1904/103
PHYSICS TECHNIQUES I
June/July 2023
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

# CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY

## MODULE I

PHYSICS TECHNIQUES I

**3 hours**

easytvet.com

**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 8 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**

© 2023 The Kenya National Examinations Council

## SECTION A (60 marks)

*Answer **ALL** questions in this section.*

1. Write the symbols for the SI units of the following quantities:

   (a) mass; (1 mark)

   (b) time; (1 mark)

   (c) temperature; (1 mark)

   (d) electric current. (1 mark)

2. A book consists of the front cover, back cover and 200 leaves. The thickness of each cover and leaf are 0.4 mm and 0.1 mm respectively. Determine the thickness of the entire book in centimetres. (4 marks)

3. Figure 1 shows capillary tubes P and Q placed in beakers containing water and mercury.

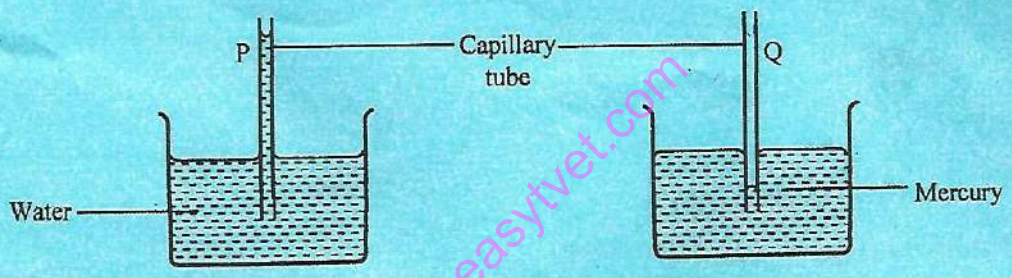



**Fig. 1**

easytvet.com

Explain why the meniscus of the liquid in capillary tube P is higher than that of the liquid in capillary tube Q. (4 marks)

4. (a) Define the term 'relative density'. (1 mark)

   (b) A piece of metal of mass 100 kg has a density of 5000 kg/m$^3$.
   Determine its volume in cm$^3$. (3 marks)

5. A metallic block weighs 9 N and has a volume of 200 cm$^3$. It is suspended from a spring balance and completely immersed in a liquid of density 1200 kg/m$^3$. Determine the reading of the spring balance. (g = 10 N/kg). (4 marks)

6. Figure 3 shows a liquid substance in a common laboratory apparatus.

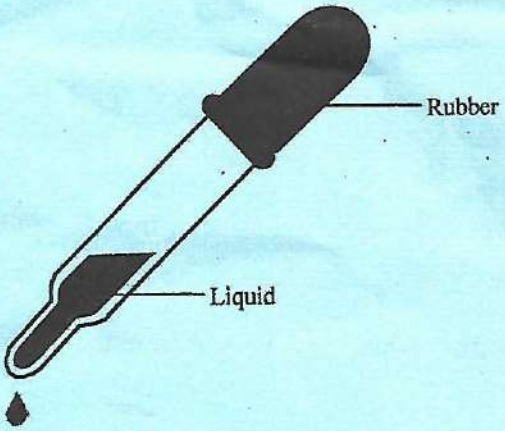



Fig. 2

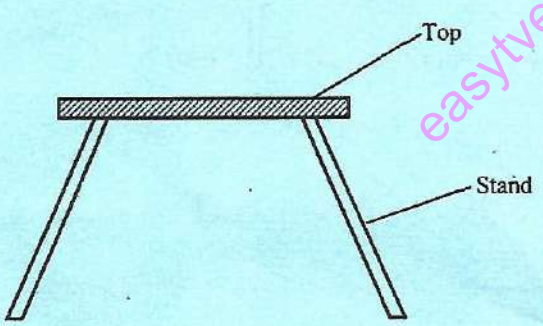
(a) Identify the apparatus. (1 mark)

(b) Explain why the liquid will not flow out until the rubber is pressed. (3 marks)

7. (a) Explain why momentum is a vector quantity. (2 marks)

(b) The velocity of a vehicle whose mass is 1500 kg changes from 20 m/s to 10 m/s in 4 seconds. Calculate the average retarding force. (2 marks)

8. (a) The following diagram represents a laboratory stool.




easytvet.com

Explain why the stands are tilted outwards. (2 marks)

(b) Explain why a steel sphere resting on a horizontal surface is said to be in a neutral equilibrium. (2 marks)

9. (a) State the Newton's first law of motion. (1 mark)

(b) Calculate the change in momentum produced when a force of 3500 N acts on a body which is at rest for 0.04 seconds. (3 marks)

10. An object of mass 0.5 kg on the end of a string is whirled around a horizontal circle of radius 2.0 m with a constant speed of 10 m/s. Determine the:

(a) angular velocity of the object; (2 marks)

(b) tension in the string. (2 marks)

11. (a) State **two** ways in which the centripetal force on a body in a circular motion can be reduced. (2 marks)

(b) Explain why the moon is said to be accelerating when revolving around the earth at a constant speed. (2 marks)

12. Calculate the heat energy in kilojoules required to raise the temperature of a $4.0 \times 10^3$ g of water from 10°C to 50 °C. (Specific heat capacity of water = 4200 J/kg K). (4 marks)

13. (a) Define each of the following terms:

(i) heat capacity;
(ii) specific heat capacity.

(2 marks)

(b) State the SI units for each of the parameters in (a). (2 marks)

14. Explain why a convex mirror is used for rear viewing in vehicles. (4 marks)

15. Figure 3 shows a ray of light travelling from water to a glass medium.

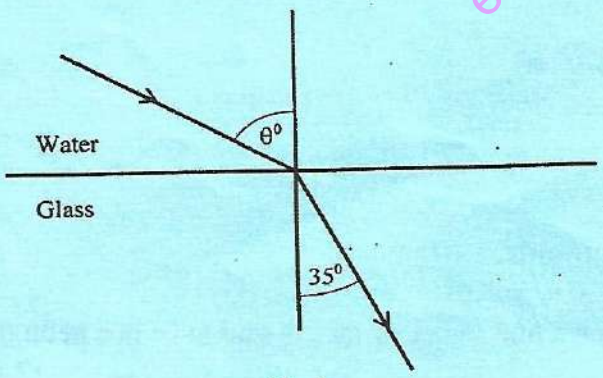



**Fig. 3**

The velocities of light and water are $2.26 \times 10^8$ ms$^{-1}$ and $2.00 \times 10^8$ ms$^{-1}$ respectively. Calculate the angle $\theta$. (4 marks)

easytvet.com

## SECTION B (40 marks)

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

16. (a) Distinguish between the properties of particles in solids and gases in terms of:

(i) arrangements;
(ii) force of attraction;
(iii) state of motion.

(4 marks)

(b) (i) Describe an experiment to verify Archimedes principle using the following apparatus and materials.

- an overflow can
- a beaker
- a spring balance
- a metal block
- water
- string

(7 marks)

(ii) A stone weighs 2.0 N in air. It is held under water by a string attached to the bottom of a container. The tension in the string is 0.5 N. Determine the density of the stone given that the density of water is 1 g/cm$^3$. (5 marks)

easyvet.com

(c) (i) Define the term 'centre of gravity' of a body. (1 mark)

(ii) Name the **three** states of equilibrium. (3 marks)

17. (a) Define each of the following terms:

(i) strength;
(ii) stiffness;
(iii) elastic deformation;
(iv) plastic deformation.

(4 marks)

(b) A weight of 8 N causes an extension of 3.2 cm when hanged on one end of a spiral spring. Determine the:

(i) extension that will be produced by 24 N weight if elastic limit is not exceeded;
(3 marks)

(ii) spring's constant in N/m. (2 marks)

(c) Figure 4 represents a horizontal bar of negligible weight at equilibrium.

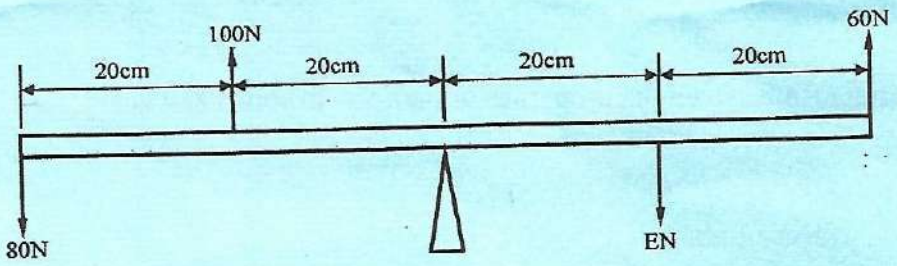



Fig. 4

Determine the:

(i) total clockwise moments in terms of E; (2 marks)

(ii) total anticlockwise moments; (2 marks)

(iii) value of force E. (2 marks)

(d) Figure 5 shows one end of glass tube dipped into mercury and the other end is connected to a gas supply.

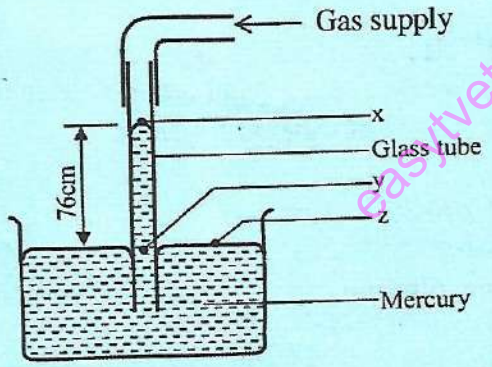



Fig. 5

(i) Determine which of the points x, y and z are at atmospheric pressure. (2 marks)

(ii) Calculate the pressure due to the column of mercury.
(Density of mercury = 13,600 kg/m$^3$, g = 10 N/kg). (3 marks)

easytvet.com

18. (a) Table I shows data obtained for the determination of focal length of a converging lens.

**Table I**

| Object distance, $u\,(cm)$ | 15 | 20 | 25 | 30 | 35 | 45 |
|---|---|---|---|---|---|---|
| Image distance, $v\,(cm)$ | 58.8 | 31.3 | 21.7 | 19.6 | 18.2 | 17.5 |
| $\frac{1}{u}cm^{-1}$ | 0.067 | II 0.050 | 0.040 | IV 0.033 | 0.029 | VI 0.022 |
| $\frac{1}{v}cm^{-1}$ | I 0.017 | 0.033 | III 0.046 | 0.05 | V 0.055 | 0.057 |

(i) Determine the values of I, II, III, IV, V and VI. (3 marks)

(ii) Plot a graph of $\frac{1}{v}(y-axis)$ against $\frac{1}{u}$. (7 marks)

(iii) Use the graph to determine the:

(I) y - intercept; (1 mark)

(II) x-intercept; (1 mark)

(III) foal length. (2 marks)

(b) A bullet of mass 10 g is fired from a gun of mass 6 kg with a velocity of 300 m/s. Calculate the recoil velocity of the gun. (4 marks)

(c) A gas of volume 200 cm$^3$ has a pressure of 1.6 Pa. Calculate its volume when the pressure is 2.0 Pa. (2 marks)

easyvet.com

19. (a) Calculate the heat energy in kJ required to convert 1 kg of ice at –10°C to vapour given:

Specific latent heat of fusion of ice = $336 \times 10^3$ Jkg$^{-1}$
Specific latent heat of steam = $2268 \times 10^3$ Jkg$^{-1}$
Specific heat capacity of ice = $2.1 \times 10^3$ Jkg$^{-1}$ K$^{-1}$
Specific heat capacity of water = $4.2 \times 10^3$ Jkg$^{-1}$ K$^{-1}$

(10 marks)

(b) Figure 6 shows a pendulum of mass 250 g attached to an inelastic string of length 0.5 m rotating in a horizontal circle of radius 0.4 m.

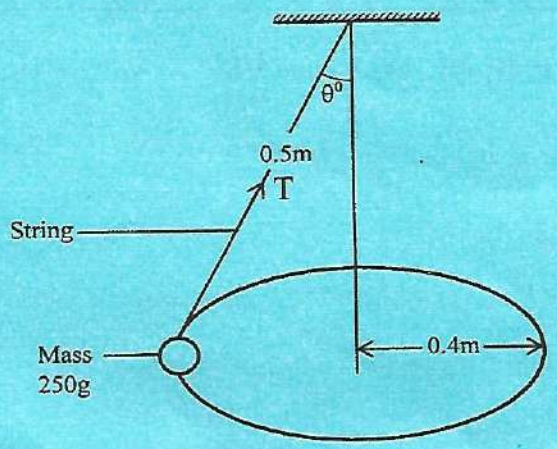



Fig. 6

easytvet.com

Determine the:

(i) angle $\theta$; (3 marks)

(ii) tension T of the spring when the mass is rotating; (3 marks)

(iii) linear velocity (g = 10 N/kg). (4 marks)

**THIS IS THE LAST PRINTED PAGE.**