EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Mathematics
Paper 2

4024/2

Friday   **28 OCTOBER 2016**

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 9 printed pages

Mathematical Formulae

1 ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

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

2 SERIES

Geometric Progression

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

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

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

3 TRIGONOMETRY

Formula for $\triangle ABC$

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

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

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

4 STATISTICS

Mean and standard deviation

Ungrouped data

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

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 Q = $\begin{pmatrix} 3 & -2 \\ x & 4 \end{pmatrix}$, find the

    (i)   value of x, given that the determinant of Q is 2,   [2]

    (ii)   inverse of Q.   [2]

  (b)   Solve the equation $x^2 + 2x = 7$, giving your answers correct to 2 decimal places.   [5]

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2   (a)   Of the 50 villagers who can tune in to Kambani Radio Station, 29 listen to news, 25 listen to sports, 22 listen to music, 11 listen to both news and sports, 9 listen to both sports and music, 12 listen to both news and music, 4 listen to all the three programs, and 2 do not listen to any programme.

    (i)   Draw a Venn diagram to illustrate this information.   [2]

    (ii)   How many villagers

      (a)   listen to music only,   [1]

      (b)   listen to one type of programme only,   [1]

      (c)   listen to two types of programmes only?   [1]

  (b)   A survey carried out at a certain hospital indicates that the probability that a patient tested positive for malaria is 0.6. What is the probability that two patients selected at random

    (i)   one tested negative while the other positive,   [3]

    (ii)   both patients tested negative.   [2]

[Turnover

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

Start

  Enter radius

    If radius < 0

    Then display "error message" and re-enter positive radius

  Else enter height

    If height < 0

    Then display "error message" and re-enter positive height

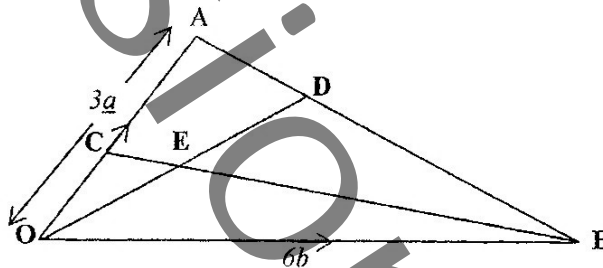   Else Volume = $\frac{1}{3}$ *π * square radius * height

    End if

  Display volume

Stop

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

(b)   In the diagram below, OAB is a triangle in which $\overrightarrow{OA} = 3\underline{a}$ and $\overrightarrow{OB} = 6\underline{b}$.
OC : CA = 2 : 3 and AD : DB = 1 : 2. OD meets CB at E.

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

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

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

    (c) $\overrightarrow{BC}$.   [2]

(ii)   Given that $\overrightarrow{BE} = h\overrightarrow{BC}$, express $\overrightarrow{BE}$ in terms of h, $\underline{a}$ and $\underline{b}$.   [1]

4   (a)   (i)   Construct a triangle ABC where AB = BC = CA = 7cm.   [1]

           (ii)   Measure and write the size of $\angle$CAB.   [1]

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

           (i)   equidistant from AB and BC,   [1]

           (ii)   4cm from B,   [1]

           (iii)   3cm from AB.   [2]

       (c)   A point R, within triangle ABC, is such that it is nearer to BC that AB, less than 3cm from AB and less than 4cm from B. Shade the region in which R must lie.   [2]

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5   (a)   Simplify $\dfrac{x-1}{x^2-1}$.   [2]

       (b)   The first three terms of a geometric progression are $x+1$, $x-3$ and $x-1$. Find

           (i)   the value of x,   [3]

           (ii)   the first term,   [1]

           (iii)   the sum to infinity.   [3]

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6   The equation of a curve is $y = x^3 - \dfrac{3}{2}x^2$. Find

       (a)   the equation of the normal where $x = 2$,   [3]

       (b)   the coordinates of the stationary points.   [3]

Section B [48 marks]

Answer any four questions in this section

Each question in this section carries 12 marks

The ages of people living at Pamodzi Village are recorded in the frequency table below.

Ages	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$
Number of people	7	22	28	23	15	5

(a) Calculate the standard deviation. [6]

(b) **Answer this part of the question on a sheet of graph paper.**

   **(i)** Using the information in the table above, copy and complete the cumulative frequency table below.

Age	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60
Number of People	7	29				100

[1]

    (ii) Using a scale of 2cm to represent 10 units on both axes, draw a smooth cumulative frequency curve where $0 \leq x \leq 60$ and $0 \leq y \leq 100$. [3]

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

8   Study the diagram below to answer the questions that follow.
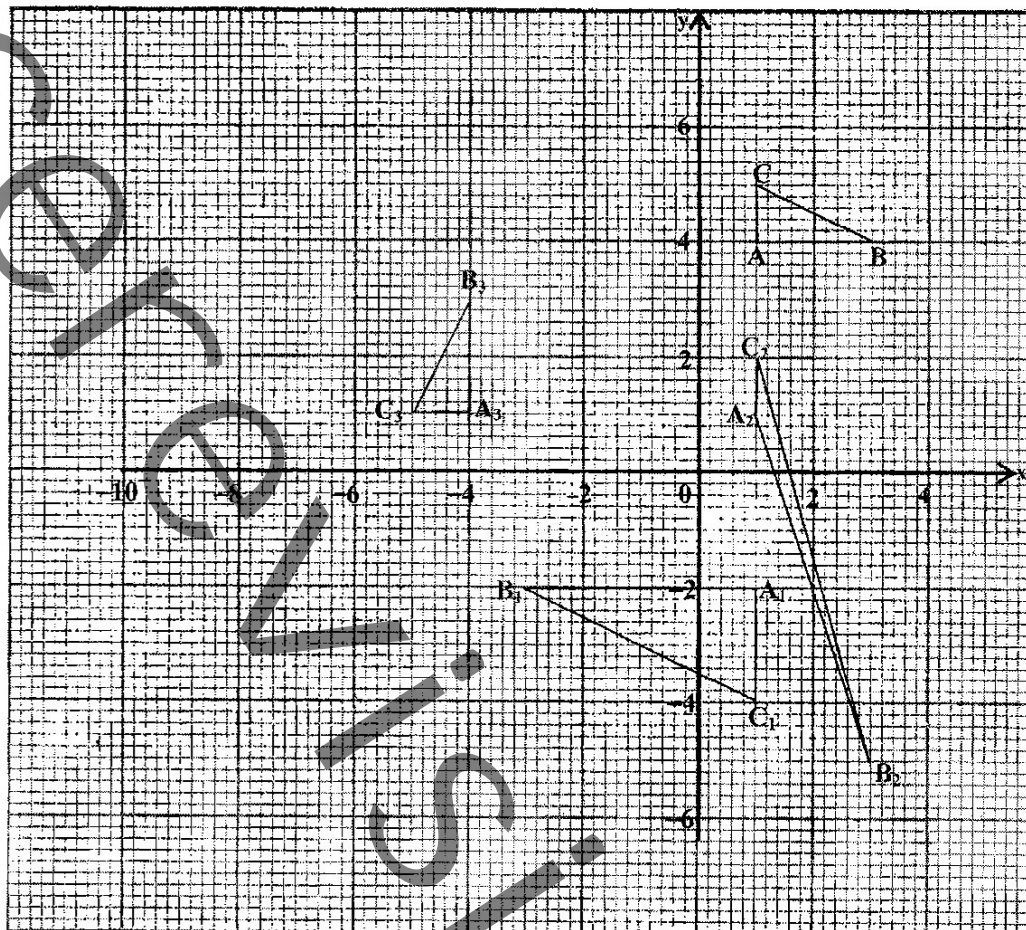
(a)   An enlargement maps triangle ABC onto triangle $A_1B_1C_1$. Find

   (i)   the centre of enlargement,   [1]

   (ii)   the scale factor.   [1]

(b)   Triangle ABC is mapped onto triangle $A_2B_2C_2$ by a shear. Find the matrix which represents this transformation.   [3]

(c)   Triangle ABC is mapped onto triangle $A_3B_3C_3$ by a single transformation. Describe this transformation fully.   [3]

(d)   A transformation with matrix $\begin{pmatrix} -3 & 0 \\ 0 & 1 \end{pmatrix}$ maps triangle ABC onto triangle $A_4B_4C_4$ not drawn on the diagram. Find

   (i)   the scale factor of this transformation,   [1]

   (ii)   the coordinates of A_4, B_4 and C_4.   [3]

[Turnover

9   (a)   The points A, B, C and D are on the surface of the earth.

(Take $\pi = 3.142$ and R = 3437nm)
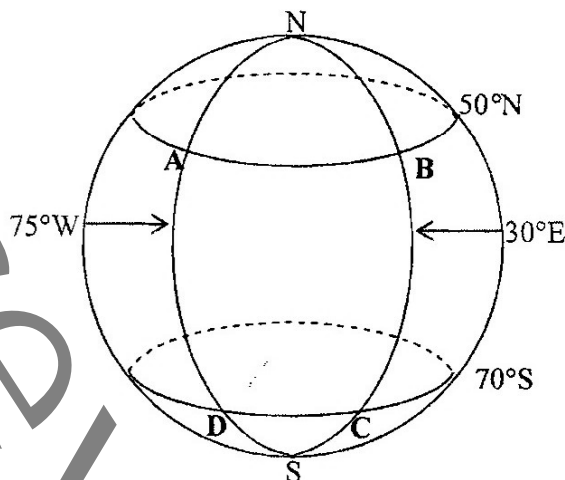
(i)   Find the difference in latitude between points C and B.   [1]

(ii)   Calculate the length of the circle of latitude 50°N in nautical miles.   [2]

(iii)   Find the distance AD in nautical miles.   [3]

(b)   The cross section of a rectangular tank measures 1.2m by 0.9m. If it contains fuel to a depth of 10m, find the number of litres of fuel in the tank. ($1m^3 = 1000$ litres).   [3]

(c)   A cone has a perpendicular height of 12cm and slant height of 13cm. calculate its total surface area. (Take $\pi = 3.142$)   [3]

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10   (a)   The diagram below shows the location of three secondary schools, namely Kamubala (K), Belengani (B) and Pendeni (P) in a district. P is 5km from K, B is 3km from K and $P\hat{K}B = 110°$.
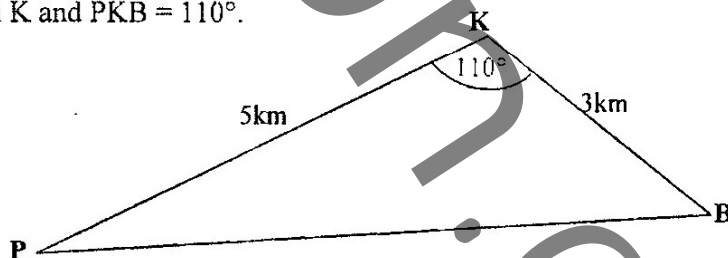
Calculate

(i)   BP,   [5]

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

(iii)   the shortest distance from K to BP.   [2]

(b)   Solve the equation $\tan \theta = 0.7$ for $0° \leq \theta \leq 180°$.   [1]

(c)   Simplify $\dfrac{17k^2}{20a^2} \div \dfrac{51k^2}{5a}$.   [2]

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11 (a) **Answer this part of the question on a sheet of graph paper.**

A Health Lobby Group produced a guide to encourage healthy living among the local community. The group produced the guide in two formats: a short video and a printed book. The group needed to decide the number of each format to produce for sale to maximise profit.

Let x represent the number of videos produced and y the number of printed books produced.

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

(a) the total number of copies produced should not be more than 800, [1]

(b) the number of video copies to be at least 100, [1]

(c) the number of printed books to be at least 200. [1]

(ii) Using a scale of 2cm to represent 100 copies on both axes, draw the x and y axes for $0 \le x \le 800$ and $0 \le y \le 800$ respectively and shade the unwanted region to indicate clearly the region where the solution of the inequalities lie. [4]

(iii) The profit on the sale of each video copy is K15.00 while profit on each printed book is K8.00. How many of each type were produced to make maximum profit? [2]

(b) Maphone manufacturing company paid a total dividend of K12 600 000.00 at the end of 2015 on 600 shares.

(i) Calculated the dividend per share. [2]

(ii) Magula owned 200 shares in the company, how much was paid out in dividends to her? [1]

12 (a) **Answer this part of the question on a sheet of graph paper.**

The values of x and y are connected by the equation $y = x(x - 2)(x + 2)$. Some corresponding values of x and y are given in the table below.

x	-3	-2	-1	0	1	2	3
y	-15	0	3	0	-3	0	k

(i) Calculate the value of k. [1]

(ii) Using a scale of 2cm to 1 unit on the x-axis for $-3 \le x \le 3$ and 2cm to represent 5 units on the y-axis for $-16 \le y \le 16$. Draw the graph of $y = (x - 2)(x + 2)$. [3]

(iii) Use your graph to solve the equations

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

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

(b) Express $\dfrac{2}{2x-1} - \dfrac{1}{3x+1}$ as a single fraction in its simplest form. [3]