

2705/102 2709/102
2707/102 2710/102
MATHEMATICS I AND
PHYSICAL SCIENCE
June/July 2019
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;

Mathematical table/non-programmable scientific calculator.

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

Answer FIVE questions choosing at least TWO questions from each section and ONE other 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 5 printed pages.

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

SECTION A: MATHEMATICS I

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

1. (a) Simplify $\frac{\log 625 - \log 25 + \frac{1}{2} \log 5}{\log 125 + \log 625 - \frac{1}{2} \log 25}$. (3 marks)

(b) Convert:

(i) 1101101 to denary;

(ii) 204 to binary. (4 marks)

(c) Make A the subject of the formulae:

$$T = \frac{2m}{n} \sqrt{\frac{L-A}{3k}}$$

(4 marks)

(d) Solve the following simultaneous equations:

$$\frac{2}{x} + \frac{3}{y} = 7$$

$$\frac{1}{x} - \frac{4}{y} = -2$$

(4 marks)

(e) Solve the equation:

$$\log 2x^3 - \log x = \log 16 + \log x$$

(5 marks)

2. (a) Given that $\vec{A} = P\vec{i} + b\vec{j} - 3\vec{k}$ and $\vec{B} = 4\vec{i} + 3\vec{j} - \vec{k}$ where P is a constant. Determine the value of P such that vectors \vec{A} and \vec{B} are perpendicular to each other. (4 marks)

(b) Evaluate the middle term in the binomial expansion of $(2x + 3y)^8$ and its value when $x = \frac{1}{3}$ and $y = \frac{1}{2}$. (6 marks)

(c) The sum of 4th and 6th terms of a geometric series is 80. If the product of the 3rd and 5th term is 256, determine:

(i) first term,

(ii) common ratio;

(iii) sum of the first eight terms. (10 marks)

3. (a) Prove the identity:

$$\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta} = \frac{2}{\sin \theta}$$

(4 marks)

- (b) The probability of breakdown of a concrete mixer is $\frac{1}{4}$, dumper $\frac{1}{6}$ and hoist is $\frac{1}{8}$ respectively. Determine the probability that:
- all machines breakdown;
 - two machines breakdown. (5 marks)

- (c) Table 1 shows the lengths in centimetres of 50 bars in a construction site.

Length (cm)	Frequency
34 - 36	2
37 - 39	6
40 - 42	12
43 - 45	14
46 - 48	10
49 - 51	5
52 - 54	1



Calculate:

- mode;
- median. (5 marks)

- (d) Solve the equation $3 \cos^2 \theta + 10 \sin \theta = 11$. For all values of θ between 0° and 360° inclusive. (6 marks)

4. (a) A minor segment is enclosed between a chord of length 14 cm and a circle of diameter 20 cm. Determine the area of the segment. (5 marks)

- (b) (i) A ship sails due north from latitude 20°S for a distance of 1440 nm. Determine the latitude of the point it reaches.

- (ii) A second ship sails due west from a position (60°N , 5°W). For a distance of 1200 km. Determine its new position. (5 marks)

- (c) Without using a protractor, construct a triangle ABC. $AB = 4 \text{ cm}$, $BC = 6 \text{ cm}$ $\angle ABC = 90^\circ$; hence:

- draw the locus of the points that are equidistant from A and B;
- draw the locus of the points that are equidistant from B and C;
- describe what is significant about the point of intersection of the two lines drawn. (5 marks)

- (d) Determine graphically the values of x and y which simultaneously satisfy the equations. (5 marks)

$$y = 2x^2 - 3x - 4$$

$$y = 2 - 4x$$

SECTION B: PHYSICAL SCIENCE

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

5. (a) (i) Write a chemical equation between the reaction of acid and metal. (1 marks)
- (ii) Metal compound A, reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction, if one of the compound formed is calcium chloride. (2 marks)
- (b) State **three** general characteristics of an acid. (3 marks)
- (c) (i) Define the term adhesive.
- (ii) State:
- I. **two** major sources of adhesive;
 - II. **two** reasons why adhesives are used to minimise corrosion at joints of dissimilar metals. (6 marks)
- (d) In an experiment, it was found out that 4.21 g of copper oxide was reduced by hydrogen to 3.74 g of copper. Use this information to deduce:
- (i) the formulae of copper oxide;
 - (ii) write an equation to represent the reduction of copper oxide in (i) (Cu = 63.5; O = 16). (8 marks)
6. (a) (i) Define polymerization.
- (ii) Distinguish between addition polymerization and condensation polymerization.
- (iii) State **two** disadvantages of synthetic polymers. (8 marks)
- (b) (i) State **two** types of hardness in water.
- (ii) Explain:
- I. **two** causes of hardness;
 - II. **three** methods used to remove hardness in water. (12 marks)



7. (a) State the basic laws which determine the reflection of light by mirrors. (2 marks)
- (b) (i) Show how power and focal length of a lens are related.
- (ii) Two lens have, focal length 20 cm and 40 cm respectively, state which lens will obtain more convenient light.
- (iii) Determine the image position and the magnification of an object placed 10 cm in front of concave mirror of focal length 15 cm. (8 marks)
- (c) (i) State:
- I. **three** types of radiation, emitted by radio active elements;
 - II. **three** uses if radio isotopes.
- (ii) Distinguish between nuclear fission and nuclear fusion. (10 marks)
8. (a) (i) State the principle of moments.
- (ii) A uniform beam of length 8.0 m loaded with weight 4000 N is supported on two levels, 1.0 M from left hand end and 3.0 M from the right support, determine, the reaction at each support. (6 marks)
- (b) 25 N force is applied to a box as shown in **figure 1** and the box moves 10 m. Determine the work done by the force.

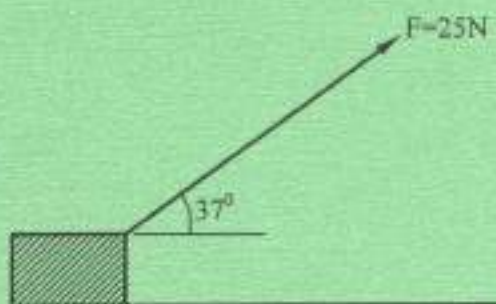


Fig. 1



(4 marks)

- (c) (i) Explain the difference and similarity between transverse waves and longitudinal waves giving an example of each.
- (ii) A sound wave travels at 340 m/s at a frequency of 1500 Hertz. Calculate its wave length. (10 marks)

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