooth cumulative frequency curve. [3]

(iii) Showing your method clearly, use your graph to estimate the interquartile range. [2]

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9 Kuunika wishes to build a lodge with single and double rooms. He needs to decide the number of each room type he should build to maximize profit.

Let x represent the number of single rooms and y the number of double rooms.

(a) Write the inequalities which represent each of the following conditions:

(i) There must be at least one single room. [1]

(ii) There must be at least 10 rooms altogether. [1]

(iii) The total number of rooms should not exceed 15. [1]

(iv) The number of double rooms must be at least twice the number of single rooms. [1]

(v) The number of double rooms should not be more than 12. [1]

(b) Using a scale of 2cm to 5 units on both axes, draw x and y axes for $0 \leq x \leq 16$ and $0 \leq y \leq 16$ respectively and shade the unwanted region to indicate clearly the region where the solution of the inequalities lie. [5]

(c) The rate for a single room is K600.00 and K900.00 for a double room. How many rooms of each type should Kuunika build to maximize the income? [2]

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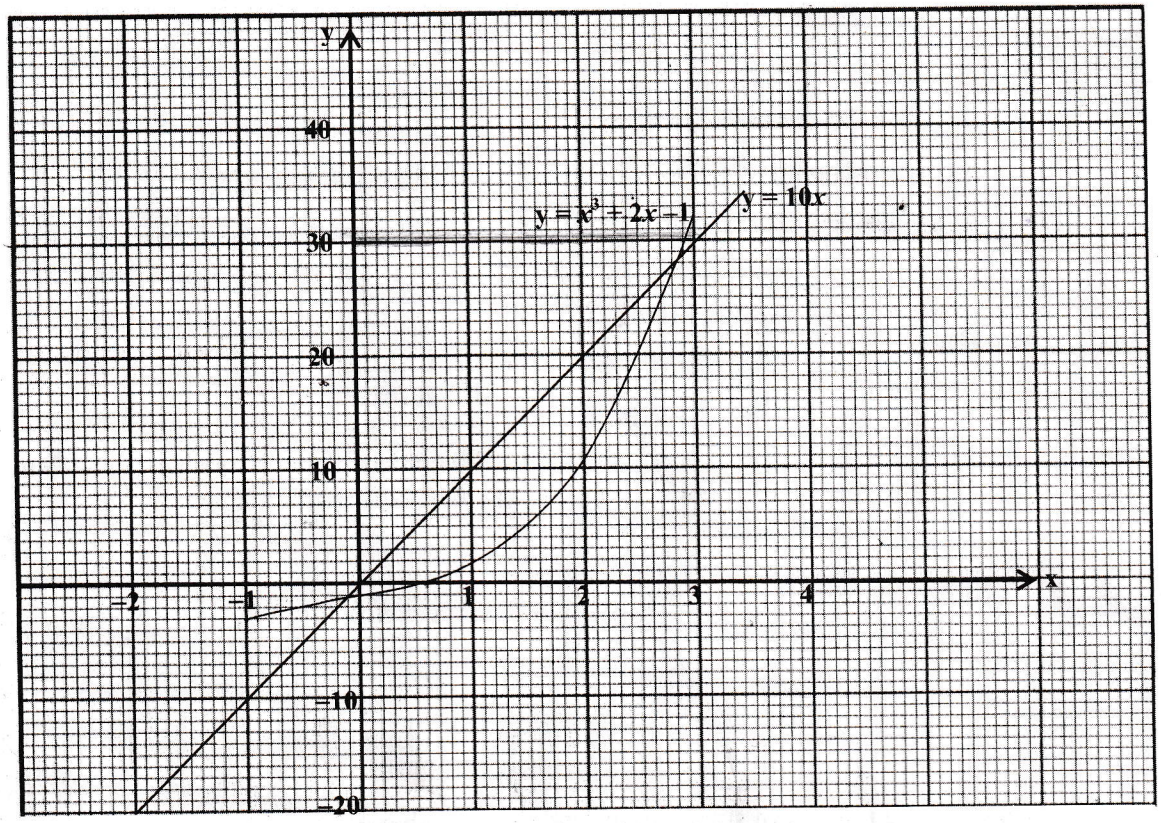
10 **(a)** The diagram below shows part of the graphs of $y = x^3 + 2x - 1$ and $y = 10x$.



(i) Use the graphs to solve the equations

(a) $x^3 + 2x = 6$, [2]

(b) $x^3 + 2x - 1 = 10x$. [2]

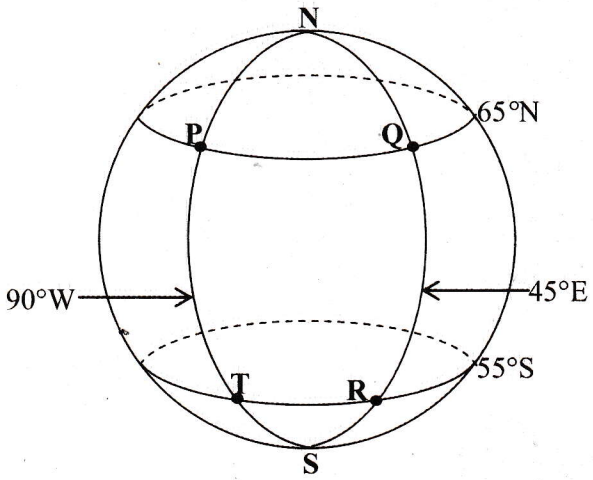
(ii) Calculate an estimate of

(a) the gradient of the curve at the point (2, 11), [2]

(b) the area bounded by the curve, $y = 10x$, $y = 0$ and $x = 2$. [3]

(b) Evaluate $\int_1^3 (3x^2 + 4x)\,dx$. [3]

11 **(a)** The points P, Q, R and T are on the surface of the earth as shown in the diagram below. [Take π as 3.142 and R = 3437nm]



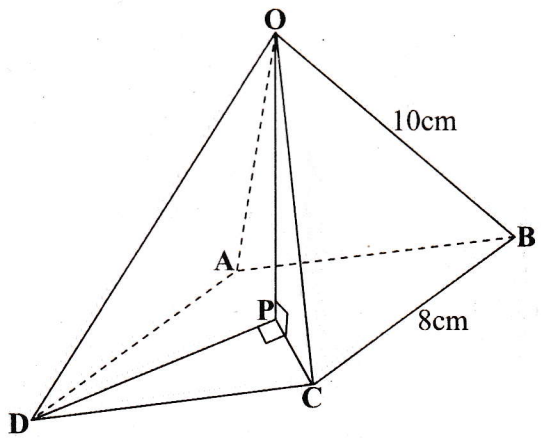
(i) Find the difference in longitude between the points T and R. [2]

(ii) Find, in nautical miles, the distance between

(a) P and Q along the latitude 65°N, [2]

(b) P and T along the longitude 90°W. [2]

(b) The figure below shows a right pyramid with a vertex O and a square base ABCD of side 8cm. $\hat{CPD} = \hat{OPC} = 90°$.

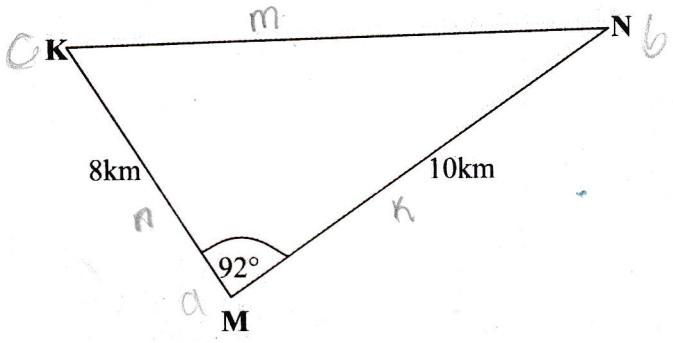


Given that OA = OB = OC = OD = 10cm, calculate

(i) the height OP, [4]

(ii) the angle between the edge OC and the base PC. [2]

12 **(a)** The diagram below shows a triangle KMN in which KM = 8km, MN = 10km and $K\hat{M}N = 92°$.



Calculate

(i) KN, [5]

(ii) the area of triangle KMN, [2]

(iii) the shortest distance from M to KN. [2]

(b) Solve the equation $2 \tan \theta = -3$ for $0° \leq \theta \leq 180°$. [1]

(c) Simplify $\frac{25p^4}{7q^2} \div \frac{5p^6}{21q^4} \times \frac{p}{15q}$. [2]

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SIR KAMUTI GIVEN