2705/102 2709/102
2707/102 2710/102
MATHEMATICS I AND PHYSICAL SCIENCE
June/July 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 examinations:
Answer booklet;
Scientific calculator.
*This paper consists **EIGHT** questions in **TWO** sections; **A** and **B**.*
*Answer **FIVE** questions choosing at least **TWO** questions from each 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 ensure 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) Solve the simultaneous equations:

$$2\log y = \log 32 - \log x$$
$$4^y = 16^x$$

(4 marks)

(b) Express $\frac{x-5}{(x+2)(x-3)}$ into partial fractions. (6 marks)

(c) A piece of land is in form of a triangle of sides 700 m × 500 m × 400 m. A bore hole is located at a point equal distance from the three vertices. Using a scaled drawing determine the length of a horse pipe that will water the whole land. (6 marks)

(d) Solve the simultaneous equations by use of substitution method.

$$\frac{10}{x} + \frac{3}{y} = 4$$

$$\frac{27}{x} + \frac{15}{y} = \frac{57}{4}$$

(4 marks)

2. (a) A hardware sells a combination of items as follows: 3 kgs of nails, 5 kgs of cement and 4 kgs of lime at the cost of Ksh 487; 2 kgs of nails, 3 kgs of cement and 6 kgs of lime at the cost of 381; $\frac{1}{2}$ kg of nails, 2 kgs of cement and 3 kgs of lime at cost of Ksh 136. Find the cost of 1 kg of each item. (10 marks)

(b) Expand $\sqrt[3]{1-\frac{1}{3}x}$ to the term containing x^4. Hence find the value of $\sqrt[3]{0.97}$ correct to 4 significant figures. (7 marks)

(c) The 4th term of a geometric series is 1500 and the 6th term is 37,500. Find the 1st term and the common ratio. (3 marks)

3. (a) Given that $Sin\ A = \frac{5}{\sqrt{61}}$ and $\cos B = \frac{-9}{\sqrt{130}}$ and A is in the first quadrant and B is in second gradient. Find the value of the following in surd form.

(i) $\cos(A+B)$;

(ii) $\sin(A+B)$.

(8 marks)

(b) The cross-section of a cylindrical log have the following diameters; 1.5 m, 1.2 m, 1.1 m, 0.9 m and 0.7 m at intervals of 0.6 m. Find the approximate volume using Simpson's rule. **(6 marks)**

(c) Plot the graph of the polar equation.

$r = 6\sin 5\theta$ **(6 marks)**

4. (a) Three items of construction plant; backactor, grader and a bulldozer have the probabilities of $\frac{3}{11}, \frac{2}{5}$ and $\frac{7}{9}$ to be in use in a given month. Find the probability that in a given month:

(i) the bulldozer is the only plant in use.

(ii) none of the plant is in use.

(6 marks)

(b) Find the area of a parallelogram enclosed by the vectors $\vec{A} = 3i + 2j - 5k$ and $\vec{B} = -2i + 4j + k$. (7 marks)

(c) The time taken by 20 technicians to complete a given task are indicated below; 26, 13, 31, 27, 28, 26, 33, 36, 42, 29, 17, 38, 48, 24, 18, 28, 23, 32, 38 and 31. Group the data starting with the class 10 - 14; Hence calculate:

(i) the mean;

(ii) the standard deviation. (7 marks)

SECTION B: PHYSICAL SCIENCE

Answer at least TWO questions from this section.

5. (a) With aid of diagram, explain the following terms as related to sound:

(i) frequency;

(ii) wavelength;

(iii) period.

(6 marks)

(b) Explain **three** factors affecting the velocity of sound in air. (6 marks)

(c) Giving examples in each case differentiate between natural and synthetic polymers. (4 marks)

(d) Explain **two** methods of disposing polymers. (4 marks)

6. (a) State the laws of:

(i) reflection;
(ii) refraction.

(4 marks)

(b) State **two** uses of mirrors in buildings. (4 marks)

(c) Describe the images formed by a concave mirror. (4 marks)

(d) A concave mirror has a radius of curvature of 30 cm. If an object of height 2 cm is placed at 24 cm infront of the mirror, find by scale drawing the image distance and its size. (8 marks)

7. (a) Explain **three** disadvantages of hard water. (6 marks)

(b) Explain the terms:

(i) temporary hardness of water;
(ii) permanent hardness of water.

(4 marks)

(c) Define the following terms:

(i) radioactivity;
(ii) gamma rays;
(iii) alpha particles;
(iv) X-ray.

(4 marks)

(d) Explain **three** uses of radio-isotopes. (6 marks)

8. (a) Explain **two** applications of redox reactions. (4 marks)

(b) Explain the properties of the following:

(i) acids;
(ii) bases;
(iii) salts.

(6 marks)

(c) With aid of a sketch explain the following:

(i) varying loads;

(ii) uniformly distributed load.

(4 marks)

(d) **Figure 1** shows a uniform metre rule of mass 300 g suspended by two strings and loaded as shown. Find the tension in the strings T_1 and T_2. (6 marks)

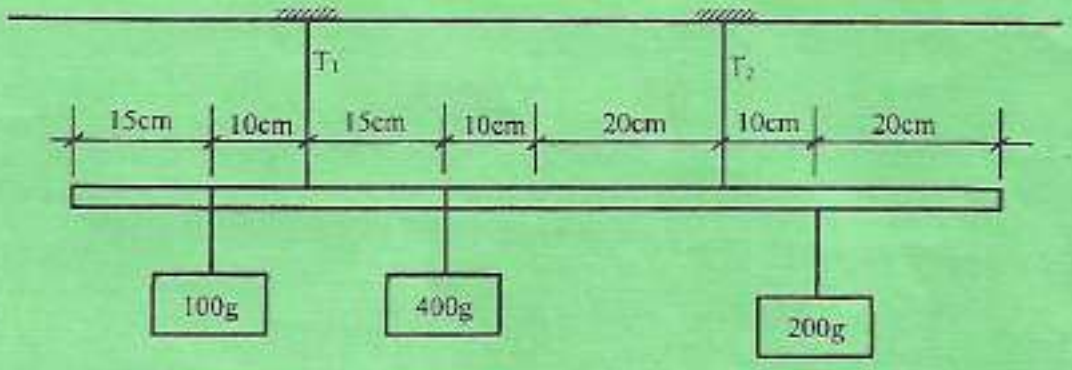

Fig. 1

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