

1904/103
PHYSICS TECHNIQUES I
June/July 2021
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY
MODULE I

PHYSICS TECHNIQUES I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Non-programmable scientific calculator.

This paper consists of TWO sections; A and B.

Answer ALL questions in section A and any TWO questions from section B in the answer booklet provided.

Each question in section A carries 4 marks while each question in section B carries 20 marks.

Maximum marks for each part of a question are 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.

SECTION A (60 marks)

Answer ALL questions in this section.

1. (a) Define the term 'basic quantity of measurements'. (2 marks)
(b) Give any **two** examples of measurements. (2 marks)
2. The level of water in a burette is 25.0 cm^3 . Fifty spherical balls each of radius 4 mm are immersed in the water. Assuming the balls do not absorb water, determine the new reading of the burette. (4 marks)
3. Explain why soap is used for cleaning dirty clothes. (4 marks)
4. (a) State any **two** expressions for determining the relative density of a substance. (2 marks)
(b) A room of dimensions 4.0 m by 5.0 m by 2.5 m has air of density 1.26 kg/m^3 . Determine the mass of air in kg. (2 marks)
5. Explain why a balloon filled with helium gas rises up in the air to a certain height and then stops. (4 marks)
6. (a) Name **two** factors that affect pressure exerted by a solid object on a flat surface. (2 marks)
(b) Explain why gases are unsuitable for use in hydraulic systems. (2 marks)
7. (a) Define the term 'moment of force' and state its SI unit. (2 marks)
(b) State any **two** applications of turning effect of the force. (2 marks)
8. A pick up truck of mass 800 kg moving at 25 m/s and a 500 kg car moving at 14 m/s in the opposite direction are involved in a head-on inelastic collision. Determine the:
(a) common speed after collision; (3 marks)
(b) direction of the vehicles. (1 mark)
9. (a) State Newton's second law of motion. (2 marks)
(b) Determine the momentum of a car of mass 1000 kg travelling at 30 m/s. (2 marks)
10. (a) Define the term 'radian' as used in circular motion. (1 mark)
(b) State any **three** factors affecting centripetal force. (3 marks)

11. A stone of mass 0.2 kg moves in a horizontal circle of radius 0.8 m at rate of 4 revolutions per second. Determine the:
- (a) periodic time; (2 marks)
- (b) linear speed. (2 marks)
12. Figure 1 shows a ray of light travelling from medium 1 to medium 2 making an angle of refraction of 30° .

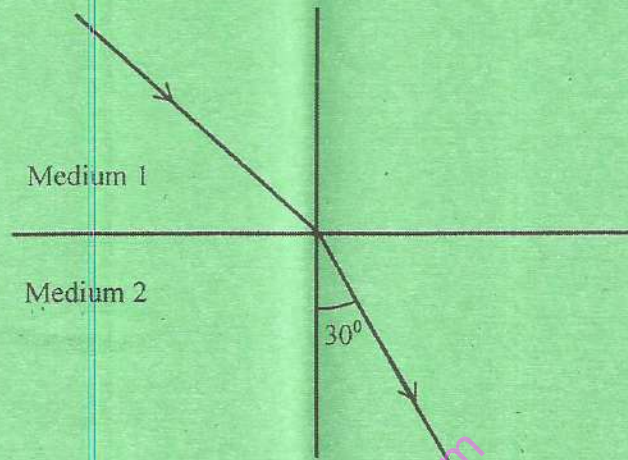


Fig. 1

- Determine the angle of incidence (${}_2n_1 = \frac{3}{2}$). (4 marks)
13. State **four** uses of plane mirrors. (4 marks)
14. A hot metal block of mass 7 kg is immersed into a vessel containing 6 kg of water at 12°C . The temperature of water rises to 28°C . Assuming no heat is lost to the surrounding, calculate the initial temperature of the block.
(Specific heat capacity of the metal = 390 J/kgK , specific heat capacity of water = 4200 J/kgK) (4 marks)
15. Explain why liquid in glass temperatures have:
- (a) a thin-walled glass bulb; (2 marks)
- (b) a thick glass stem. (2 marks)

SECTION B (40 marks)

Answer any **TWO** questions from this section.

16. (a) Describe a method to determine the density of cooking oil using a measuring cylinder and an electronic balance. (6 marks)
- (b) Table I shows results obtained in an experiment to verify Hooke's law using a helical spring.

Table I

Load (N)	0	0.3	0.6	0.9	1.2	1.5	1.6
Extension(m) $\times 10^{-2}$	0	1.2	2.4	3.6	4.8	7.1	10

- (i) Plot a graph of load (y-axis) against extension. (6 marks)
- (ii) Use the graph to determine the spring's constant. (2 marks)
- (iii) Explain the shape of the graph. (2 marks)
- (c) A rectangular block of mass 2 kg measures 30 cm by 12 cm by 4 cm. Determine the minimum pressure it can exert on a flat surface. ($g = 10 \text{ N/kg}$) (4 marks)
17. (a) A balloon made of mass 9 kg has a volume of 28 m^3 . It contains helium gas of density 0.18 kg/m^3 . Calculate:
- (i) upthrust force; (4 marks)
- (ii) resultant upward force. (4 marks)
- (Density of air = 1.3 kg/m^3)
- (b) List **four** instruments for measuring pressure. (4 marks)
- (c) Using appropriate illustrations, explain:
- (i) stable equilibrium; (4 marks)
- (ii) neutral equilibrium. (4 marks)

18. (a) State the laws of reflection of light. (2 marks)
- (b) A swimming pool full of water appears to be 8.0 cm from the bottom. The speed of water and light are 2.25×10^8 m/s and 3.0×10^8 m/s respectively. Determine the:
- (i) refractive index of water; (2 marks)
- (ii) actual depth of the pool; (2 marks)
- (iii) vertical displacement. (2 marks)
- (c) A body of mass 1500 g is moving in a circle of radius 1.3 m at a uniform velocity of 2.0 m/s. Calculate the:
- (i) acceleration of the body; (2 marks)
- (ii) centripetal force acting on the body. (3 marks)
- (d) (i) State Boyle's law. (1 mark)
- (ii) A weather balloon contains one litre of hydrogen at 27°C and pressure of 1.0×10^5 Pa. The balloon rises to a height where the pressure and temperature of the gas become 8.0×10^4 Pa and 5°C respectively. Calculate the new volume of the gas in cm^3 . (6 marks)
19. (a) State the SI unit of specific latent heat of fusion. (1 mark)
- (b) An aluminium mass of 40 g is heated to 200°C and then quickly immersed in 160 g of water contained in a copper calorimeter of mass 24.0 g. The initial and final temperatures of water are 12°C and 21.8°C respectively. Calculate the specific heat capacity of aluminium. Assume no heat is lost.
- (Specific heat capacity of copper = 390 J/kgK) (7 marks)
- (c) Explain why:
- (i) a bucket of water can swing in a vertical circle without spilling; (3 marks)
- (ii) a cyclist makes a turn on a circular bend inwardly. (3 marks)
- (d) A stone of mass 0.6 kg moving horizontally at velocity of 12 m/s hits a wall. The stone is in contact with the wall for 0.3 seconds before dropping. Calculate the:
- (i) impulse exerted on the wall; (3 marks)
- (ii) impulsive force applied on the stone by the wall. (3 marks)

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