2705/102   2709/102
2707/102   2710/102
MATHEMATICS I AND PHYSICAL
SCIENCE
Oct./Nov. 2021
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;
    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.
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.

Turn over

SECTION A: MATHEMATICS I

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

1. (a) Simplify the expressions:

    (i) $\dfrac{\log 256 - \frac{1}{3}\log 64}{\log 64 + \frac{1}{2}\log 16}$

    (ii) $\left[\dfrac{81a^4 b^2}{121a^{-6}b^8}\right]^{\frac{1}{2}}$

    (7 marks)

    (b) Solve the equations

    (i) $3^{2x+1} = 27^{\frac{4x}{3}}$

    (ii) $\log_x 4 + 2\log_2 x^2 = 6$

    (13 marks)

2. (a) The sum of the first three terms of an arithmetic progression is 3 and the difference between the seventh term and the fourth term is -6.

    Determine:-

    (i)   first term and the common difference;

    (ii) sum of the first twenty terms.

    (6 marks)

    (b) Express the equation $x^2 + (y-2)^2 = 4$ in polar form.   (7 marks)

    (c) Find the ratio of the term in x^5 to the term in x^3 in the binomial expression of $(x+4)^{10}$ and determine its value when $x = \frac{1}{3}$ correct to four decimal places.

    (7 marks)

3. (a) Express the partial fraction into a single fraction: $\dfrac{2x}{(x^2+1)} + \dfrac{3}{(x+1)}$. (3 marks)

(b) A solid aluminium cone of radius 14 cm and perpendicular height of 25 cm is melted and converted to a bowl in form of a hemisphere. If the bowl has a uniform thickness of 2 cm. Find the internal and external radii if no material is wasted. (10 marks)

(c) (i) Given that:

$$Sin(\theta + \alpha) = 2\,Cos(\theta - \alpha) \text{ show that}$$

$$Tan\theta = \dfrac{2 - \tan\alpha}{1 - 2\tan\alpha}.$$

(ii) Hence solve the equation

$$Sin\left(\theta + \dfrac{\pi}{4}\right) = 2\,Cos\left(\theta - \dfrac{\pi}{4}\right) \text{ for values of } \theta \text{ between } 0° \text{ and } 360°.$$

(7 marks)

4. (a) A researcher analyzed the usage of a sample of 100 workers, in Embakasi sub-county of Nairobi county and the report is as follows:

Wages Ksh. '000' per month	Number of workers
30 - 39	2
40 - 49	5
50 - 59	40
60 - 69	15
70 - 79	20
80 - 89	10
90 - 99	5
100 - 109	3

Calculate:

(i) mean wage;

(ii) standard deviation of the distribution.

(10 marks)

(b) A contractor has twelve sites. In five sites he has used tiles for flooring and in three sites terrazzo, then 4 sites parquets floor blocks. If one morning the contractor visits two sites at random; draw a probability tree diagram to represent the kind of floor finish found. Hence find the probability that:

(i) All sites visited had tile as floor finish.

(ii) One had parquet while one had terrazo.

(iii) Non had terrazo.

(10 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) (i) Explain the meaning of the term moments. (2 marks)

(ii) State the conditions of stability. (4 marks)

(b) A uniform beam AB measures 200 cm and weighs 2.1 N. It is placed on two supports C and D such that they are 30 cm from each end of the beam. A 0.5 N weight is hanged on the beam 45 cm from C and 0.9 N weight is hanged similarly 55 cm from D. Sketch and determine the reactions at the supports. (11 marks)

(c) State and explain factors affecting stability. (3 marks)

6. (a) Describe **three** properties of covalent compounds. (6 marks)

(b) Describe the following types of forces:

(i) magnetic force;
(ii) electro-motive force;
(iii) couples force;
(iv) frictional force.

(8 marks)

(c) Explain the following methods of polymerisation:

(i) addition;
(ii) condensation.

(6 marks)

7. (a) An object 20 mm tall is placed 35 cm from a concave mirror of focal length 20 cm. By means of accurate graphical construction determine the:

(i) position of the image;

(ii) size of the image;

(iii) nature of the image formed.

(10 marks)

(b) Explain the following terms:

(i) hard water;
(ii) soft water.

(2 marks)

(c) Explain **four** methods of softening hard water. (8 marks)

8. (a) Define the following terms using a chemical equation:

(i) salt;

(ii) neutralization;

(iii) acids.

(6 marks)

(b) Describe the following types of radiation emitted by radioactive substances:

(i) Alpha particles;
(ii) Beta particles;
(iii) Gamma rays.

(6 marks)

(c) Describe **three** applications of isotopes. (6 marks)

(d) A certain nuclide has a half life of 15 hours. What fraction of a given mass of the nuclide would be left after 5 days? (2 marks)

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