

1704/102
MATHEMATICS I AND
PHYSICAL SCIENCE
June/July 2022
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN BUILDING TECHNOLOGY
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 any FIVE questions choosing at least TWO questions from each section.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

This paper consists of 6 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) Find the 1st term and 6th term of a G.P whose 2nd and 3rd terms are 5 and 10 respectively. (5 marks)
- (b) A solid round bar of metal is to be melted and cast into a bowl in the shape of a hemisphere. If the internal diameter of the bowl is to be 200 mm and its thickness is 3.0 mm, determine the length of the metal bar if its diameter is 40 mm. (7 marks)
- (c) Use Simpson's rule to determine the area enclosed by ABCD in figure 1 below, given that the lengths of the y-coordinates are as shown in the figure. (5 marks)

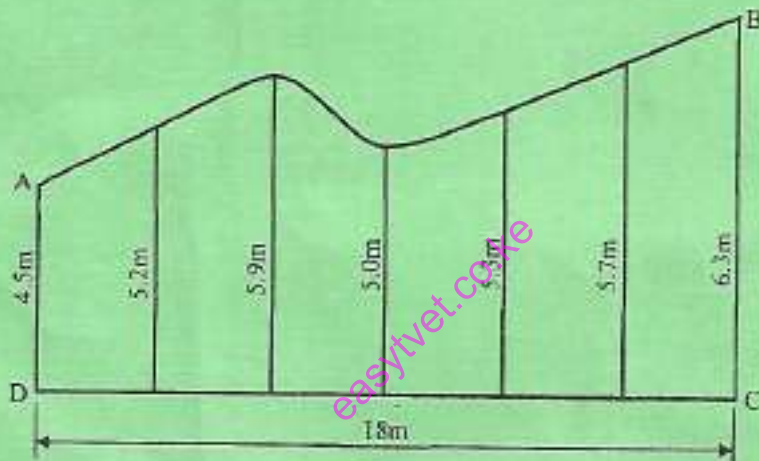


Fig. 1

- (d) A solid cube has a breadth that is twice its width and one-third its length. If the breadth is 15 cm, calculate the total surface area of the cube. (3 marks)
2. (a) Table 1 below shows recordings of an event y with respect to x .

Table 1

x	1	2	3	4
y	-1	2	5	8

- (i) Draw a graph of x against y and hence use the graph to determine the equation relating x to y .
- (ii) Use the equation determined in (i) above to determine the value of y when $x = 20$. (7 marks)

(d) Prove that $2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta$ (2 marks)

Determine angle A and hence calculate the area of the triangle. (5 marks)

AB = 20 cm
AC = 15 cm
BC = 9 cm

(c) A triangle ABC has the following dimensions:

(b) Draw the graph of $\sin(x + 30^\circ)$ in intervals of 30° , for values of x from 0° to 300° inclusive. (8 marks)

(5 marks)

- (i) $\cos 150^\circ$
(ii) $\sin 210^\circ$
(iii) $\cos 330^\circ$

Use the CAST rule to determine the following values in surd form.

Angle	Sine
0°	0
30°	$\frac{1}{2}$
60°	$\frac{\sqrt{3}}{2}$
90°	1

3. (a) The trigonometric sine ratio values of four common angles are as shown below:

(13 marks)

- (i) Use a suitable bar chart to represent this information.
(ii) Determine the 4 year average percentage for each means of transport and hence represent this information on a pie-chart.

Transport	Year 1 (%)	Year 2 (%)	Year 3 (%)	Year 4 (%)
Private car	5	10	10	5
Matatu	30	35	40	45
Motorcycle	40	45	45	30
Walking	25	10	5	20

Table 2

(b) Table 2 below shows the different means of transport used by workers in a town, over a period of 4 years.

4. (a) Use long division to solve to 2 decimal places $981 \div 12.3$ (3 marks)
- (b) Solve without a calculator
 $\frac{75}{3} \times 625^{\frac{1}{2}}$ (3 marks)
- (c) Simplify:
(i) $(a^x \times b^y)^{\frac{1}{2}} \times (a^y \times b^x)^a$
(ii) $\sqrt[3]{(C^9)} \times V^4 \times C$ (4 marks)
- (d) Solve to 3 decimal places:
(i) $5e^x = 100$
(ii) $y^6 = 175$ (6 marks)
- (e) Using substitution method, determine the values of x and y in the equations below.
 $3y + x = 8$
 $3x + y = 9.6$ (4 marks)

SECTION B: PHYSICAL SCIENCE

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

5. (a) Define the following:
(i) atom;
(ii) element;
(iii) compound. (6 marks)
- (b) With the aid of a sketch, describe the components of an atom. (6 marks)
- (c) With the aid of a sketch, explain the term 'covalent bond'. (4 marks)
- (d) Using the water molecule as an example, explain the meaning of molecular weight. (4 marks)

6. (a) Determine the value of V such that the beam in figure 2 below will be equilibrium.

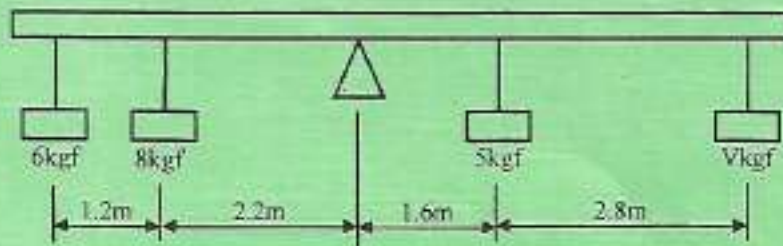


Fig. 2

(5 marks)

- (b) Define momentum and give a practical example to explain this phenomenon. (4 marks)
- (c) Differentiate between velocity and acceleration giving the units of measurements in each case. (3 marks)
- (d) It takes 6 seconds for a hoist to lift 6 kN of concrete 5 metres above ground level. Calculate the power used by the hoist, indicating all relevant S.I units. (4 marks)
- (e) Given a cylinder of diameter 30 cm and height 15 cm, filled with water to the top, calculate:

- (i) the pressure at the base of the container;
- (ii) thrust exerted by the water on the base.

Take $g = 9.8 \text{ M/sec}^2$ (4 marks)

7. (a) Differentiate between elasticity and plasticity as a property of material. (3 marks)

- (b) A round hollow steel pipe of 30 mm external diameter and 20 mm internal diameter is subjected to a 24 kN force. Given that its elasticity modulus $E = 200 \text{ kN/mm}^2$, calculate:

- (i) stress in the pipe;
- (ii) strain in the pipe.

(7 marks)

- (c) State:

- (i) Newton's three laws of motion;

- (ii) the **five** different types of motion represented by the graphs A, B, C, D and E in the **figure 3** below. (10 marks)

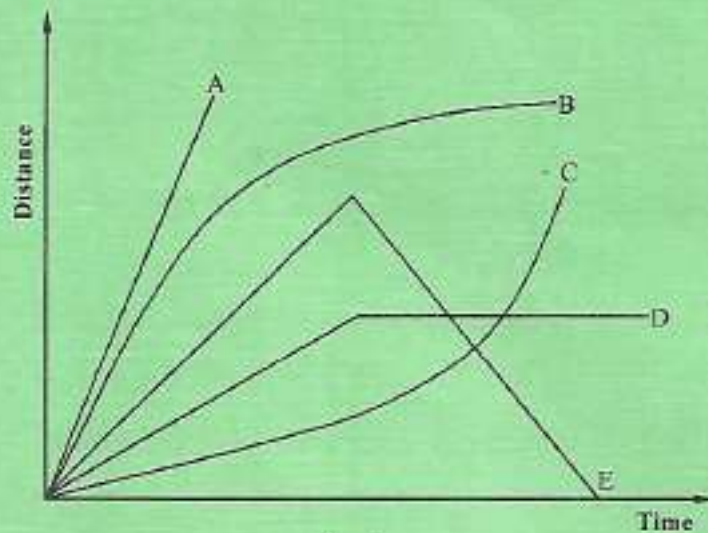


Fig. 3

8. (a) Determine the relative density of a metal sphere of diameter 5 cm and mass 524 gms. Take density of water as 1 gm/cm^3 . (5 marks)
- (b) Describe a hydrometer and explain how it is used. (5 marks)
- (c) A barometer at the top of a hill records 720 mmHg of air pressure. Determine its height above sea level given that air pressure decreases by 1.2 Kpa for every 100 metre rise. Take air pressure at sea level as 760 mmHg and density of mercury as 13600 kg/m^3 . (7 marks)
- (d) Calculate to 2 decimal places the tension in members AB and BC in **figure 4**. (3 marks)

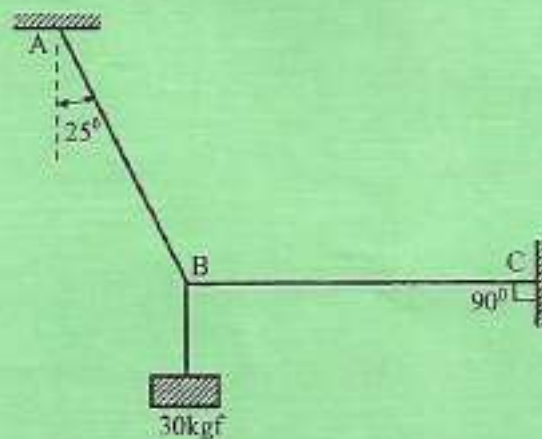


Fig. 4

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