

2705/102 2709/102
2707/102 2710/102

MATHEMATICS I AND PHYSICAL SCIENCE

Oct./Nov. 2018

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN BUILDING
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;*
- scientific calculator;*
- drawing instruments.*

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.

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) Use quadratic formula to solve the following equation: $\frac{2}{x-3} + 4 = \frac{x+4}{3}$. (6 marks)
- (b) Solve the equation: $\text{Log}3x^3 - \log x^2 = \log 27 - \log x$. (4 marks)
- (c) Transpose the formula $T = 4\pi \sqrt{\frac{(M+m)l}{3(M+2m)g}}$ to make M the subject. (5 marks)
- (d) The bending moment at a point in a beam is given by: $M = \frac{2.5x(12-x)}{2}$ where x metres is the distance from the point of support. Find the value of x when the bending moment is 56 NM. (5 marks)
2. (a) A septic tank is to be excavated at the rate of 15 m^3 during the first day, 35 m^3 during the second day, 55 m^3 during the third day and so on. Find the number of days required to excavate a rectangular septic tank measuring $16 \text{ m} \times 7 \text{ m} \times 7 \text{ m}$. (4 marks)
- (b) A piece of land cost Ksh 500,000 and 5 years later it is sold for Ksh 1,250,000. Find the percentage appreciation if the appreciation is constant annually. (4 marks)
- (c) (i) If $\sin(\theta + \phi) = 2 \cos(\theta - \phi)$ prove that:

$$\tan \theta = \frac{2 - \tan \phi}{1 - 2 \tan \phi}$$
 (4 marks)
- (ii) Solve the equation $3 \cos 2\theta + \sin \theta = 1$ for values of θ from 0° to 180° . (4 marks)
- (d) Draw the graph of $y = e^{-x^2}$ over the range of $x = -2$ to $x = 2$. (4 marks)
3. (a) A vertical, cylindrical ventilation shaft of diameter 300 mm has its end at an angle of 24° to the horizontal. Determine the area in cm^2 of the plate required to cover the end. (5 marks)
- (b) A metal sphere weighing 36.0 kg is melted down and recasted into a solid cone of base radius 14 cm. If the density of the metal is 8 g/cm^3 . Find:
 (i) the radius of the metal sphere;
 (ii) the perpendicular height of the solid cone, assuming that 10 % of the metal is lost in the process. (8 marks)
- (c) Expand $(5+x)^7$ up to the term in x^2 and hence evaluate $\sqrt[5]{5.1}$ to 6 decimal places. (7 marks)



4. (a) The following data represents the frequency distribution of 50 blocks of grade M15 that were tested for compressive strength in N/mm^2 .

| Compressive strength in N/mm^2 | No. of blocks |
|----------------------------------|---------------|
| 12.0 - 12.2 | 7 |
| 12.2 - 12.4 | 11 |
| 12.4 - 12.6 | 18 |
| 12.6 - 12.8 | 10 |
| 12.8 - 13.0 | 4 |

Determine the:

- (i) mean;
 (ii) standard deviation;
 (iii) interquartile range of the distribution.

$\frac{\sum fx}{\sum f}$

(14 marks)

- (b) A batch of 24 articles consist of 14 good ones, 6 with only minor defects, and 4 with major defects. Two articles are taken at random tested and replaced. Use a tree diagram to find the probability that:

- (i) one article is good while the other has major defect;
 (ii) one article has major defect while the other article has minor.

(6 marks)



SECTION B: PHYSICAL SCIENCE

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

5. (a) (i) Define the moment of a force about a point.
 (ii) State the principle of moment. (4 marks)
- (b) Figure 1 shows a system of forces acting on a light uniform rod of 1 metre long.

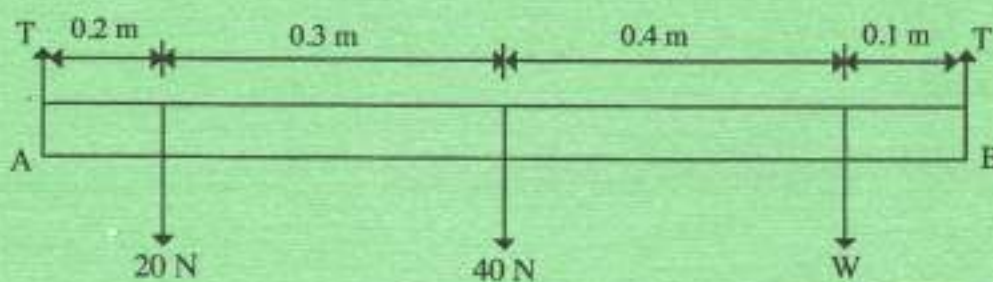


Figure 1

Find:

- (i) the value of W so that the tensions are equal;
 (ii) the tension T. (6 marks)
- (c) State five factors which affect propagation of sound. (8 marks)
- (d) State four methods of sound prevention in an environment. (2 marks)
6. (a) State the laws of reflection. (2 marks)
- (b) State the characteristics of images formed by concave mirrors. (4 marks)
- (c) State four uses of curved mirrors. (4 marks)
- (d) An object 4.0 cm tall is placed 18.0 cm from a concave mirror of focal length 6.0 cm. By using full scale ray diagram, determine:
- (i) the distance of the image;
 (ii) the height of the image;
 (iii) nature of the image.

(10 marks)

7. (a) Explain what is meant by the following terms as applied to atomic physics:
- mass number;
 - atomic number;
 - nucleons.
- (3 marks)
- (b) A particular atom of neon has atomic number 10 and mass number 20.
- Calculate the number of protons and neutrons in this atom.
 - Another atom of neon has a mass number of 22. Compare and contrast this atom with the first atom in (i) above.
- (4 marks)
- (c) Explain **three** uses of radioisotopes in the construction industry. (6 marks)
- (d) With the aid of a graph of activity against time for a radioactive material, explain how the half-life for radioactive material is determined. (7 marks)
8. (a) (i) State the **two** types of polymers.
- (ii) Give **two** examples in each of the type stated in (i) above. (6 marks)
- (b) Explain the following method of polymerization:
- addition;
 - condensation.
- (4 marks)
- (c) State **four** characteristics of a base. (4 marks)
- (d) Describe **three** properties of ionic compounds. (6 marks)



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$2 \times 0.3 = 0.6$