PHYSICS
FORM 4
OPENER TERM 3 2025
MARKING SCHEME

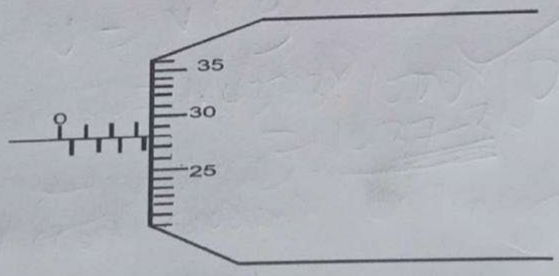
Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of the examination in the spaces provided above.
(c) This paper consists of two sections; A and B.
(d) Answer all the questions in sections A and B in spaces provided.
(e) All working must be clearly shown in the spaces provided in this booklet.
(f) Non-programmable silent electronic calculators may be used.
(g) This paper consists of 14 printed pages.
(h) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
(i) Candidates should answer the questions in English.

SECTION A (25MARKS)

Answer all the questions.

1. The micrometer screw gauge in figure 1 below gives the reading of the diameter of a piece of a wire.



Given that the length of the wire whose diameter was read by using figure above is 4cm, determine the volume of the wire.

S.L.R = 3.50 mm ✓
T.S.R = 26 x 0.01
A.R = 3.76 mm ✓ (2)

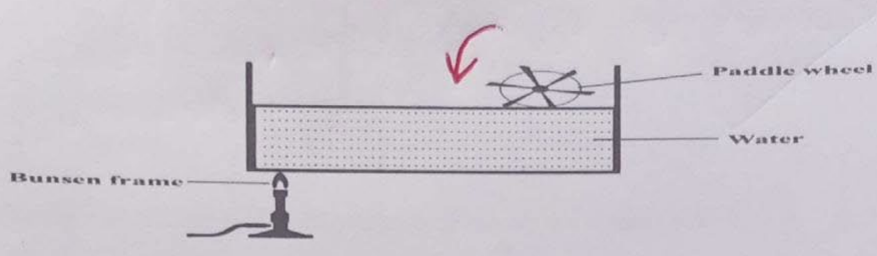
(2Marks)

2. State one advantage alcohol has over mercury as a thermometric liquid.

It can measure the lowest temperature ✓

(1mark)

3. The paddle wheel in **Figure 2** is observed to rotate when the Bunsen flame is placed below the container



(i) Indicate, on the diagram, the direction of rotation of the paddle wheel. (1 mark)

(ii) Explain why the paddle wheel rotates. (2 marks)

Water the is heated lowering its tensity and it rise ✓1 A convectional current is created which drives the wheel ✓1 (2)

4. Two rods of copper **A** and **B** of the same length but different thickness with candle wax attached to either end is heated as shown in Fig. 2.

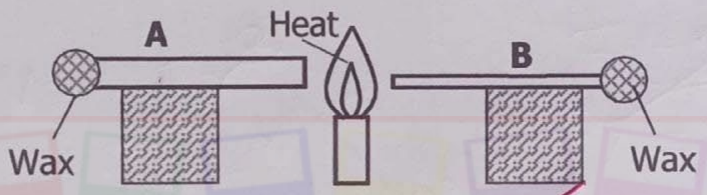


Fig. 2

State and explain the observation made. (2marks)

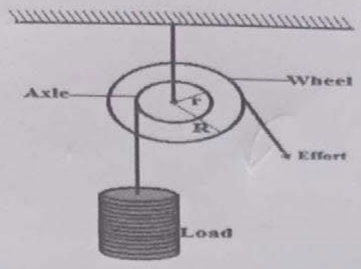
- wax on A will fall fast because it has more electrons (particles) are to kept (2) cross-sectional area for heat transfer

5. State **two** factors that lowers the surface tension force on a water surface . (2marks)

- increase in temperature ✓1
- addition of impurities ✓1 (2)

don't accept temperature impurities

6. The figure shows the side view of a system of wheel and axle being used to raise a load L by applying an effort E. The radius of a large wheel is R and that of a small wheel is r. Study the diagram and answer the questions that follow



Show that the velocity ratio (V.R) of this machine is given by the equation $V.R = \frac{R}{r}$

(2 marks)

V·R = Effort distance / Load distance ✓1

V·R = 2πR / 2πr ✓1

V·R = R/r ✓1 (2)

7. Explain why the narrow stem of a hydrometer provides greater sensitivity than a wide one
(1mark)

heat is transfered faster

8. FIGURE below shows an inclined plane. Study it and answer the questions that follow

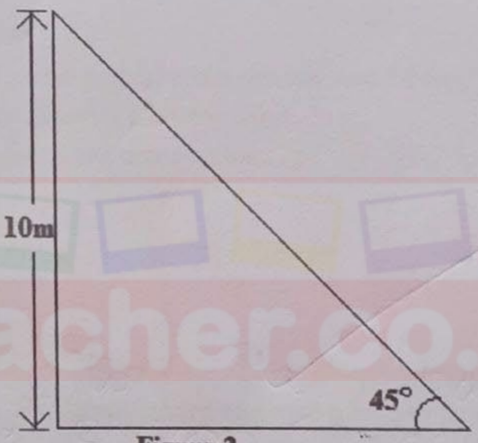


Figure 3

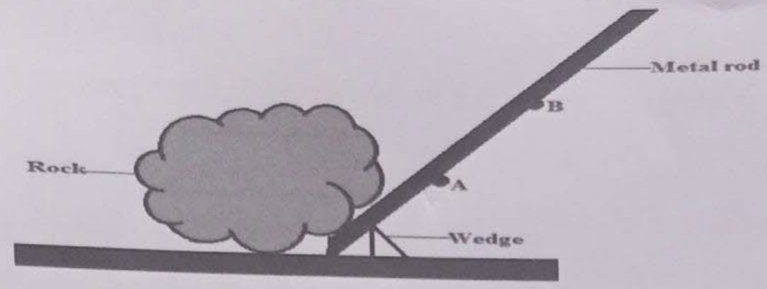
Determine the velocity ration of the machine

(2 marks)

V·R = 1/sinθ ✓1

1/sin45 = 1.4142 ✓1 (2)

9. FIGURE shows a metal rod used to roll a rock. Study the diagram and answer the questions that follow



State with a reason at which point A or B on the metal rod where it is easier to roll the rock
(2 marks)

B - turning distance increases with the perpendicular

10. An empty density bottle weighs 25g when empty and 70g when full of fresh water.

Determine the volume of the density bottle.
(2marks)

Mass of water = 70 - 25
45g

$V = \frac{m}{\rho} = \frac{45g}{1g/cm^3}$

$V = 45cm^3$ ✓ (2)

11. Water flows along a horizontal pipe of cross section area 24 crn2 with a speed of 3 m/s. The speed increases to 9 m/s where there is a constriction.
Calculate the cross-section area of the constriction. (2marks)

$V_1 A_1 = V_2 A_2$ ✓

$\frac{24cm^3 \times 3m/s}{9} = \frac{9m/s \times A_2}{9}$

$A_2 = 8cm^2$ ✓ 1

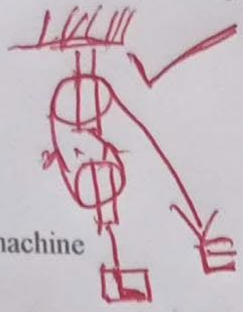
(2)

12. A highly inflated balloon bursts when transferred to a hotter environment. Explain this observation using kinetic theory of gases (2marks)

Rising the temp increases the average speed of particles so they collide more vigorously and more frequently with container walls. If the volume does not increase pressure increases ✓

13. Fig shows a beaker placed on a bench. A block of ice is placed in the beaker as shown. State and explain the change in the stability of the beaker when the ice melts.
(2marks)

aw a single pulley arrangement with a velocity ratio of 2 (2marks)

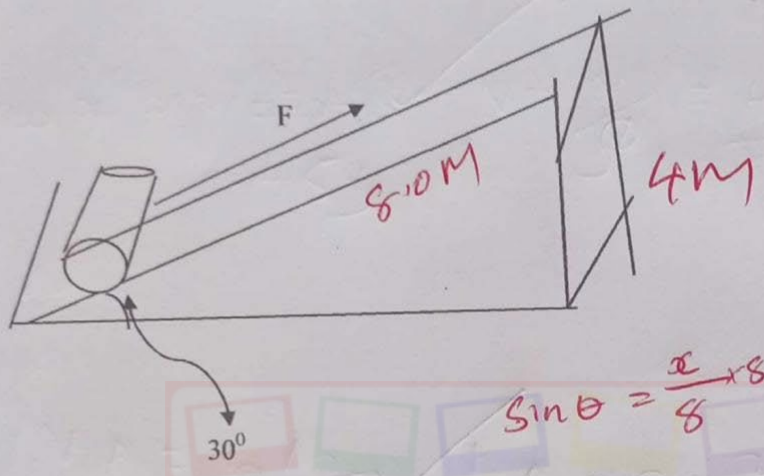


he must indicate Effort or Load

(b) Define the term efficiency of a machine (1mark)

- It is the ratio of work output to work input as a percentage

(c) Figure below shows a log of mass 75kg being rolled up a plane inclined at 30^0 to the horizontal. The force F applied is 450N and the distance moved by the log along the plane is 8.0 m (take g=10N/kg)



$\sin\theta = \frac{x}{8}$

Determine:

(i) The work done by the effort (2marks)

$= D_E \times E$ | $450N \times 8M = 3600J$

(ii) The work done on load (2marks)

$D_L \times E$ | 750×4 | $= 3000$

(iii) The efficiency of the inclined plane as a machine (2 marks)

$\eta = \frac{\text{work output}}{\text{work input}} = \frac{3000}{3600} \times 100 = 83.33\%$

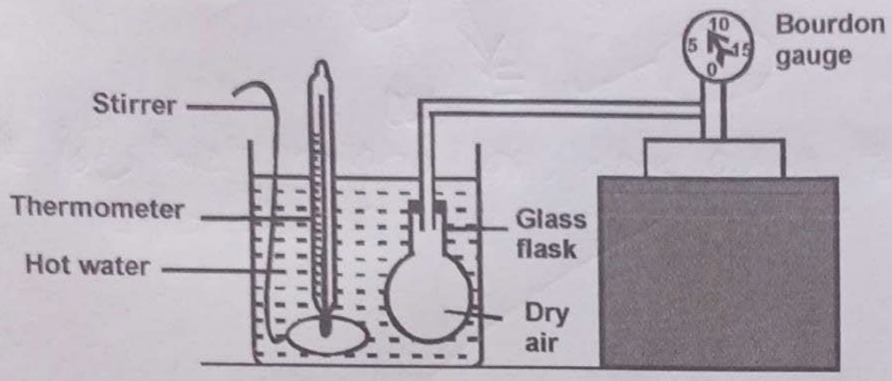
15. a) State the pressure law; (1 mark)

The pressure of a fixed mass of a gas is directly proportional to the absolute temperature (Kelvin) at a constant volume.

xplain how a gas exerts pressure. (2 marks)

→ When a gas is heated, Temperature of a gas rises its particles move faster and exert a greater pressure on the walls of the cylinder.

The figure below shows a set up used to verify pressure law.



i) State the measurement that may be taken in the experiment. (2 marks)

Temperature
Pressure

- A graph of Pressure against temp is plotted
- It is a straight line with positive gradient
→ This shows that the Pressure is directly proportional to absolute temp.

ii) Explain how the measurement in (i) above may be used to verify pressure law. (3 marks)

- The initial temp and Pressure reading are taken and recorded
- The water bath is heated gently and some more pairs of Pressure and temp readings are taken and recorded at suitable temp intervals

iii) A car tyre is at pressure of 5.0×10^5 Pa at a temperature of 37°C. While it is running, the temperature rises to 75°C. What is the new tyre pressure? (Assume the tyre does not expand) (3 marks)

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{5.0 \times 10^5}{(273+37)} = \frac{x}{(75+273)} = 561290.32$

$x = \frac{(5 \times 10^5) \times (348)}{310}$

16.a) Define centripetal acceleration. (1 mark)

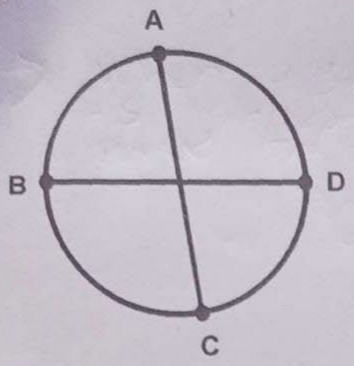
It is the acceleration of a body towards the centre of the circle.

b) Distinguish between angular and linear velocity. (2 marks)

It is the rate of change of angular displacement

Linear velocity is ~~rate~~ displacement per unit time

c) The figure 4 below shows an object of mass 0.2kg whirled in vertical circle of radius 0.5m at uniform speed of 5m/s.



Determine the tension of the string at;

i) Position A. (2 marks)

$\frac{MV^2}{r} - mg \quad \frac{0.2 \times 5^2}{0.5} - 0.2 \times 10 = 8N$

ii) Position B. (2 marks)

$\frac{MV^2}{r} + mg \quad \frac{0.2 \times 5^2}{0.5} + 0.2 \times 10 \quad 12N$

ii) At what point is the string likely to cut. Explain. (2 marks)

C - highest tension

17 (a) State Newton's second law of motion (1mark)

The rate of change of linear momentum is directly proportional to external force applied and takes place in the direction of force

(b) A Matatu starts from rest and accelerate to cover a distance of 49m in 7 seconds. Determine

(i) Its acceleration (3mks)

$s = ut + \frac{1}{2}at^2$

$49 = 0 \times 7 + \frac{1}{2} \times a \times 49 \quad a = 2 m/s^2$

(ii) Its velocity after 7 seconds (2mks)

$v^2 = u^2 + 2as$

$v^2 = 0 + 2 \times 2 \times 49 \quad v = 14 m/s$

c) A bullet of mass 10g traveling horizontally with a velocity of 300m/s strikes a block of wood of mass 290g which rests on rough horizontal floor. After impact they move together and come to rest after traveling a distance of 15m.

(i) Calculate the common velocity of the bullet and the block. (2marks)

$(m_1u_1 + m_2u_2) = (m_1 + m_2)v$

$(0.01 \times 300) + (0.29 \times 0) = (0.01 + 0.29)v$

$3 = 0.30v \quad v = 10 m/s$

Calculate the acceleration of the bullet and the block.(2marks)

$u = 10 m/s$
$v = 0$
$s = 15$

$v^2 = u^2 + 2as$
$v^2 = 100 + 2 \times 15 \times a$ | $: 3.33 m/s^2$

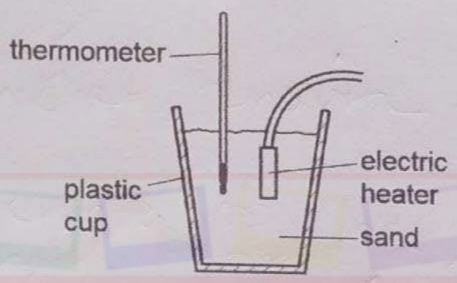
(iii) Calculate the coefficient of sliding friction between the block and the floor. (2marks)

$F = \mu r$

iv) A high jumper usually lands on a thick soft mattress. Explain how the mattress helps in reducing the force of impact (1mark)

To increase the time to land. When time is increased the force of impact is reduced making the jumper to land safely.

18. The figure shows a plastic cup. The cup contains sand, an electric heater and a thermometer



The power rating of the heater is 50 W. The mass of the sand in the cup is 550 g. The initial temperature of the sand is 20 °C. The heater is switched on for 2.0 minutes. The temperature is recorded until the temperature stops increasing. The highest temperature recorded by the thermometer is 33 °C.

a) Calculate the energy supplied by the heater (2 marks)

$Pxt = 50 \times 2 \times 60$

$= 6000 J$

b) Determine the value of the specific heat capacity of the sand from the information provided (3 marks)

$Pxt = mc\Delta\theta$

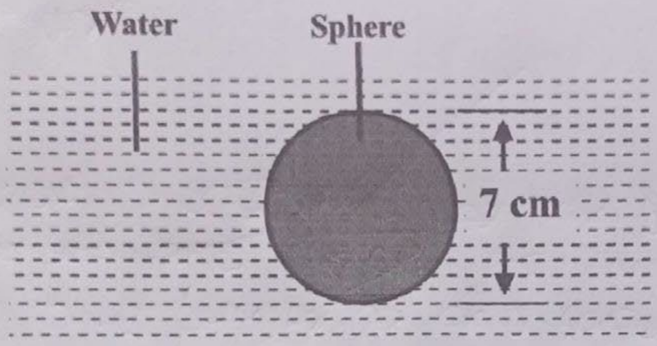
$6000 J = 0.55 \times c \times 13$

$= 839.16 J kg^{-1} K^{-1}$

wo reasons why the specific heat capacity of sand may be different from the value calculated (1mark)

some energy is lost to surrounding

19. Figure below shows the cross-section of a solid sphere of a diameter 7 cm floating in a water of density 1.0 gcm^{-3}.



(i) Determine the:

(I) density of the sphere, (2 mark)

$V = \frac{4}{3}\pi r^3$

$\frac{4}{3} \times \frac{22}{7} \times 0.07^3$

$1.4373 \times 10^{-3} m^3$

$M = 1.4373 kg \times 1000$

$= 1437.3 kg$

$\rho = M/V = 1000 kg/m^3$

(II) Upthrust on the sphere. (Take gravitational intensity, g =10 Nkg^{-1}. (3 marks)

$U = V\rho g$

$= 1.4373 \times 1000 \times 10$

$= 14373 N$

(ii) Explain what is observed when salt is added to the water in set up in figure above (2 marks)

Accept student explanation