2705/102 2709/102
2707/102 2710/102
MATHEMATICS I AND
PHYSICAL SCIENCE
Oct./Nov. 2016
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/ 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 shown.
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) (i) Prove the trigonometric identity:

$$\text{Sin}(A+B)+\text{Sin}(A-B)=2\,\text{Sin}\,A\,\text{cos}B.$$ (4 marks)

(ii) Solve the trigonometric equation:

$$7\tan^2\theta+\sec\theta=4 \text{ for } 0^\circ\le\theta\le 360^\circ$$ (8 marks)

(b) The marks obtained by 45 students in a physics examination are given in table 1 below. Group the data into seven classes, hence find:

(i) frequency of each class;
(ii) the mean mark.

34	40	45	39	35	38	46	45	44	34	50
45	35	39	38	35	37	39	43	48	37	42
50	39	46	41	44	41	51	42	47	49	36
47	48	49	50	38	44	44	43	51	34	41
37										

Table 1

(8 marks)

2. (a) Obtain the first terms of the expansion $\left(1+\frac{1}{4}x\right)^8$ in the ascending powers of x. Hence find the value of $(1.02)^6$ correct to four decimal places. (7 marks)

(b) Draw a circle centre O radius 4 cm. If M is a point 7 cm from O, construct two tangents to the circle from M to touch the circle at points N and P.

(i) measure NP;
(ii) calculate the area MNOP.

(7 marks)

(c) Factorise the expression:

$$9x^2 - 11x + 2$$ (3 marks)

(d) Simplify the expression:

$$\sqrt[3]{\frac{2^x\cdot 5^{3x}}{2^{-3x}\cdot 5^x}}$$ (3 marks)

3. (a) Sketch the graph of $y - 9 = 3x^2 + 2x$ for the values of [illegible] graph to solve:

(i) $3x^2 - 2x - 1 = 0$;
(ii) $3x^2 + 2x - 1$.

(14 marks)

(b) Obtain the value of x for which $(x + 1), (x - 5)$ and $(x - 2)$ is a geometric progression. Hence find the sum of the first 12 terms of the progression. (6 marks)

4. (a) A piece of timber has a cross-sectional area of A square units perpendicular to its length at a distance d units from one end as shown in table 2 below.

d	0	2	4	6	8	10	12
A	2.8	4.7	6.2	7.3	7.1	6.7	6.2

Table 2

Draw a graph of A against d and use Simpson's rule with 12 intervals to find the volume of the piece of timber. (8 marks)

(b) Find the area of a triangle whose two sides are the vectors:

$\underline{a} = -\underline{i} - 2\underline{j} + \underline{k}$

$\underline{b} = 2\underline{i} - 3\underline{k}$

(6 marks)

(c) A bag contains 9 red, 5 white and 15 black balls. If two balls are drawn in turn without replacement from the bag:

(i) draw a tree diagram representing the probability;
(ii) determine the probability of having:

(I) no white ball;
(II) one red and one black.

(6 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) Define the following terms:

(i) mass;
(ii) moments of a force.

(2 marks)

(b) A uniform wooden lath AB, 200 cm long and weighing 2 N rests on two supports C and D placed 10 cm from each end of the lath respectively. A 30 N weight hangs from a loop of thread 50 cm from end A and a 80 N weight hangs 60 cm from end B. Sketch the set - up and hence calculate the reactions at the supports. (8 marks)

(c) State:

(i) the **two** laws of reflection.
(ii) any **three** applications of curved mirrors.

(5 marks)

(d) (i) The critical angle for water is 48.5°. Calculate its reflective index. (2 marks)

(ii) How many images would be seen from two mirrors whose reflective surfaces make an angle of 12° to each other. (3 marks)

6. (a) With a sketch, define the following terms as applied to waves:

(i) amplitude;
(ii) frequency;
(iii) wave length.

(6 marks)

(b) Describe **three** methods employed to minimize sound pollution in a construction site. (6 marks)

(c) (i) State **two** types of chemical bonds. (2 marks)

(ii) Outline **two** properties in each of the chemical bonds mentioned in (i) above. (6 marks)

7. (a) Define the following terms giving an example of each:

(i) acid;
(ii) base;
(iii) salt.

(6 marks)

(b) Write a balanced chemical equation for the reaction between lime and hydrochloric acid. (4 marks)

(c) Explain the reason why sea water is not recommended for use in construction. (2 marks)

(d) Describe **four** uses of radioisotopes. (8 marks)

8. (a) State **four** difference between oxidation and reduction in a chemical reaction. (8 marks)

(b) Distinguish between soft and hard water. (2 marks)

(c) Differentiate between naturally occurring polymers and synthetic polymers giving **one** example of each. (4 marks)

(d) Give **three** examples of applications of polymers in the construction industry. (6 marks)

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