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MATHEMATICS I AND PHYSICAL SCIENCE
June/July 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;
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) (i) Simplify $\log_3 81 + 1$. (4 marks)

(ii) Solve $5^{3x+1} = 6^{2x-1}$ (4 marks)

(iii) Simplify without using tables

$$\frac{25^{\frac{1}{2}} \times 8}{(1+4)^2} + \left(\frac{2^3}{5}\right)^2$$ (4 marks)

(b) Make n the subject of the formula

$$A = P\left(1 + \frac{r}{100}\right)^n$$ (5 marks)

(c) Solve the simultaneous equations

$$5x + 2y = 1$$
$$6x - 7y = 20$$

(3 marks)

2. (a) Solve the following simultaneous equations

$$2x + y - 3z = 1$$
$$3x - 2y + 4z = 5$$
$$x + 2y + 5z = -1$$

(10 marks)

(b) A box contains 6 white, 2 yellow and 4 blue beads. Two beads are picked are at a time with replacement. Draw a tree diagram, then use it to find the probability of picking:

(i) different colours;
(ii) same colours;
(iii) white, yellow and blue in that order.

(10 marks)

3. (a) Divide $(2x - 1)$ by $4x^3 - 6x^2 + 4x$. (5 marks)

(b) Solve $2x^2 - 3x - 2 = 0$. (5 marks)

(c) Express as partial fractions $\frac{3x+5}{x^3 - x^2 - 2x}$. (10 marks)

4. The masses of 50 parcels are given as follows:

Masses (kg)	Frequency (f)
10 - 14	2
15 - 19	4
20 - 24	7
25 - 29	14
30 - 34	8
35 - 39	7
40 - 44	3
45 - 49	5

(a) Calculate:

(i) the mean;
(ii) the standard deviation.

(b) (i) Draw a cumulative frequency curve.

(ii) Use the curve to estimate the median.

(20 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) State the **four** properties of images formed on plane mirrors. (4 marks)

(b) Find the distance of the image from a concave mirror of focal length 15 cm if the object is 20 cm from the mirror. (5 marks)

(c) A ray of light travels from air into water at an angle of incidence of 60°. Calculate the angle of refraction, given that the refractive index of water is 1.33. (5 marks)

(d) State any **two** uses of each of the following curved mirrors:

(i) concave;
(ii) convex;
(iii) parabolic.

(6 marks)

6. (a) Define the following terms:

(i) resultant force;
(ii) center of gravity;
(iii) torque.

(6 marks)

(b) State the principle of moments. (2 marks)

(c) In the figure 1, calculate the reactions Ra and Rb. (6 marks)

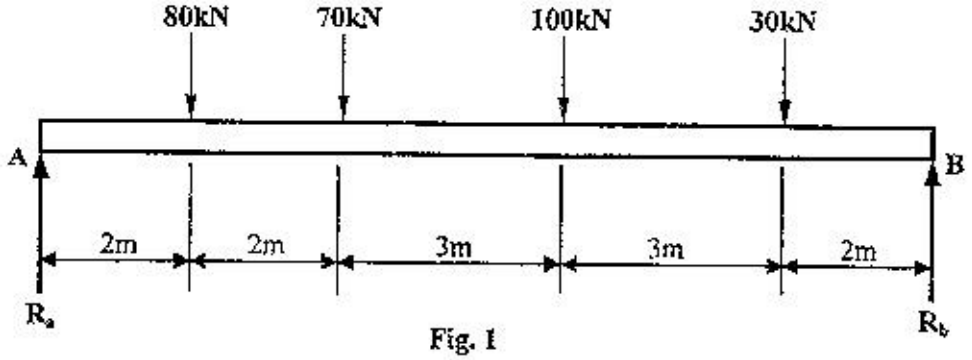

Fig. 1

(d) With the aid of sketches, define the following types of loads:

(i) point load;
(ii) uniformly varying;
(iii) uniformly distributed load.

(6 marks)

7. (a) Define the following terms:

(i) sound intensity;
(ii) frequency;
(iii) sound.

(6 marks)

(b) With the aid of sketches, explain any **three** methods of sound insulation. (9 marks)

(c) A particle is making two revolutions per second in a circular orbit of radius 10 cm. Calculate:

(i) the angular velocity;
(ii) the linear velocity;
(iii) the centripetal acceleration.
leave your answer in terms of π.

(5 marks)

8. (a) Define the following terms:

(i) valency;
(ii) relative atomic mass;
(iii) the mole.

(6 marks)

(b) Determine the percentage by mass of water in hydrated gypsum, $CaSO_4.2H_2O$
(Ca = 40, S = 32, O = 16, H= 1) (4 marks)

(c) Find the mass of NH_3 in moles that will be produced if 10 g of H_2 is reacted with enough N_2 using the Habar process. (6 marks)

(d) When iron is heated in a steam of dry chlorine, it produces a chloride that contains 34.5% by mass of iron. Determine the empirical formular of the chloride.

(4 marks)

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