

1904/103

PHYSICS TECHNIQUES I

June/July 2022

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 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 (60 marks)

Answer ALL questions in this section.

1. Differentiate between basic units and derived units, giving an example of each. (4 marks)
2. The level of a liquid in a burette is 8.2 cm^3 . 50 spherical liquid droplets, each of diameter 0.2 cm fall out. Determine the new reading of the burette (4 marks)
3. (a) Define the term 'matter'. (1 mark)
(b) Using kinetic theory of matter, explain what happens to a solid when heated. (3 marks)
4. (a) State the Archimedes' principle. (2 marks)
(b) Explain why an object immersed in water weighs less than in air. (2 marks)
5. Figure 1 shows a cylindrical tube of diameter 14 cm partially filled with lead shots floating vertically in water.

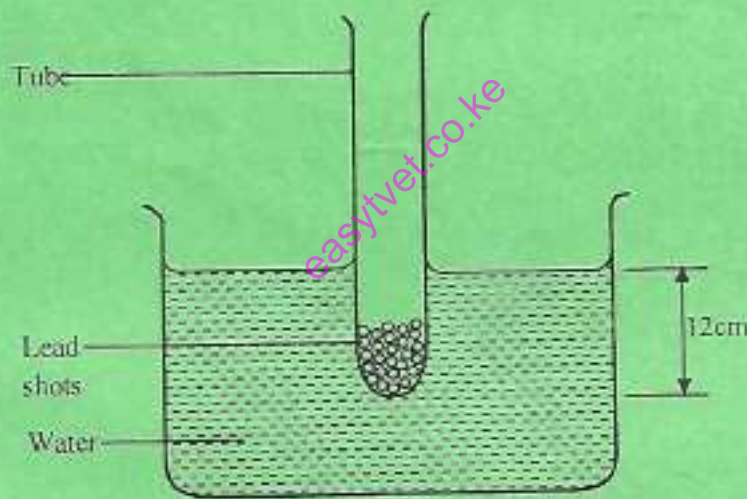


Fig. 1

Determine the:

- (a) volume of the water displaced; (2 marks)
 - (b) weight of the water displaced. (2 marks)
6. (a) Define the term 'atmospheric pressures'. (1 mark)
(b) Name any **three** units that are used to measure pressure. (3 marks)

7. Figure 2 shows a uniform metal rod pivoted at 45 cm mark with a mass of 7.0 kg suspended at the 0 cm mark. The system is in equilibrium.

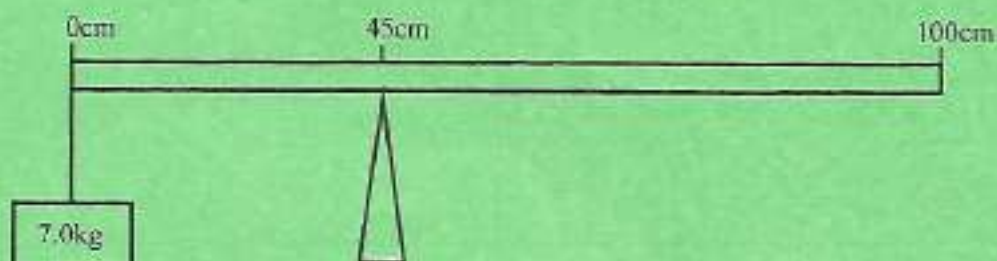


Fig. 2

Determine the:

- (a) mass of the metal rod; (3 marks)
- (b) normal reaction at the pivot point. (1 mark)
8. (a) State **two** differences between elastic and inelastic collisions. (2 marks)
- (b) Explain why momentum is a vector quantity. (2 marks)
9. A pistol of mass 500 g fires a bullet of mass 2 g. The bullet leaves the pistol at a velocity of 300 m/s. Determine the recoil velocity of the pistol. (4 mark)
10. Explain the principle of separation of cream from milk using a centrifuge machine (milk is more dense than cream). (4 marks)
11. A body of mass 0.6 kg is tied to a string and whirled in a horizontal circle of radius 2 m with a speed of 3.0 m/s. Calculate the:
- (a) centripetal acceleration; (2 marks)
- (b) tension in the string. (2 marks)
12. State **four** quantities that change when a solid is heated. (4 marks)
13. A metal block of mass 600 g is heated to 120° C and then immersed fully into 3 kg of water. The final temperature is found to be 60° C. Determine the initial temperature of the water. (Specific heat capacity of water = 4200 J/Kg K, Specific heat capacity of metal = 840 J/kg k). (4 marks)

14. Figure 3 represents a diagram drawn to scale showing an object O placed in front of a concave mirror and its principal focus, F.

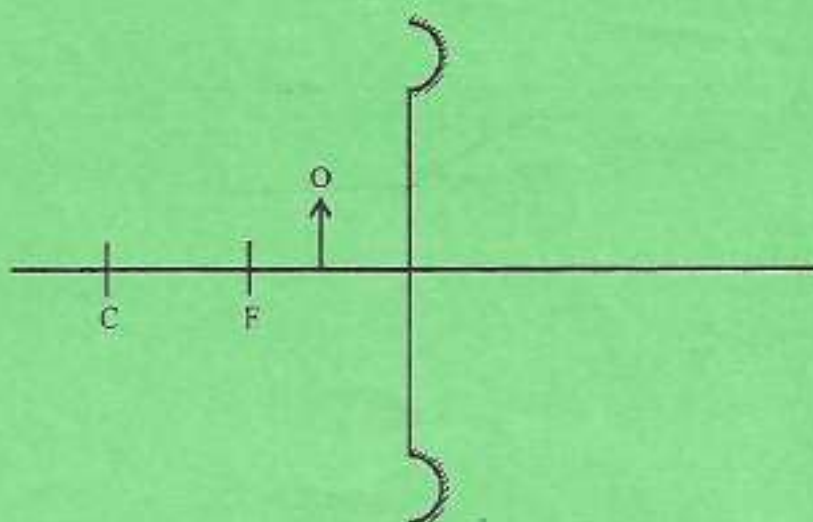


Fig. 3

- (a) Copy and complete the diagram to show the image formed. (3 marks)
- (b) State **one** characteristic of the image formed in (a) above. (1 mark)
15. An object is placed 10 cm in front of a convex lens of focal length 15 cm. Calculate the:
- (a) image distance; (2 marks)
- (b) magnification. (2 marks)

SECTION B (40 marks)

Answer any TWO questions from this section.

16. (a) A trainee recorded the following readings in an experiment on determination of the density of a liquid:
- Mass of density bottle full of water = 45 g
 Mass of density bottle full of liquid = 360 g
 Mass of empty density bottle = 20 g
- (i) Outline the expected procedure in this determination. (3 marks)
- (ii) Calculate the density of the liquid in kg/m^3 .
 (Density of water = 1 g/cm^3) (7 marks)
- (b) (i) State the principle of transmission of pressure in liquids. (1 mark)

- (ii) A block of copper of density 8.9 g/cm^3 measures 5 cm by 3 cm by 2 cm . Determine the minimum pressure it exerts on a horizontal surface. ($g=10 \text{ N/kg}$) (5 marks)
- (c) (i) State the Charles' law. (1 mark)
- (ii) A bicycle pump contains 50 cm^3 of air at 17° C and 1.0 atmosphere pressure. Determine the pressure when the air is compressed to 10 cm^3 and its temperature rises to 27° C . (3 marks)
17. (a) The cross-sectional area of a ferry boat in the region of a lake waterline is 1440 cm^2 . Twenty cars of average mass 2200 kg are driven on board. Determine the extra depth to which the ferry would sink into the waters. (6 marks)
- (b) (i) State the principle of moments. (2 marks)
- (ii) Figure 4 represents the arm of a tower in equilibrium with the loading forces acting on it at specified distances.

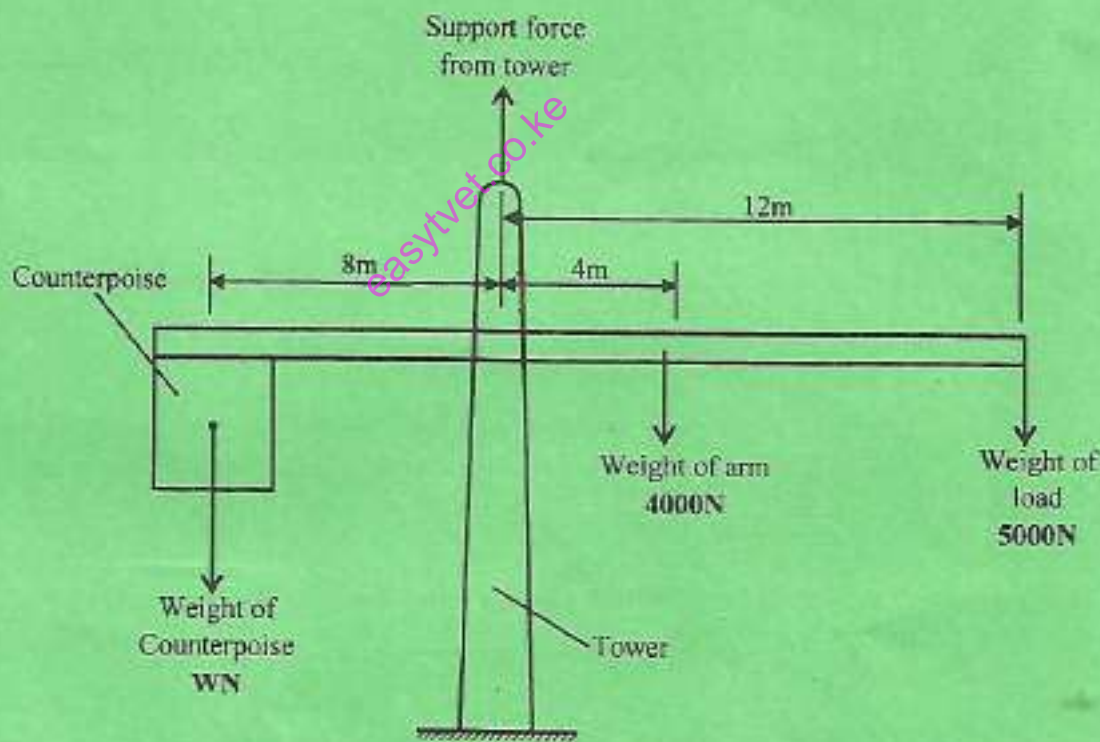


Fig. 4

Calculate the:

- (I) weight of the counterpoise W in Newtons (N). (7 marks)
- (II) support force provided by the tower. ($g = 10 \text{ N/kg}$) (2 marks)
- (c) State three types of equilibria. (3 marks)

18. (a) (i) Define the term 'specific latent heat of fusion'. (2 marks)
- (ii) 480 g of water at a temperature of 43°C was placed in a well lagged can of negligible heat capacity. 136g of ice cubes at 0°C were added to the water. The final temperature of the mixture was 16°C . Assuming no heat is lost to the surrounding, determine the specific heat of fusion of the water. (Specific heat capacity of water = $4200\text{ JKg}^{-1}\text{K}^{-1}$) (7 marks)
- (b) A pulley wheel of radius 150 mm rotates at 300 rev/min. Calculate the:
- (i) angular velocity in rad/s; (3 marks)
- (ii) linear speed; (2 marks)
- (iii) periodic time. (2 marks)
- (c) State any four types of forces. (4 marks)
19. (a) A ray of light from air travels successively through parallel layers of water, oil, glass and then into air again. The angle of incidence in air is 60° . The refractive indices of water, oil and glass are $\frac{4}{3}$, $\frac{6}{15}$ and $\frac{3}{2}$ respectively.
- (i) Draw a diagram to show how the ray passes through the multiple layers. (4 marks)
- (ii) Calculate the angle of:
- (I) refraction in water; (3 marks)
- (II) incidence at the oil - glass interface. (4 marks)
- (b) In a smoke cell experiment, a hand microscope, lens and smoke are used. White specks (smoke particles) are seen to move randomly from one point to another.
- (i) State why the specks are seen moving randomly. (1 mark)
- (ii) Explain what will happen if the temperature in the smoke cell is increased. (2 marks)
- (iii) State the role of:
- (I) smoke; (1 mark)
- (II) hand microscope. (1 mark)
- (c) (i) Explain why the weight of a body varies from place to place. (2 marks)
- (ii) An object weighs 28.4 N on earth and 11.4 N on another planet. Calculate the gravitational acceleration due to that planet. (Take g on earth = 10 N/kg) (2 marks)

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