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MATHEMATICS I AND PHYSICAL SCIENCE
June/July 2014
Time: 3 hours

Candidate's Signature: _____

Date: _____

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

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have the following for this examination:
  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 from section B and ONE from either section, in the spaces provided in this question paper.
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
Candidates should answer all the questions in English.

For Examiner's Use Only

Section	Question	Maximum Marks	Candidate's Score
A	1	20	
	2	20	
	3	20	
	4	20	
B	5	20	
	6	20	
	7	20	
	8	20	
	TOTAL SCORE		

This paper consists of 16 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

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SECTION A: MATHEMATICS

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

1. (a) (i) Transpose the formula $T = 2\pi\sqrt{\left(\dfrac{K^2 + L^2}{Lg}\right)}$ to make g the subject. (3 marks)

    (ii) Solve the simultaneous equations:

    $2x + y = 4$
    $2x^2 + y^2 = 10$

    (6 marks)

    (iii) Simplify $\dfrac{3x^2 + 5xy + 2y^2}{3x^2 + 8xy + 4y^2}$. (4 marks)

    (b) (i) Evaluate:

    $$\frac{\log 81 - \log 729 + \frac{1}{2}\log 6561}{3\log 9}.$$

    (4 marks)

    (ii) Determine which term of the series

    $19683, 6561, 2187, \ldots$ is $\frac{1}{3}$. (3 marks)

2. (a) Table 1 represents a monthly record of water required in thousands of litres, at a construction site.

2	8	4	5	4	23	73
21	22	25	28	27	22	52
4	3	8	7	5	25	76
24	27	26	22	22	23	44
6	7	8	6	6	71	73
27	22	23	30	25	77	41
75	75	76	77	80	63	49
70	68	65	66	67	62	42
52	48	54	43	53	49	55
12	13	32	32	31	11	14
33	35	13	15	34	35	38
13	33	36	40	17	15	39
39	17	13	40	35	32	18
32	34	34	19	19	36	31
42	48	58	54	47	60	42
55	46	56	41	33	14	38
16	20	34	33			

(i)   Represent the data in a frequency distribution, starting with 0 - 10, 10 - 20, ...

(ii)   Draw a histogram from part (i);

(iii)   Use the histogram to obtain the modal value.

(9 marks)

(b)   Two ordinary unbiased dice are thrown. Determine the probability that the:

(i)   sum on the two dice is 3;

(ii)   sum on the two dice exceeds 9;

(iii)   two dice show the same number;

(iv)   number on the two dice differ by more than 2.

(11 marks)

3.   (a)   A pyramid with a square base has an altitude of 15 cm. If the side of the square base is 9 cm, determine its volume.   (2 marks)

(b)   If V_1 = 20 units at 85°, V_2 = 40 units at 120° and V_3 = 25 units at 210°, calculate the resultant of

$$V_1 - V_2 + V_3 .$$

(10 marks)

(c)   Solve the equation $2\operatorname{Sec}^2\theta = 3(2 - \tan\theta)$.   (8 marks)

4.   (a)   A triangle has sides 10 cm, 11 cm and 12 cm respectively. Determine the:

(i)   smallest angle;

(ii)   area of the triangle.

(10 marks)

(b)   Simplify $\dfrac{1}{\sqrt{(x^2 - a^2)}}$ where $x = a\operatorname{Cosec}\theta$ leaving the answer in terms of $\tan\theta$.

(5 marks)

(c)   A casting is in the shape of a frustum of a cone of end radii 9 cm and 12 cm, with a central cylindrical hole of diameter 3 cm. Calculate the volume of the casting if its height is 10 cm.   (5 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) Identify the type of bond between the following atoms:

    (i)   K-N;
    (ii) N-O;
    (iii) Cl-Cl.

    (3 marks)

    (b) Describe three characteristic properties of electrovalent (or ionic) compounds. (Give examples)   (7 marks)

    (c) Define the following in terms of electron transfer:

    (i)   oxidation;
    (ii) reduction.

    (4 marks)

    (d) Explain the observations you would make, in terms of chemical and ionic equations, when you bubble chlorine gas through a solution of iron (II) chloride.   (6 marks)

6. (a) Describe **five** impacts of synthetic polymers towards humans and the environment.
                                                                                   (10 marks)

    (b) Describe **three** applications of radiation.   (6 marks)

    (c) Describe the meaning of the following terms as used in sound:

    (i)   doppler effect;   (2 marks)

    (ii) pitch;   (1 mark)

    (iii) loudness.   (1 mark)

7. (a) An object 6 cm tall, stands on the principal axis of a concave mirror of focal length 25 cm and is placed 40 cm from the mirror. By means of an accurate graphical construction, determine the:

    (i)   position;
    (ii) size and;
    (iii) nature of the image.

    (8 marks)

(b) A beam 10 m long is supported 2 m from its left hand end and 1 m from its right hand end. Forces of 40 kN and 60 kN are applied vertically at the left and right hand ends respectively. A force of 5.0 kN is applied vertically midway between the supports. Calculate the reactions at the beam supports, neglecting the weight of the beam itself.

(12 marks)

8. (a) (i) State the difference between temporary and permanent hardness of water.

(2 marks)

(ii) Explain **three** methods of how temporary hardness of water may be removed, giving equations for the chemical changes involved. (6 marks)

(b) Describe with at least one example, the meaning of the following terminologies in relation to acid being a proton donor:
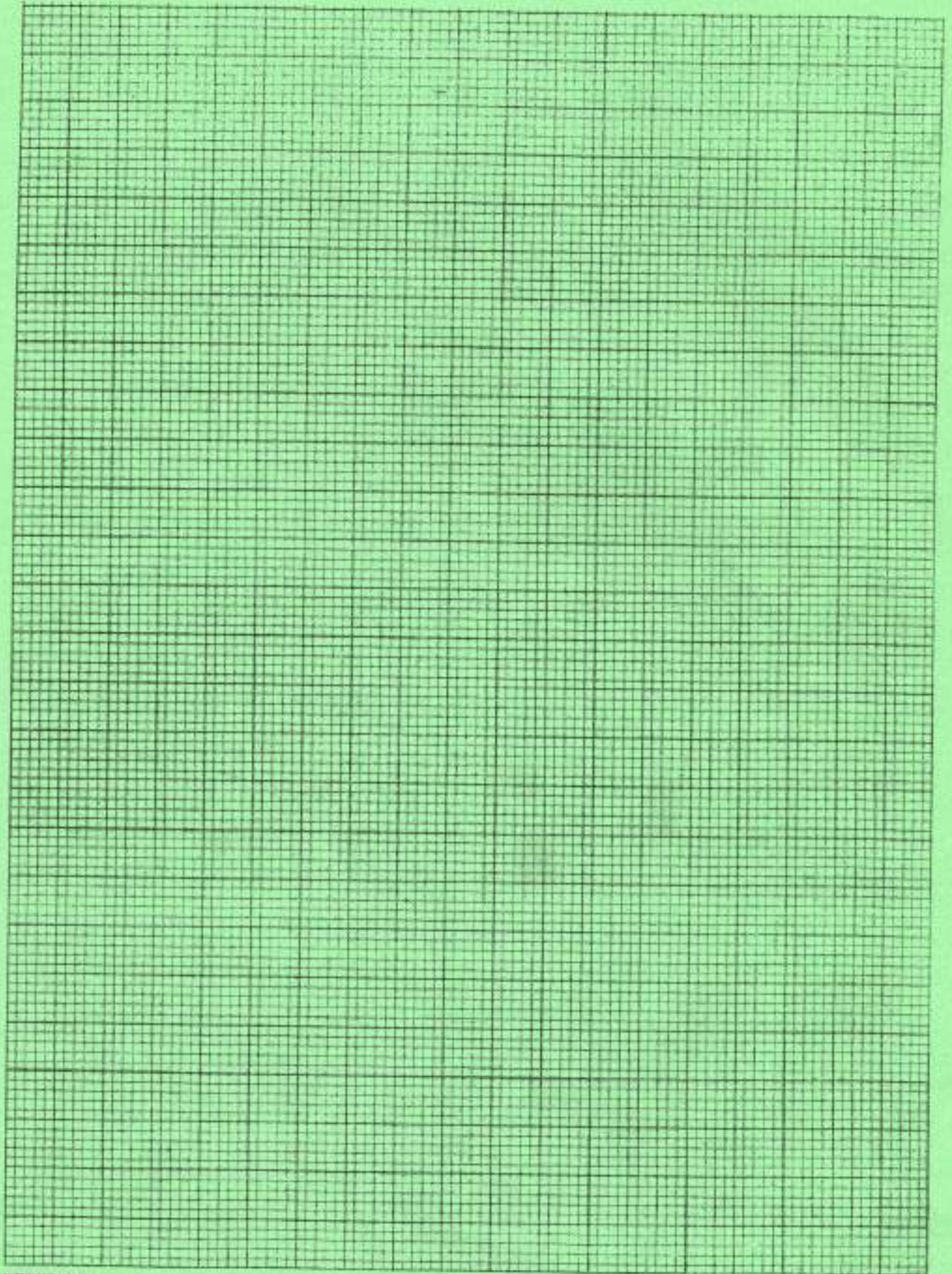
(i) monobasic acid;
(ii) dibasic acid;
(iii) triabasic acid.

(6 marks)

(c) Using an example, describe the following oxide:

(i) acidic oxides;
(ii) neutral oxides;
(iii) amphoteric oxides.

(6 marks)

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