**1904/103**
**PHYSICS TECHNIQUES I**
**Oct./Nov. 2019**
**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;*
*Scientific calculator (battery operated).*
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **TWO** questions from section **B** in the answer booklet provided.*
*Maximum marks for each part of a question are indicated.*
***Candidates should answer the questions in English.***

**This paper consists of 7 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** the questions in this section.*

1. List any **four** instruments used for measuring length. (4 marks)

2. Convert the following measurements into SI unit:

   (a) 0.05 cm;

   (b) $0.05\,cm^3$;

   (c) 750,000 millimetres;

   (d) 200 milliseconds.

   (4 marks)

3. Use the kinetic theory to explain why air kept at a constant temperature and volume exerts a constant pressure. (4 marks)

4. A mass of 100 g was hung from the lower end of a spring. The spring extended by 100 mm and its elastic limit was not exceeded. Determine the spring's constant. (4 marks)

5. A body of mass 3 kg weighs 22 N in kerosene and 20 N in water. Determine:

   (a) the relative density of kerosene;

   (b) the density of kerosene.

   (4 marks)

6. (a) A solid of dimensions 5 cm by 4 cm by 10 cm has a mass of 800 g. Determine its density. (2 marks)

   (b) State the law of flotation. (2 marks)

7. The U-tube shown in figure 1 contains mercury of density $13,600\,kg\,m^{-3}$ and is connected to a laboratory gas supply.

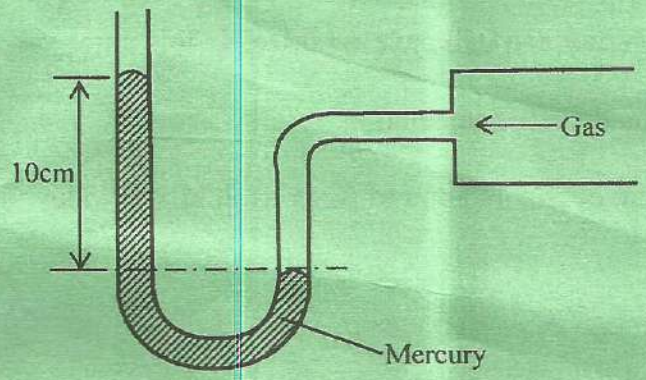


**Fig. 1**

Determine the total pressure exerted by the gas. (Take atmospheric pressure = $1.0 \times 10^5$ Pa). (4 marks)

8. The pressure exerted by the point of a needle on the body when a patient is being injected is approximately $1 \times 10^8\ Nm^{-2}$. The area of the needle point is $0.1\ mm^2$. Determine the force the doctor needs to exert to produce the necessary pressure. (4 marks)

9. (a) List any **three** factors that affect stability of a body. (3 marks)

   (b) Name any **one** application of stability. (1 mark)

10. Differentiate between elastic and inelastic collision. (4 marks)

11. (a) Define "angular velocity". (1 mark)

   (b) A ball tied to a string is rotated with uniform speed in a circle of radius 10 cm. It takes 1.5 s to describe an arc of length 6 cm. Determine its:

   (i) linear speed;

   (ii) angular velocity.

   (3 marks)

12. (a) List any **two** factors that affect heat transfer by conduction. (2 marks)

   (b) List **two** differences between a clinical and an ordinary liquid-in-glass thermometer. (2 marks)

13. A 3 KW electric kettle is put on for 3 minutes after the water has started boiling.

(a) Determine the mass of water that will have vaporized in this time.

(b) State **one** assumption made in the calculation.

(Take specific latent heat of vaporization of water as $2.26 \times 10^6 \text{ J kg}^{-1}$).

(4 marks)

14. (a) Define a virtual image. (1 mark)

(b) Figure 2 shows an object O placed in front of a plane mirror.

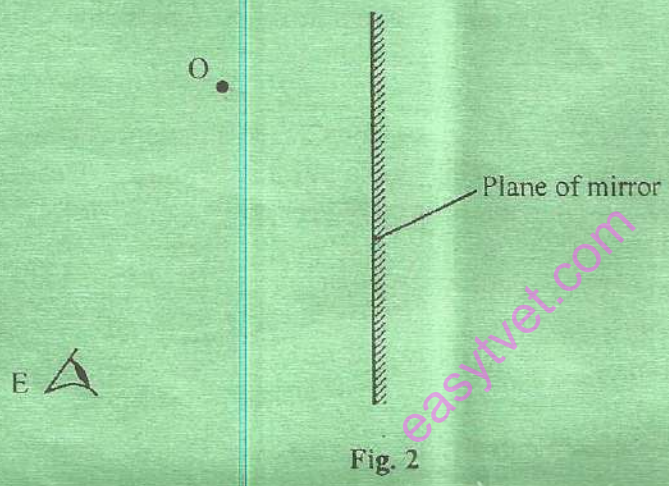


Fig. 2

On the same diagram, copy and draw rays to locate the position of the image I, as seen from the eye, E. (3 marks)

15. (a) State Snell's law. (1 mark)

(b) A ray of light passes from air into water at an angle of 60°. Determine the angle of refraction.

(Take refractive index of water as $\frac{4}{3}$). (3 marks)

## SECTION B (40 marks)

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

16. (a) Define the following terms:

(i) Specific latent heat of fusion.

(ii) Specific latent heat of vaporization.

(4 marks)

(b) Determine the amount of heat in mega joules required to convert 1 kg of ice at $-10^{\circ}$ to steam at $100^{\circ}$ C.

(Take: Specific heat capacities of ice and water as $2100\ J\ kg^{-1}K^{-1}$ and $4200\ J\ kg^{-1}K^{-1}$ respectively.
Specific latent heat of fusion of ice as $3.3 \times 10^5\ J\ kg^{-1}$.
Specific latent heat of vaporization of water as $2.3 \times 10^6\ J\ kg^{-1}$).

(10 marks)

(c) (i) State Boyle's law. (2 marks)

(ii) The volume of a fixed mass of a gas collected at 20° C and 770 mmHg is $24\ cm^3$. Determine the volume of the gas at standard temperature and pressure.

(Take the standard temperature and pressure as 0° C = 237 K and 760 mmHg respectively). (4 marks)

17. (a) Differentiate between upthrust and gravitational force. (3 marks)

(b) A hydrogen balloon used to carry instruments up into the atmosphere in a meteorological centre has a capacity of $30\ cm^3$ on the ground. The total mass of the balloon and hydrogen is 3 kg.

(Take the density of hydrogen and air as $0.089\ kgm^{-3}$ and $1.29\ kgm^{-3}$ respectively).

(8 marks)

(c) Define centre of gravity of an object. (2 marks)

(d) Figure 3 shows a light bar pivoted at a point and acted on by various forces such that it remains in equilibrium.

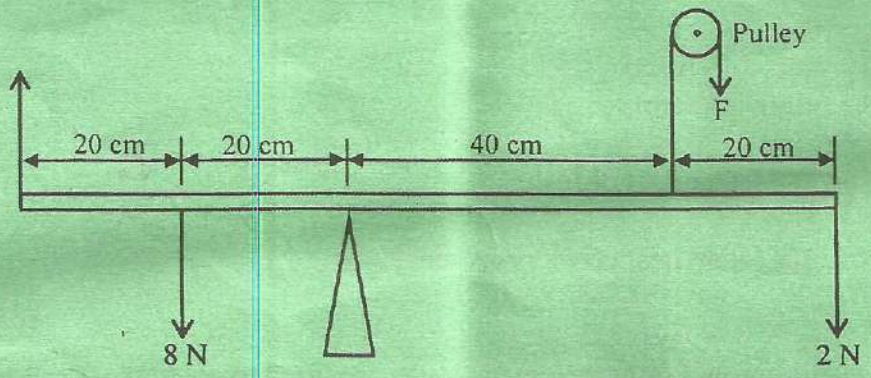


Fig. 3

Determine the:

(i) total clockwise moments;
(ii) total anticlockwise moments;
(iii) force F.

(7 marks)

18. (a) Explain why:

(i) water wets the glass surface;

(ii) mercury forms spherical drops.

(4 marks)

(b) A hydraulic machine has a plunger of cross-sectional area of 0.50 $m^2$ where a force of 8 N is applied. The large piston has a cross-sectional area of 2 $m^2$. Determine the load in kilograms that can be lifted. (5 marks)

(c) An object of height 1.0 cm is placed 5.0 cm on principle axis in front of a concave mirror of focal length 3.0 cm. By scale drawing, determine the:

(i) image distance;
(ii) image size;
(iii) nature of the image formed.

(8 marks)

(d) A vertical object placed on a bench is observed to have three shadows of different sharpness in different directions. Explain this observation. (3 marks)

19. (a) State the law of conservation of linear momentum. (2 marks)

(b) A supermarket trolley of mass 1.8 kg rests on a horizontal surface. Another trolley of mass 1.3 kg moving at 5.4 $ms^{-1}$ collides with the first trolley and the two trolleys stick together. Determine:

(i) the total momentum before collision;

(ii) the velocity of the trolleys immediately after collision.

(7 marks)

(c) State Hooke's law. (2 marks)

(d) Table I shows the extension of a spiral spring with its respective stretching force that was applied to the spring during the experiment.

Table I

| Force (N) | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.1 |
|---|---|---|---|---|---|---|---|
| Extension (cm) | 0 | 0.95 | 1.9 | 2.9 | 3.9 | 5.5 | 7.25 |

(i) Plot the graph of load (y - axis) against the extension of the spring. (6 marks)

(ii) From the graph, determine:

(I) the elastic limit of the spring;

(II) spring's constant within Hooke's law.

(3 marks)



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