

1704/102
MATHEMATICS I AND
PHYSICAL SCIENCE
June/July 2016
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.

This paper consists of EIGHT questions in TWO sections: A and B.

Answer any FIVE questions; choosing at least TWO questions from Section A, TWO questions from Section B and ONE question from either section in the answer booklet provided.

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 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

Answer at least TWO questions from this section.

1. (a) A piece of timber 273 cm long is cut into three pieces in the ratio of 3:8:10. Determine the lengths of each of the three pieces. (6 marks)
- (b) A storage tank holds 450 litres of water when it is three-quarters full. Determine how much water it would contain when it is two thirds full. (2 marks)
- (c) Three firms P, Q and R contribute to a fund. P contributes $\frac{1}{3}$ of the total, Q contributes $\frac{1}{4}$ of the remainder while R contributed Ksh. 800,000. Determine the total amount raised. (4 marks)
- (d) Solve: $2^{x+1} = 3^{2x-1}$ correct to 4 significant figures. (8 marks)

2. (a) If $T = \frac{\lambda(x-c)}{c}$, make x the subject of the formula. (3 marks)

(b) Determine the roots of the equation $x^2 - 4x + 4 = 0$ by factorisation. (3 marks)

(c) The compound C₄H₆ reacts with oxygen in proportion given by the equations

$$40y - 6z = 60$$

$$30y + 5z = 140$$

Determine y and z, hence the formula C_xH_y. (4 marks)

(d) (i) Find the sum of the first eight terms of the geometrical progression.
 $2 + 6 + 18 + \dots$ (3 marks)

(ii) In an engineering process two variables x and y are related by $y = ax + \frac{b}{x}$ where a and b are constants. Find a and b, if y = 15 when x = 4 and y = 12 when x = 2. (8 marks)

(c) The area of a metal plate is 576 mm². If its length is 48 mm, find its width. (2 marks)

(a) A block of copper weighing 30 kg is drawn out to make 500 m of wire of uniform circular cross-section. Given that 1 cm³ of copper weighs 8.91 g, calculate the:

- (i) volume of the copper in cm³
 - (ii) area of the cross-section of the wire in cm²
- (4 marks)

(b) A rectangular piece of metal with dimensions 4.5 cm by 7.5 cm by 12 cm is melted down and recast into a square pyramid of perpendicular height 150 cm. Find the area of the base of the pyramid. (4 marks)

$$15 = a(2) + \frac{b}{2}$$

$$-5/a = a(2) - 15$$

Handwritten notes and calculations on the right side of the page, including 2×12 , 3×12 , 4×12 , 5×12 , 6×12 , 7×12 , 8×12 , 9×12 , 10×12 , 11×12 , 12×12 , 13×12 , 14×12 , 15×12 , 16×12 , 17×12 , 18×12 , 19×12 , 20×12 , 21×12 , 22×12 , 23×12 , 24×12 , 25×12 , 26×12 , 27×12 , 28×12 , 29×12 , 30×12 .

(c) The angle of depression of a car viewed at a particular instant from the top of a 45 m high vertical building is 27° . Find the distance of the car from the building at this instant. (4 marks)

(d) Find the area of a regular hexagon which has sides 8 cm. (4 marks)

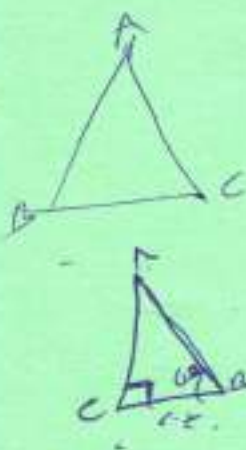
(e) Evaluate $\frac{4 \sin 60^\circ}{\cos 45^\circ}$ without using a calculator and leave the answer in surd form. (4 marks)

4. (a) In triangle ABC, angle $\angle ACB = 90^\circ$, angle $\angle ABC = 42^\circ$ and $BC = 6.2$ cm. Find the length of AC. (2 marks)

(b) If $\tan(A + B) = 1.8$ and $\tan A = 0.6$, calculate $\tan B$. (4 marks)

(c) Given that $\theta = 36^\circ$, show that $\cos^2 \theta + \sin^2 \theta = 1$ is valid for the given value of θ (4 marks)

(d) The following frequency distribution represents the marks of students in a certificate class.



Marks	Number of students
10 - 20	5
20 - 30	10
30 - 40	17
40 - 50	12
50 - 60	6

Calculate the mode of the distribution. (4 marks)

(e) Examination marks in mathematics for 35 students were recorded as shown in Table 2.

Table 2

83 ✓ 1	85	75	96 ✓ 1	77	72
98 ✓ 2	88 ✓ 1	75 ✓ 2	78 ✓ 3	86 ✓ 2	69 4
80 (1)	82 2	77 ✓ 4	80 3	81 6	73 5
80 ✓	92 ✓ 2	83 ✓ 4	80 6	95 ✓ 0	83 ✓ 7
91 ✓ 3	93 ✓ 0	82 3	88 6	81 ✓ 9	78
82 ✓ 7	95 ✓ 0	82 4	87 9	82 2	1

(i) Prepare a frequency distribution table using a class interval of 10.

(ii) From part (i) above, calculate the median. (6 marks)

SECTION B: PHYSICAL SCIENCE

Answer at least TWO questions from this section.

5. (a) Define the terms:
- atom;
 - element;
 - compound;
 - mixture.
- (4 marks)
- (b) Differentiate between physical and chemical changes of matter giving two examples of each. (6 marks)
- (c) (i) Explain the two methods used in the preparation of insoluble salts. (6 marks)
- (ii) Write a balanced chemical equation for the reaction between lead nitrate and sodium sulphate. (4 marks)
- $Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + NaNO_3$
- (d) State any four properties of acids. (4 marks)
6. (a) (i) Describe the three states of matter. (5 marks)
- (ii) Explain how a centrifuge can be used to separate a solid and liquid mixture. (5 marks)
- (b) State the SI units for the following physical quantities:
- length;
 - mass;
 - time;
 - volume.
- (4 marks)
- (c) Figure 1 shows a uniform horizontal beam supported at each end by pillars. Determine the reaction forces in the supporting pillars R_L and R_R . (6 marks)

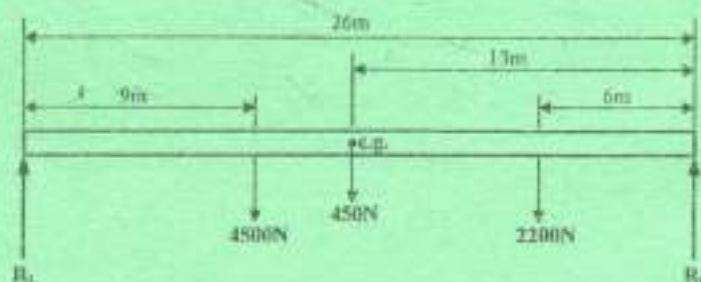


Fig. 1

- (d) An object of mass 5.3 kg is hung at the 25 cm mark of a meter rule pivoted at its centre. Find the moment due to the object (1 kg = 9.81 N). (5 marks)
7. (a) A body is projected upwards with a velocity of 45 m/sec from the top of a tower 90 metres high. Determine the:
- (i) time it takes to reach the ground;
- (ii) velocity at which the body strikes the ground. (6 marks)
- (b) (i) A steel rod used in the construction of 1.2 metres long support is subjected to a maximum load of 4.4 kN. If the extension of the rod is not to exceed 0.383 mm and Young's modulus, $E = 200$ Gpa, determine the diameter of the rod.
- (ii) Table 1 shows the result obtained during a tensile test on a steel rod of 11.28 mm diameter. Draw the load-extension graph and from the graph, determine the stress at the elastic limit. (8 marks)

Table 1

Load (kN)	4	8	12	16	20	24	28
Extension (mm)	0.01	0.02	0.03	0.04	0.05	0.06	0.08

- (c) (i) A machine with a velocity ratio of 5 requires 1000 Joules of work to raise a load of 500N through a vertical distance of 1.5 metres. Determine the:
- (I) efficiency;
- (II) mechanical advantage of the machine.
- (ii) The handle of a screw jack is 35 cm long and the pitch of the screw is 0.5 cm. Determine the velocity ratio of the system. (6 marks)
8. (a) A body of weight 400 N is prevented from sliding down a plane inclined at 10° to the horizontal by a force of 45 N acting upwards and parallel to the plane. Calculate the coefficient of friction. (6 marks)
- (b) (i) Explain the importance of density measurement to a structural engineer.
- (ii) A body of mass 0.8 kg suspended by a string is totally immersed in water. If the tension in the string is 4 N, determine the:
- (I) volume;
- (II) density of the body. (7 marks)

(c) Explain the following terms:

- (i) Potential energy;
- (ii) Kinetic energy.

(4 marks)

(d) With the aid of a diagram, explain the construction and operation of a simple mercury barometer.

(3 marks)

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