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**MATHEMATICS I AND PHYSICAL
SCIENCE**

June/July 2017

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 tables/non-programmable 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 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 $\frac{1}{2}$ of $(4\frac{1}{2} - 2\frac{3}{4}) + 2\frac{1}{5} \div \frac{3}{5} - \frac{1}{2}$. (4 marks)
- (b) Solve the equations:
- (i) $(\sqrt{625})^2 = 5^{2x+2}$;
- (ii) $\text{Log}_8(x+3)^2 = 2$. (7 marks)
- (c) Three bells ring at intervals of 12, 42 and 90 minutes. If the bells rang together at 9.20 am on Monday, determine the time they will ring together again. (4 marks)
- (d) The total daily wages paid to 30 unskilled and 10 skilled workers in a construction firm was Ksh 18,000. Due to economic down turn, the company sized its workforce to 20 unskilled and 5 skilled workers. By doing this, the daily wages reduced to Ksh 10,500. Use the elimination method to determine the daily wages of each category of workers. (5 marks)
2. (a) Convert:
- (i) $x^2 - y^2 = 5$ into polar form ;
- (ii) $r = 8 \cot\theta \operatorname{cosec} \theta$ into cartesian form . (6 marks)
- (b) Determine the area of a regular hexagon which has sides of 10 cm. (4 marks)
- (c) A committee of 6 is to be selected from 8 men and 7 women. Find the number of ways in which the committee can be formed so that it contains at least 4 men. (4 marks)
- (d) Determine the value of the coefficient independent of x in the binomial expansion of:
 $(3x^2 - \frac{1}{2x})^9$. (6 marks)
3. (a) Find the area of the triangle whose two sides are the vectors:
 $A = 2i + 4j + 2k$ and
 $B = 7i - j + k$ (7 marks)

$$30 \times 5 + 10 \times 5 = 15000 \times 5$$

$$20 \times 10 + 5 \times 10 = 10700 \times 10$$

$$\frac{1}{2} \times \frac{2}{7}$$

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- (b) A packet contains 120 washers, 44 of which are made of brass, 56 are made of copper and the remainder are made of steel. One washer is taken at random, but not replaced and a second washer is treated similarly. Determine the probability that:
- both washers are made of steel;
 - the first is made of brass and the second is made of copper. (6 marks)
- (c) A ship leaves an island A (38.5° N , 37.05° E) and sails due North at a point B on latitude 52° N . Determine the:
- distance covered by the ship in km;
 - position of C, if the ship sails due East to a point C 2,400 km from B. (7 marks)
4. (a) The seventh term of an arithmetic progression is twice its third term. The sum of the first seven terms of the same progression is 175. Determine the:
- common difference;
 - first term;
 - least value of n given that the n th term of the progression is greater than 145. (7 marks)
- (b) **Table 1** shows the heights of 50 students pursuing a course in civil engineering.

Table 1

Height (cm)	140-144	145-149	150-154	155-159	160-164
Frequency (f)	3	15	19	11	2

Calculate the:

- mode;
 - median height. (7 marks)
- (c) Solve the equation $2 \sec^2 \theta = 4 \tan \theta + 1$ for $0^\circ \leq \theta \leq 360^\circ$. (6 marks)



SECTION B: PHYSICAL SCIENCE

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

5. (a) State the two laws of reflection. (2 marks)
- (b) With the aid of a labelled diagram, describe the construction and operation of a simple microscope. (6 marks)
- (c) A ray of light passing from glass to air is monochromatic and has a frequency and wavelength of 4×10^{14} Hz and 5×10^{-7} m respectively. Calculate the:
- (i) velocity of light in the glass;
- (ii) refractive index, if the velocity of light in air is 3×10^8 m/s. (6 marks)
- (d) Using chemical equations, describe how the following methods can be used to remove permanent hardness of water:
- (i) precipitation with washing soda;
- (ii) ion exchange;
- (iii) distillation. (6 marks)
6. (a) Explain the following types of chemical bonds:
- (i) ionic bond;
- (ii) covalent bond;
- (iii) co-ordinate bond. (6 marks)
- (b) With the aid of a labelled diagram, describe how the following radiations are deflected in an electric field:
- (i) alpha particles;
- (ii) beta particles;
- (iii) gamma particles. (8 marks)
- (c) Determine the empirical formula of the compound formed when 1.2 g of magnesium reacts with 3.55 g of chlorine. Take the molar mass of magnesium and chlorine to be 24 g and 35.5 g respectively. (6 marks)
7. (a) State four advantages of synthetic polymers. (4 marks)
- (b) State two uses of polythene. (2 marks)
- (c) Explain three factors affecting speed of sound. (6 marks)
- (d) A student standing between two walls shouts once. He hears the first echo after 3 seconds and the next after 5 seconds. Calculate the distance between the walls. (8 marks)

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8. (a) (i) State the principles of moments.
 (ii) **Figure 1** shows a uniform horizontal level beam supported on a fulcrum.
 Calculate the:
- (I) magnitude of the load N required to maintain equilibrium;
 (II) magnitude of the reaction R at the support.

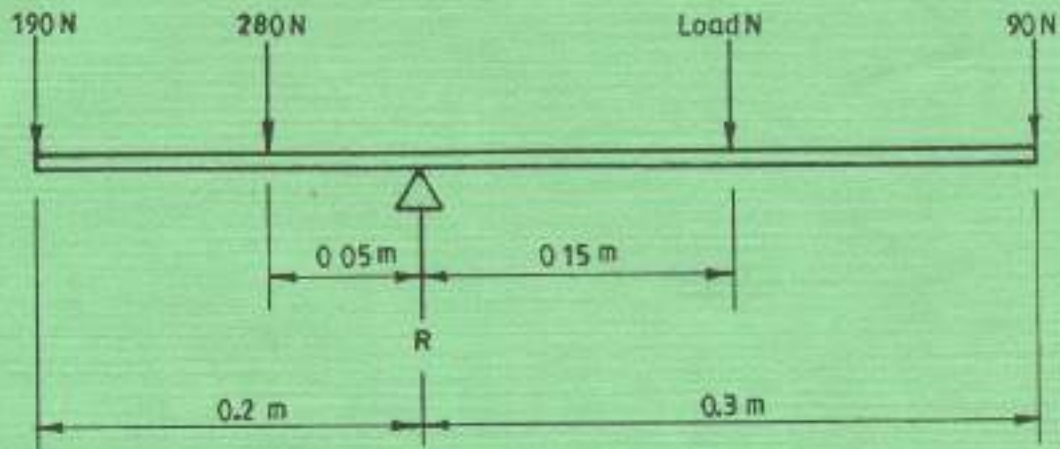


Figure 1

(10 marks)

- (b) State **four** properties of acids. (4 marks)
- (c) Explain the following types of salts, giving examples of each:
- (i) normal salt;
 (ii) acid salt;
 (iii) double salt. (6 marks)

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