

2705/102 2709/102

2707/102 2710/102

**MATHEMATICS I AND PHYSICAL  
SCIENCE**

Oct./Nov. 2022

Time: 3 hours



**THE KENYA NATIONAL EXAMINATIONS COUNCIL**

**DIPLOMA IN BUILDING TECHNOLOGY  
DIPLOMA IN CIVIL ENGINEERING  
DIPLOMA IN ARCHITECTURE**

**MODULE I**

**MATHEMATICS I AND PHYSICAL SCIENCE**

**3 hours**

**INSTRUCTIONS TO CANDIDATES**

*You should have the following for this examination:*

*Answer booklet;*

*Drawing instruments;*

*Mathematical tables/Scientific calculator.*

*This paper consists of EIGHT questions in TWO sections; A and B.*

*Answer FIVE questions choosing TWO questions from section A, TWO questions from section B and ONE question from either section.*

*All questions carry equal marks.*

*Maximum marks for each part of a question are as indicated.*

*Candidates should answer the questions in English.*

**This paper consists of 6 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**

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**Turn over**

**SECTION A: MATHEMATICS I**

Answer at least **TWO** questions from this section.

- ✓ (a) Determine the highest common factors of the following numbers: 48, 108 and 140. (4 marks)
- (b) Solve the following logarithmic equations:
- (i)  $\log_5(2x + 4) = 2$ ;
- (ii)  $\log_2(x^2 - 6x) = 3 + \log_2(1 - x)$ . (6 marks)
- (c) (i) Solve the following quadratic equation by the method of completing the square.  
 $3x^2 - 2x - 1 = 0$
- (ii) Make 'a' the subject of the formulae  $y = \frac{a^2m - a^2n}{x}$ . (10 marks)
2. (a) Use binomial theorem to determine the first three terms of the expansion  $(25 - x)^{\frac{1}{2}}$ . Hence, calculate the value of  $\sqrt{24}$  correct to three decimal place. (6 marks)
- (b) (i) Prove the following identity:  
$$\frac{1}{\tan x} + \tan x = \frac{1}{\sin x \cos x}$$
- (ii) Solve the following trigonometrical equation:  
 $3(1 - \sin x) = 2 \cos^2 x$  for  $0^\circ \leq x \leq 360^\circ$ . (9 marks)
- (c) Determine a cartesian equation for the polar curve  $r = 2(\cos \theta - \sin \theta)$ ,  $0 \leq \theta \leq 2\pi$ . Hence show it represent a circle and indicate its radius and cartesian coordinates of its centre. (5 marks)

- ✓ (a) The daily commuting distance of 125 workers to the nearest kilometres is summarised in **table 1**.

**Table 1**

Distance	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
Frequency	12	22	48	26	8	5	3	1

Calculate:

- (i) mean;
- (ii) standard deviation.

(7 marks)

- (b) A truck transporting materials, can be delayed due to the following reasons technical problems (T) weather conditions (W) and traffic congestion (C). These events are independent of each other and the truck will be delayed if one or more of these events occur. Given that  $P(T) = 0.1$ ,  $P(W) = 0.05$  and  $P(C) = 0.2$ , determine the probability that the truck will be delayed:

- (i) due to exactly one reason;
- (ii) due to all the reasons.

(6 marks)

- (c) Figure 1 shows a circular sector OAB subtended by an angle  $\theta$  radians at its centre.

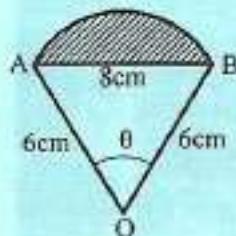


Fig. 1

Determine:

- (i) size of the angle  $\theta$ ;
- (ii) area of the shaded segment.

(7 marks)

4. (a) The second and the fifth term of a geometric series is 12 and 1 respectively. Calculate:

- (i) first term;
- (ii) common ratio;
- (iii) sum to infinity of the series.

(6 marks)

- (b) Relative to a fixed origin O, the point A has co-ordinates  $(-2, 4)$ . The point B is such that  $\overrightarrow{BA} = 5\mathbf{i} - \mathbf{j}$ . Determine:

- (i) distance of B from O;
- (ii) angle OAB.

(7 marks)

(c) Plot the graph of  $y = 2x^2 + 4x + 5$ ; for  $-3 \leq x \leq 1$  hence use the graph to solve the following equations:

(i)  $2x^2 + 4x - 3 = 0$ ;

(ii)  $2x^2 + 2x - 2 = 0$ .

(7 marks)

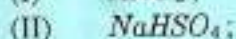
### SECTION B: PHYSICAL SCIENCE

Answer at least TWO questions from this section.

- ✓ (a) (i) State **two** types of hardness of water.
- (ii) Outline the **two** causes of hardness in water in each of the two types, stated in (i) above.
- (iii) List **two** methods of removal of hardness of water in each of the two types, stated in (i) above.

(8 marks)

- (b) (i) Define the following terms:
- (I) oxidation;
- (II) reduction;
- (III) oxidation number.
- (ii) Determine the oxidation number of each elements in these compounds:



(6 marks)

- (c) (i) State the **two** types of intramolecular bonding.
- (ii) State **four** properties which makes magnesium chloride an ionic compound.

(6 marks)

6. (a) (i) State **four** image characteristics of convex mirrors.
- (ii) An object is 25 cm from a concave spherical mirror of radius 80 cm. Determine the position and relative size of its image.

(8 marks)

- (b) (i) Explain the three properties of sound wave.
- (ii) A stone is dropped off a bridge from a height of 200 m above the water level. How long after dropping the stone will the splash be heard? Take speed of sound 343 m/s and  $g = 8.5 \text{ m/s}^2$ .

(12 marks)

- (a) (i) State the two types of circular motion.
- (ii) List the three quantities of circular motion.
- (iii) A wheel of diameter 2 m is shown in figure 2 with axle at O. A force  $F = 2 \text{ N}$  is applied at B in the direction shown.

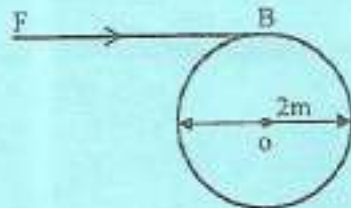


Fig. 2

Calculate the moment of the force about:

- (I) centre O;
- (II) point A.

(9 marks)

- (b) Define the terms:

- (i) couple;
- (ii) moment of couple.

(4 marks)

- (c) Figure 3 shows a uniform horizontal beam.

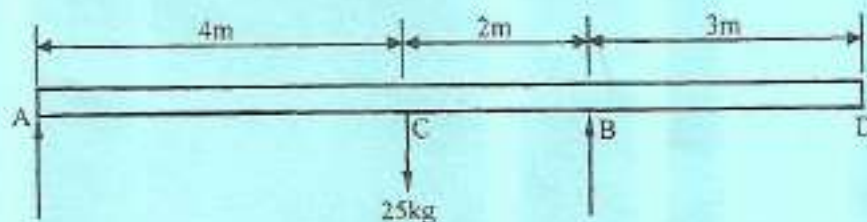


Fig. 3

If the mass of the beam is 25 kg, calculate the reactions of the support of the beam at point A and point B.

(7 marks)

8. (a) (i) State **four** differences between an acid and a base.  
(ii) Outline the process of making a soluble salt from an acid and alkali. (7 marks)
- (b) (i) Define the following terms:  
(I) vulcanisation;  
(II) thermoplastics;  
(III) co-polymer.  
(ii) List **four** classes of polymers on the basis of molecular forces.  
(iii) Distinguish between natural and synthetic polymers, giving **one** example of each. (7 marks)
- (c) (i) Define the term radio activity.  
(ii) List **four** application of radio activity.  
(iii) Explain **two** ways of minimizing exposure to any type of radiation. (6 marks)

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