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 table/ non-programmable scientific calculator;*
> *Drawing instruments.*
This paper consists of EIGHT questions in TWO sections; A and B.
Answer FIVE questions choosing at least TWO questions from each section and ONE other 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) Given that $5\log_3 y - 2\log_3(x+3) = 2\log_3 y + \log_3 x$. Express y in terms of x.

    (5 marks)

    (b) Solve the equation $3^{x^2} = 81^{x-1}$.

    (4 marks)

    (c) Convert $r = 6\tan\theta\sec\theta$ to cartesian form.

    (5 marks)

    (d) Obtain the value of t for which (t + 1), (t - 5), and (t - 2), ... is a geometric progression. Hence obtain the sum of the first 10 terms.

    (6 marks)

2. (a) Solve the equation $5^{2x} - 7(5^x) + 12 = 0$ correct to three decimal places.

    (6 marks)

    (b) Use the binomial theorem to expand $\left(1 - \frac{1}{3}x\right)^{1/3}$ up to the term in x^3. Hence evaluate $\sqrt[3]{0.97}$ correct to four decimal places.

    (7 marks)

    (c) Express $\dfrac{5x^2 - 5x - 9}{(x+3)(x-1)^2}$ into partial fractions.

    (7 marks)

3. (a) Solve the simultaneous equation by substitution method.

    $$2x + 3y + z = 7$$
    $$3x + 4y + 2z = 11$$
    $$5x + 2y + z = 9$$

    (8 marks)

    (b) Given that $\sin(\theta + \alpha) = \sqrt{3}\cos(\theta - \alpha)$ where $\cos\theta\cos\alpha \neq 0$, show that
    $$\tan\theta = \frac{\sqrt{3} - \tan\alpha}{1 - \sqrt{3}\tan\alpha}.$$

    (8 marks)

    (c) A surveyor sketched a triangular land in mm and the sides were 58 mm, 52 mm and 28 mm. If the scale he used was 1:1000, find the area in m^2.

    (4 marks)

4. (a) The marks of a subject obtained by 30 trainees in a class were recorded as follows.

70	74	85	62	74
50	98	73	101	90
62	64	76	77	77
90	58	51	52	66
100	102	60	76	102
78	53	100	92	78

(i) Construct a frequency table with a class interval of 5 marks beginning with 49.

(ii) Draw a histogram to represent that data.

(8 marks)

(b) An artist has 5 green, 7 blue and 3 red crayons of the same size and shape in a bag. If he picks two crayons at random from the bag without replacement. Find the probability that:

(i) the two are of the same colour;
(ii) no red is picked;
(iii) a blue and green in that order.

(8 marks)

(c) Two forces act on a particle as follows: $F_1 = 30$ N at $30°$ and $F_2 = 50$ N at $120°$. Find the magnitude and direction of the resultant force. (4 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) Differentiate between a longitudinal wave and a transverse wave. (4 marks)

(b) State:

(i) **three** uses of echo.
(ii) **two** points of distinctions between loudness and intensity of sound.

(7 marks)

(c) (i) State the Snell's law.
(ii) Explain **two** factors affecting refractive index of a medium. (5 marks)

(d) State **four** applications of fiber optics. (4 marks)

6. (a) State:

   (i) the principle of moments;
   (ii) the **two** conditions of equilibrium. (6 marks)

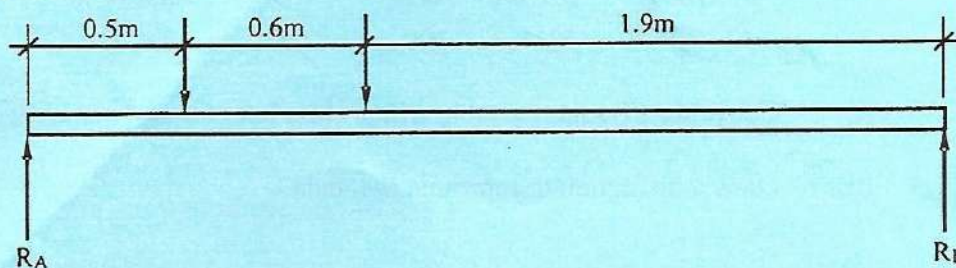   (b) **Figure 1** shows a simply supported uniform beam of mass 12000 kg loaded with two load as shown.

   Fig. 1

   Taking $g = 10$ N/kg, calculate the reactions R_A and R_B. (10 marks)

   (c) A stationary car has a mass of 1.7 tonnes. Without starting the engine, a force of 300 N is applied. How long does it take the car to attain a velocity of 4 m/s? (4 marks)

7. (a) Define the term radiation. (2 marks)

   (b) Explain the following terms as used in nuclear reaction:
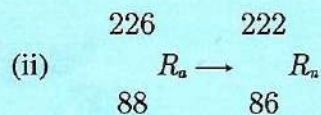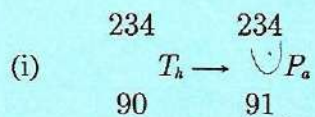
   (i) nuclear fusion;

   (ii) nuclear fission. (4 marks)

   (c) List **three** properties of each particle emitted by the unstable nuclides decay.

   (i) Alpha (α) particle;
   (ii) Beta (β) particle;
   (iii) Gamma (γ) particle. (9 marks)

(d) From the radio nuclides decay equations below, identify the particle emitted in each case and complete the chemical equations.

(i) $$^{234}_{90}T_h \longrightarrow \ ^{234}_{91}P_a$$

(ii) $$^{226}_{88}R_a \longrightarrow \ ^{222}_{86}R_n$$

(5 marks)

8. (a) Explain **three** types of bonds depending on their mode of formation.

(6 marks)

(b) State **four** reasons as to why the outermost electrons are important in bonding.

(4 marks)

(c) Explain the **two** types of hardwater.

(4 marks)

(d) List **two** properties in each of the following:

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

(6 marks)

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