1

NAME: ......MARKING SCHEME.......

INDEX NO:…………………… CLASS:…….. ADM.NO:………………

KENYA CERTIFICATE OF SECONDARY EDUCATION
PHYSICS 232/1
PAPER 1

TIME: 2 HOURS

SUKELLEMO

INSTRUCTIONS TO CANDIDATES.

Write your name and Index Number in the spaces provided above.
Attempt ALL questions in the spaces provided.
All working MUST be shown.

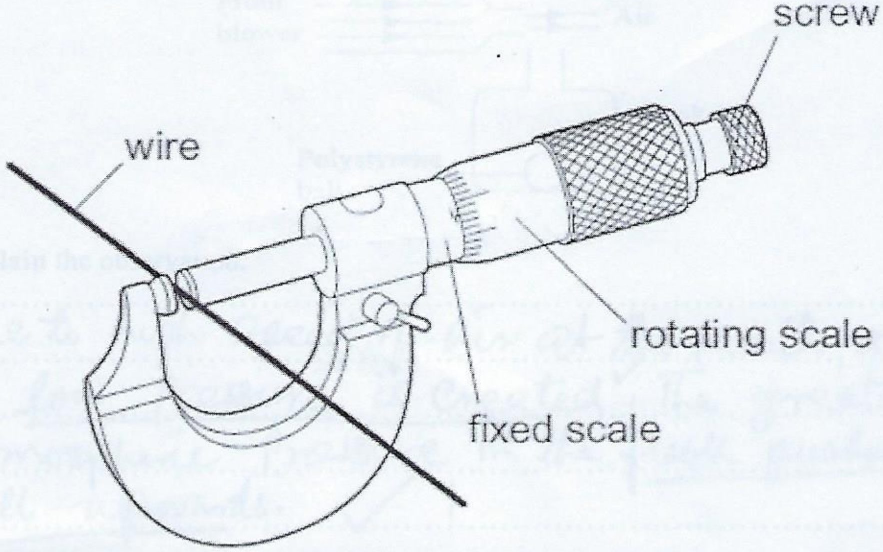
For Examiner's use only

SECTION	QUESTION	MAXIMUM SCORE	CANDIDATE'S SCORE
A	1-12	25	
B	13	10	
	14	09	
	15	9	
	16	10	
	17	9	
	18	7	
	Total	80	

The paper consist of 15 printed pages.
Candidates should check to see that no page is missing.

SECTION A (25marks)

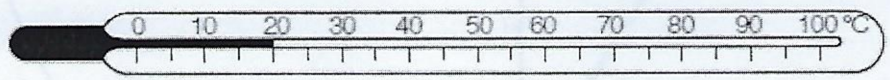
1. A micrometer is used to measure the diameter of a uniform wire



State what is done in order to obtain an accurate answer. (1mark)

Wire is held between anvil and spindle. Micrometer is closed using a ratchet until the wire is held gently. Ratchet slips when object is gripped firmly enough. Main scale and thimble scale readings are noted.

2. The figure below shows a mercury thermometer



This thermometer has a suitable range for use in laboratory experiments, but has a **low sensitivity** for some experiments.

(i) With reference to this thermometer, what is meant by **low sensitivity**. (1mark)

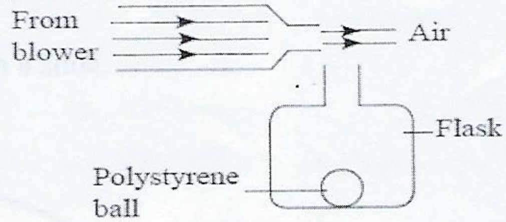
- Does not respond fast to small changes in temperature
- Scale cannot indicate very small changes in the thermometer.
- Accuracy of thermometer is 5.0°C

(Any 1 x 1mk)

(ii) State **one** change in the design of a thermometer that increases its sensitivity. (1mark)

Change scale to accomodate very small changes in temperature.

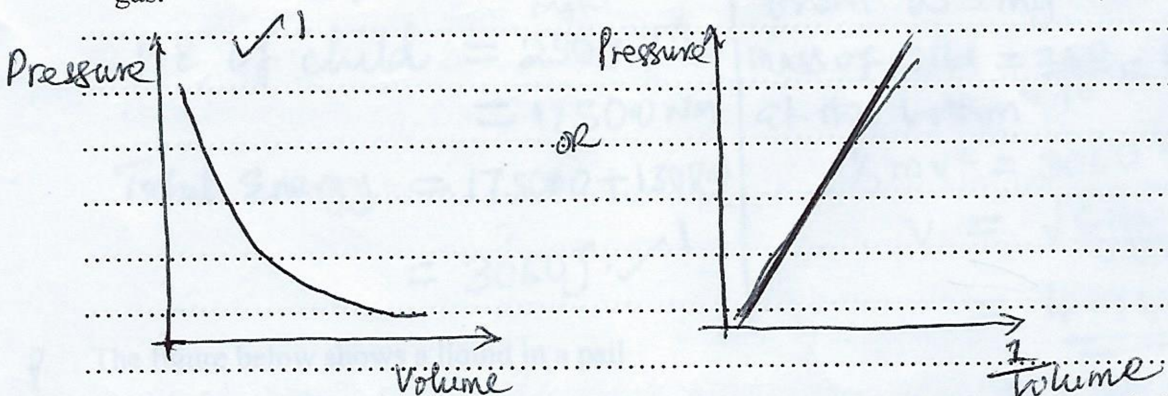
3. The figure below shows a very light polystyrene ball placed in a flask. When a jet of air is violently blown over the mouth of the flask, the ball is observed to rise from the bottom



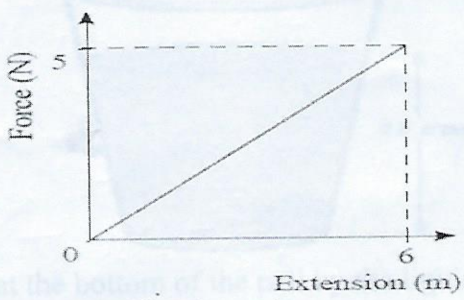
Explain the observation. (2 marks)

Due to high speed of air at the mouth, a region of low pressure is created. The greater atmospheric pressure in the flask pushes the ball upwards.

4 A fixed mass of gas undergoes a change of volume at constant temperature Sketch a graph showing the relationship between the volume and the pressure of the gas. (1mark



5. The figure below shows a graph of Force (N) against extension for a spring with elastic limit not exceeded:



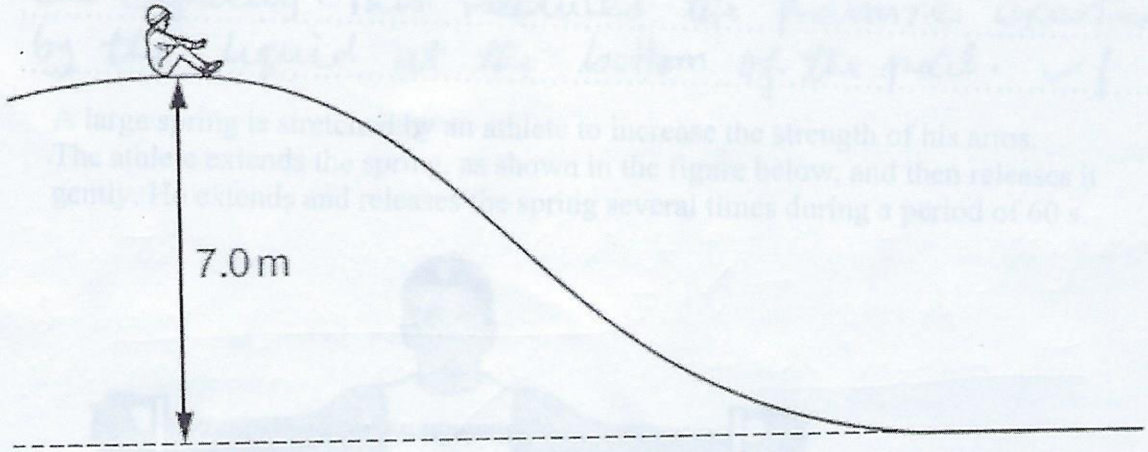
Determine the work done in stretching the spring. (2 marks)

Work done = Area under the graph.

$= \frac{1}{2} \times 5 \times 5$

$= 15.0$ Nm or 15.0 J.

6. A child slides down a slide.

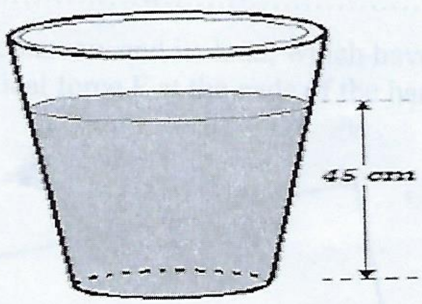


The weight of the child is 250 N. The height of the slide is 7.0 m. The work done against friction as the child travels down the slide is 1300 J.Determine the speed the child reaches the ground with. (3marks)

P.E of child = 250×7 (mgh)
= 17500 NM
Total Energy = 17500+13000
= 3050J ✓1

From W = mg
mass of child = $\frac{250}{10}$ = 25 Kg
at the bottom
$\frac{1}{2}mv^2$ = 3050 ✓1
$v = \sqrt{\frac{6100}{250}}$
= 4.940 m/s ✓1

7 The figure below shows a liquid in a pail



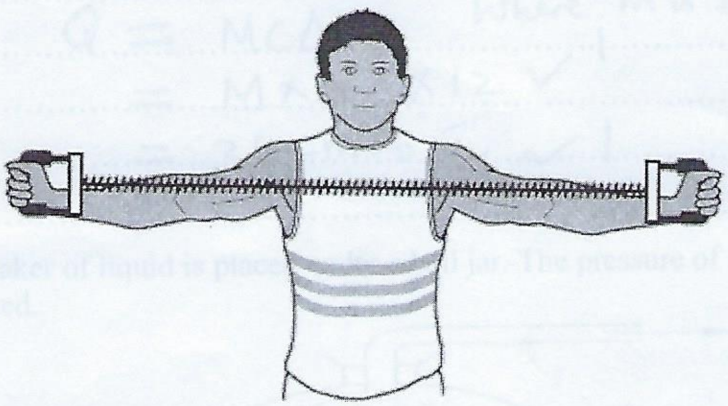
(a). If the pressure exerted at the bottom of the pail by the liquid is **3555N/m²** determine the density of the liquid. (2marks)

P = hρg ✓1
3555 = 0.45 × ρ × 10
ρ = 790 Kg/m³ ✓1

b) Suggest a reason why pail manufactures prefer the shape shown to other shapes.(1mark)

In order to reduce the height of the pail but maintain the capacity. This reduces the pressure exerted by the liquid at the bottom of the pail. ✓1

8. A large spring is stretched by an athlete to increase the strength of his arms. The athlete extends the spring, as shown in the figure below, and then releases it gently. He extends and releases the spring several times during a period of 60 s.



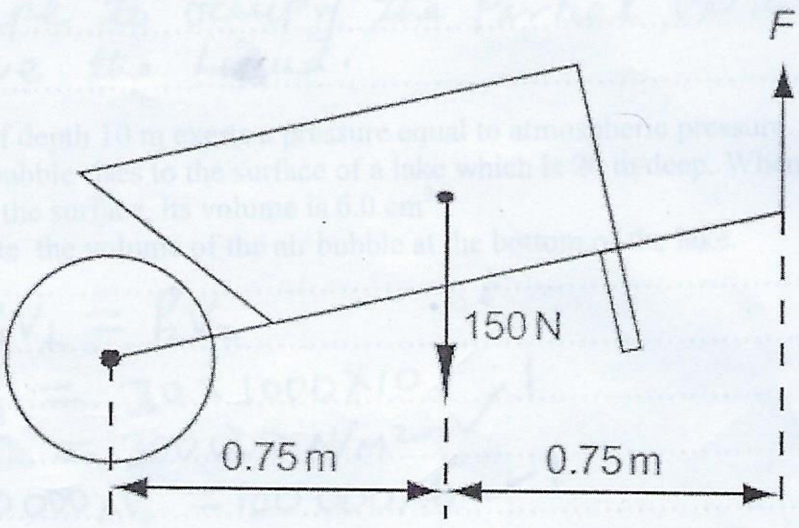
During **one** extension of the spring, its length increases from 70 cm to 93 cm. The average force exerted by the athlete is 400 N.
Calculate the work done by the athlete in one extension. (2marks)

Work done = Force x extension

= 460 x 0.23 ✓1

= 92.0J. ✓1

9 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by a vertical force F at the ends of the handles.



Calculate the value of F (2marks)

Clockwise moments = Anticlockwise moments

$F \times 1.5m = 150 \times 0.75$ ✓1

$F = 75.0N$ ✓1

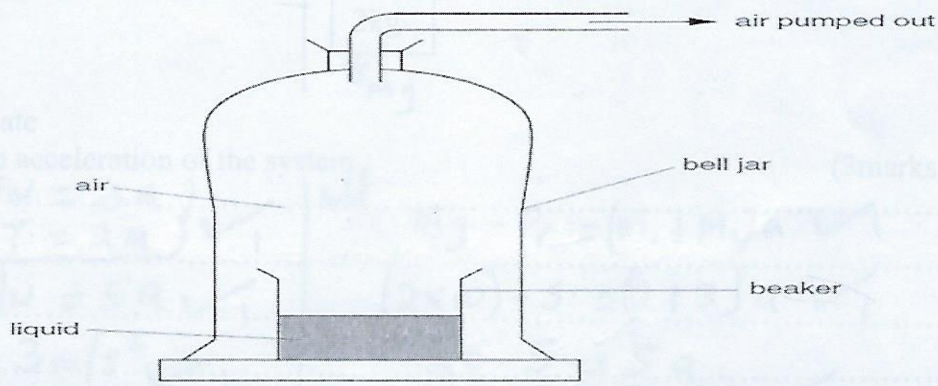
10. At the start of the day the temperature of the air in the classroom is 18 °C. Calculate the energy needed to raise the temperature of the air in the classroom from 18 °C to 30 °C. The specific heat capacity of air is 970 J/(kg °C). (2marks)

$Q = MC\Delta\theta$ where m is the mass of air.

$= M \times 970 \times 12$ ✓1

$= 364m.0 J.$ ✓1

11. A beaker of liquid is placed under a bell jar. The pressure of the air above the liquid is reduced.



State and explain the observation which will be made in the liquid. (2marks)

The liquid cools down. ✓ Molecules at the surface ✓ escape to occupy the Partial vacuum created above the Liquid.

12. Water of depth 10 m exerts a pressure equal to atmospheric pressure.
An air bubble rises to the surface of a lake which is 20 m deep. When the bubble reaches the surface, its volume is 6.0 cm^3.
Calculate the volume of the air bubble at the bottom of the lake. (3marks)

$P_1V_1 = P_2V_2$

$P_1 = 30 \times 1000 \times 10$ ✓1

$= 300.000 N/m^2$

$300.000 \times V_1 = 100.000 \times 6$ ✓1

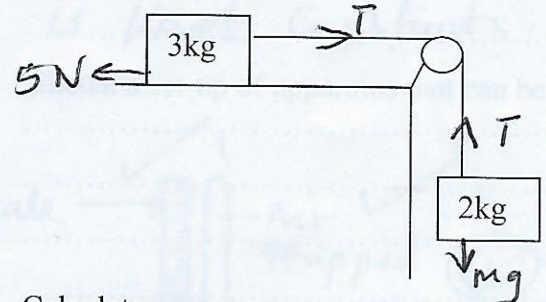
$V_1 = 2.0m^3$ ✓1

SECTION B(55 marks)

13.(a) State the law of conservation of energy. (1mark)

Energy can neither be created nor destroyed but can only transfered from one form to another ✓1

(b) The figure below shows a 3.0kg block attached to a 2.0kg mass by a light inextensible string which passes over a frictionless pulley. The force of friction between the horizontal surface and the block is 5N. The block is released from rest so that both masses move a distance of 0.8m.



Calculate

(i) the acceleration of the system. (3marks)

$T - 5N = 3a$

$+\ 20N - T = 2a$ ✓1

$(20-5)N = 5a$ ✓1

$a = 3m/s^2$ ✓1

Alt

$Mg - F_r = (M_1 + M_2)a$ ✓1

$(2 \times 10) - 5 = (2+3)a$ ✓1

$20 - 5 = 5a$

$a = 3m/s^2$ ✓1

(ii) the velocity of the 2kg mass after falling through the height of 0.8m.(2marks)

$u = 0m/s$

$a = 3m/s^2$

$s = 0.8m$

$V^2 = u^2 + 2aS$

$V^2 = 0^2 + 2 \times 3 \times 0.8$ ✓1

$V^2 = 4.8$

$V = \sqrt{4.8}$

$V = 2.19m/s$ ✓1

(iii) the work done against friction. (1mark)

$W = F \times d$

$= 5N \times 0.8M$

$= 4J$ ✓1

(iv) the tension of the string before the block hits the ground. (3marks)

$Mg - T = Ma$ ✓1 | $T = 14N$ ✓1

$(2 \times 10) - T = 2 \times 3$ ✓1

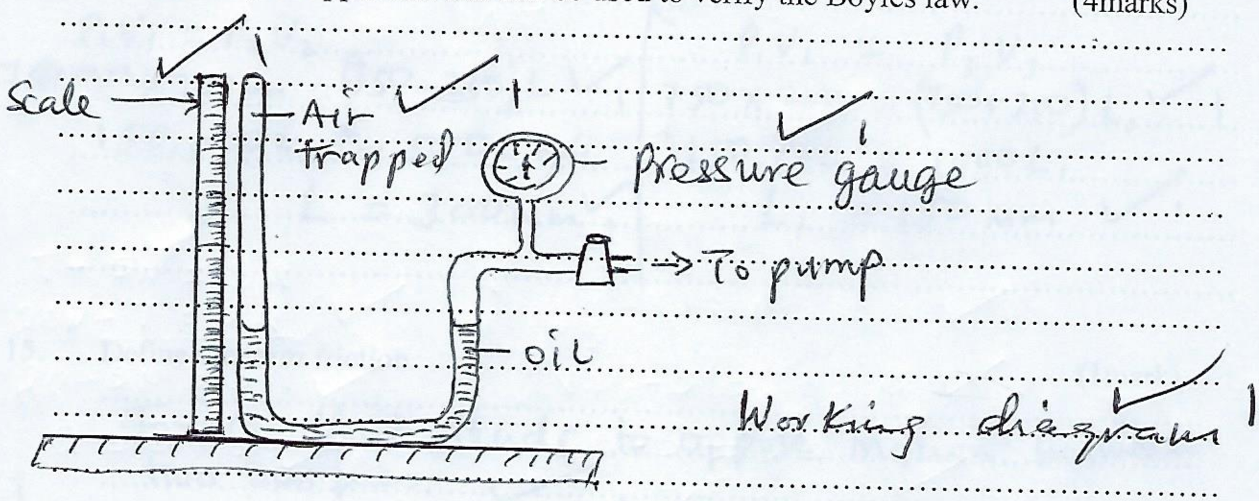
$20 - T = 6$

$-T = -14$

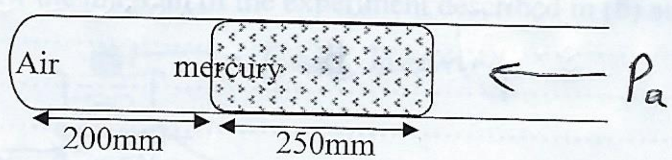
14. (a) State Boyles law (1mark)

The pressure of a fixed mass of gas is inversely proportional to its volume provided the temperature is kept constants. ✓1

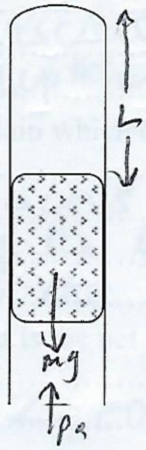
(b) Sketch a set-up of apparatus that can be used to verify the Boyles law. (4marks)

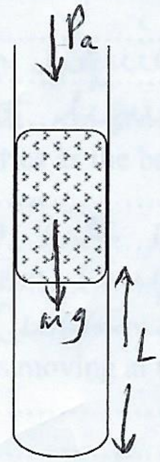


(c) Air is trapped inside a glass tube by a thread of mercury 250mm long. the air column is 200mm when the tube is held horizontally.



Given that the atmospheric pressure is 750mm Hg, determine the length of air column when the tube is held as shown in the diagrams below. (4marks)

i) 

ii) 

(i)
$P_1V_1 = P_2V_2$
$750mm \times 200mm = (750-250)L$ ✓1
$150{,}000\ mm^2 = 500L\ mm$
$L = 300mm$ ✓1

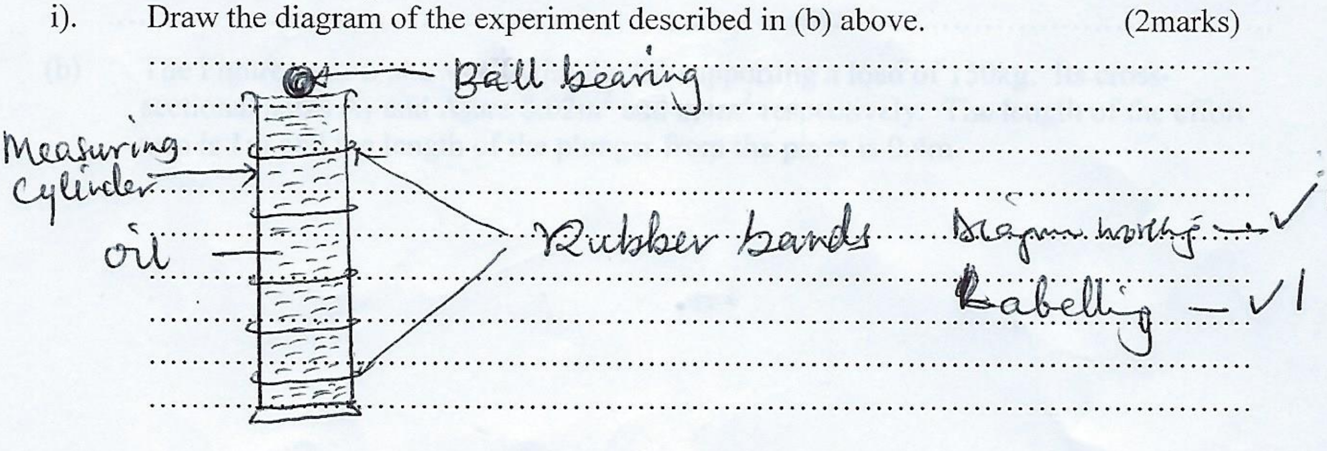
(ii)
$P_1V_1 = P_3V_3$
$750 \times 200 = (750+250)L_1$ ✓1
$150{,}000 = 1000L_1$
$L_1 = 150mm$ ✓1

15. Define the term friction. (1mark)

Force that tends to oppose motion between two surfaces. ✓1

b. A spherical steel ball is released from rest just above the surface of a column of oil which is in a long wide tube.

i). Draw the diagram of the experiment described in (b) above. (2marks)



ii). State **three** forces affecting the movement of the ball as it falls in the oil. (3marks)

- Weight of the ball bearing ✓1
- Viscous drag due to liquid ✓1
- Upthrust force due to liquid ✓1

ii. Explain which of the forces in b (i) above varies as the ball falls. (1mark)

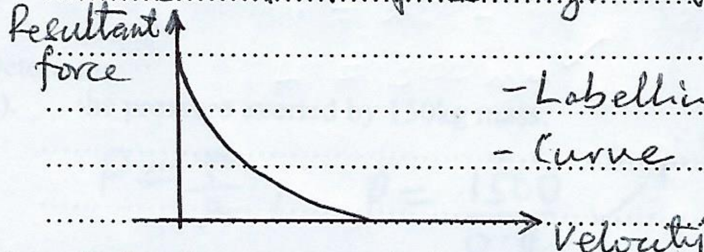
Viscous drag increases with increase in velocity of the ball until when weight becomes equal to the upward forces (upthrust force + viscous drag) ✓1

iii. What is the net force acting on the ball that is moving at terminal velocity? (1mark)

Zero. ✓1

iv. Sketch a graph to show the variation of resultant force on the ball with velocity from the moment it was released. (2marks)

Resultant force against velocity



- Labelling of axes ✓1
- Curve ✓1

16. Define the term atmospheric pressure. **(1 marks)**

The pressure exerted on the surface of the earth by weight of the air column above it. ✓1

(b) The Figure below shows a hydraulic lift supporting a load of 150kg. Its cross-sectional areas A_1 and $A_2$are $0.02m^2$ and $0.4m^2$ respectively. The length of the effort arm is 1m and the length of the plunger from the pivot is 0.4m.

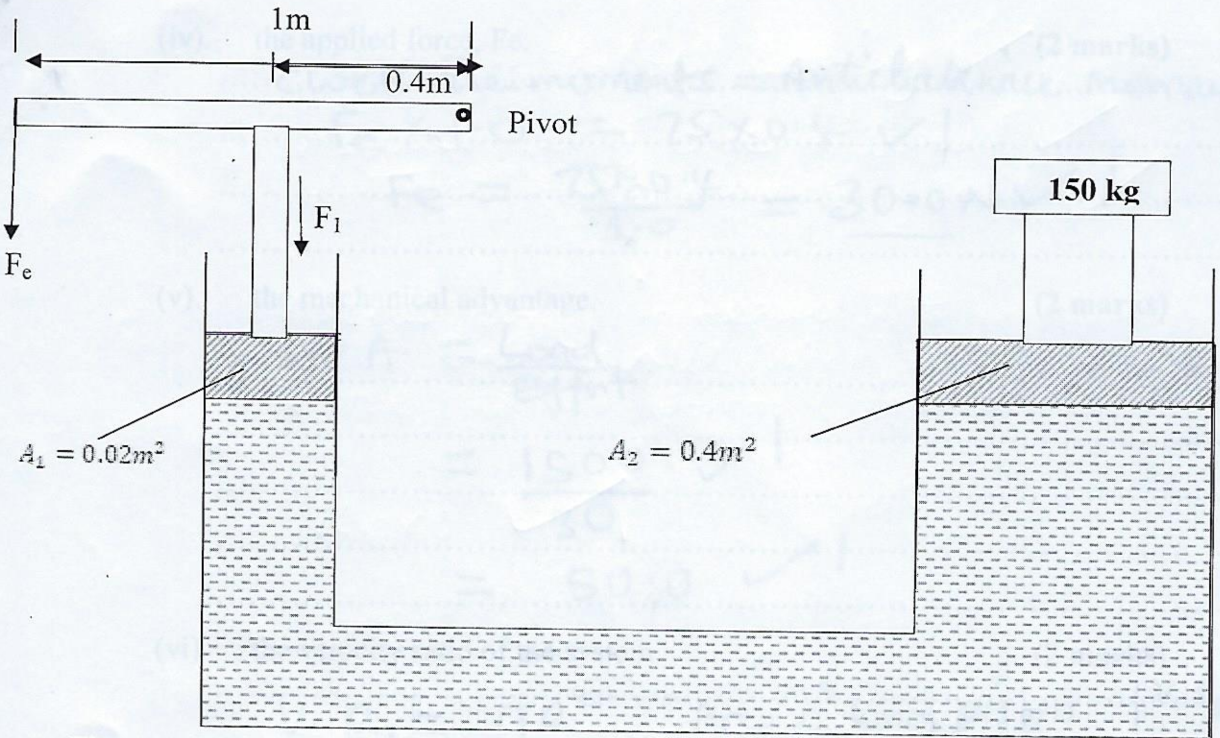


Fig.

Determine:

(i). the pressure exerted by 150kg mass. (1 mark)

$P = \frac{F}{A}$; $P = \frac{1500}{0.4}$ ✓1

$= 3750.0\ N/m^2$ ✓1

(ii). the pressure exerted by F_1 on the smaller piston. (1 mark)

$3750.0\ N/m^2$ ✓1

(iii). the force F_1. (2 marks)

$P = \frac{F_1}{A}$

$F_1 = P \times A$ ✓1

$= 3750 \times 0.02$ ✓1

$= 75.0\ N.$ ✓1

(iv). the applied force, Fe. **(2 marks)**

Clockwise moments = Anticlockwise moments

$Fe \times 1.0 = 75 \times 0.4$ ✓1

$Fe = \frac{75 \times 0.4}{1.0} = 30.0N$ ✓1

(v). the mechanical advantage. **(2 marks)**

$M.A = \frac{Load}{Effort}$

$= \frac{1500}{30}$ ✓1

$= 50.0$ ✓1

(vi). the velocity ratio of the system. **(2 marks)**

$V.R_1$ of hydraulic press $= \frac{\pi R^2}{\pi r^2} = \frac{\text{Area of load piston}}{\text{Area of Effort piston}}$

$= \frac{0.4}{0.02}$

$= 20.0$

$V.R_2$ (lever) $= \frac{\text{Effort dist}}{\text{Load dist}}$

$= \frac{1}{0.4}$

$= 2.5$

$V.R = V.R_1 \times V.R_2$ ✓1

$= 20 \times 2.5$ ✓1

$= 50.0$ ✓1

(vii) the efficiency of the system. **(2 marks)**

$\text{efficiency} = \frac{M.A}{V.R} \times 100$ ✓1

$= \frac{50}{50} \times 100$

$= 100\%$ ✓1

17.(a)(i) State the law of floatation. (1mk)

A floating body displaces its own weight of the fluid in which it floats. ✓1

(ii) A hydrometer of mass 25g floats in an acid of density $1.8 g/cm^3$ with 3cm of its stem above the acid. If the cross-section area of stem is $0.5 cm^2$ determine the total volume of the hydrometer.(3mks)

Weight of hydrometer = upthrust

$W = \frac{25}{1000} \times 10 = 0.25 N$

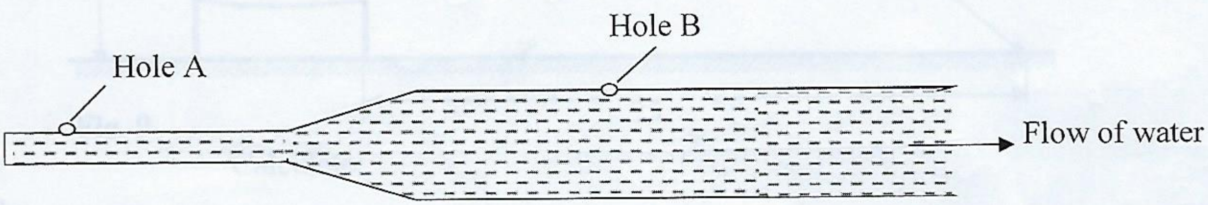
$U = (V - Ay)\rho$ ✓ where V - volume of the hydrometer, A - cross-sectional area of stem, y - length of stem not immersed in acid, ρ = density of acid

$0.25 = (V - 5\times10^{-5} \times 3\times10^{-2}) \times 1800$ ✓1

$V = 0.00014 m^3$

$= 140.0 cm^3$ ✓1

(b) Water flows through a pipe of varying diameter as shown below.



(i) The pipe has two identical holes A and B. Briefly explain the hole that has its jet of water rising highest. (2marks)

At hole B ✓1

Pressure is high where velocity is low ✓1. The cross-sectional area of the pipe where there is hole B is larger. Hence the water flows at lower velocity.

(ii) If the diameter of the wider section of the pipe is 7cm while the narrower end is 2.1cm, determine the speed of the water in the narrow end if that at the wider end is 10m/s. (3marks)

$A_1V_1 = A_2V_2$ ✓1

$\pi r_1^2 V_1 = \pi r_2^2 \times 10$ ✓1

$V_1 = \frac{1.225\times10^{-3} \times 10}{0.00011025}$

$V_1 = \underline{111.11 m/s}$ ✓1

18. A stone is thrown with a horizontal velocity ***u*** from the top of a building of height 125m so as to hit a target on the ground 75m from the base of the building as shown in Figure 9 below.

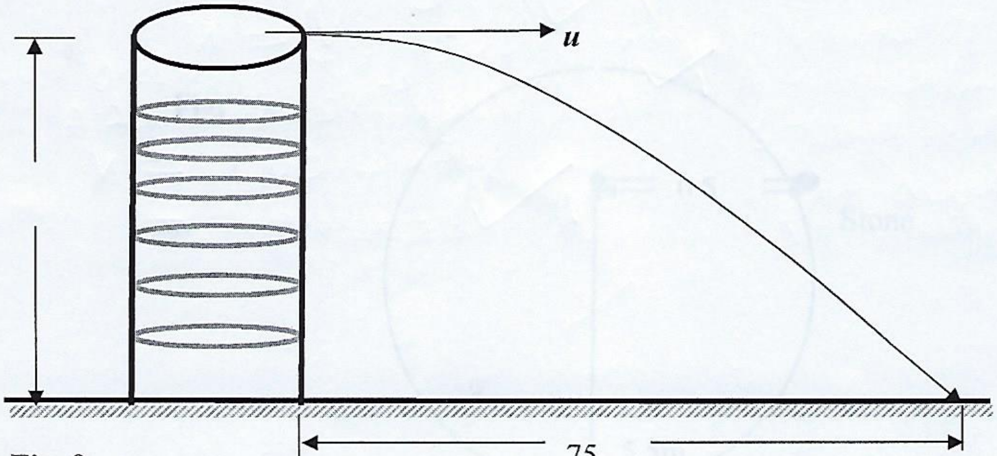


Fig. 9

Calculate:

(i) the time taken for the stone to hit the target. **(2 marks)**

Alt:
$S = \frac{1}{2}gt^2$
$125 = \frac{1}{2} \times 10 \times t^2$
$125 = 5t^2$
$25 = t^2$
$t = 5.0\,s$

$t = \frac{u}{g}$ and $H = \frac{u^2}{2g}$

$u^2 = 125 \times 2 \times 10$

$u = 50.0\,m/s$

$t = \frac{50}{10}$

$= 5.0$ seconds

(ii) the horizontal velocity, **u**, of the stone. **(2 marks)**

~~$H = \frac{u^2}{2g}$~~

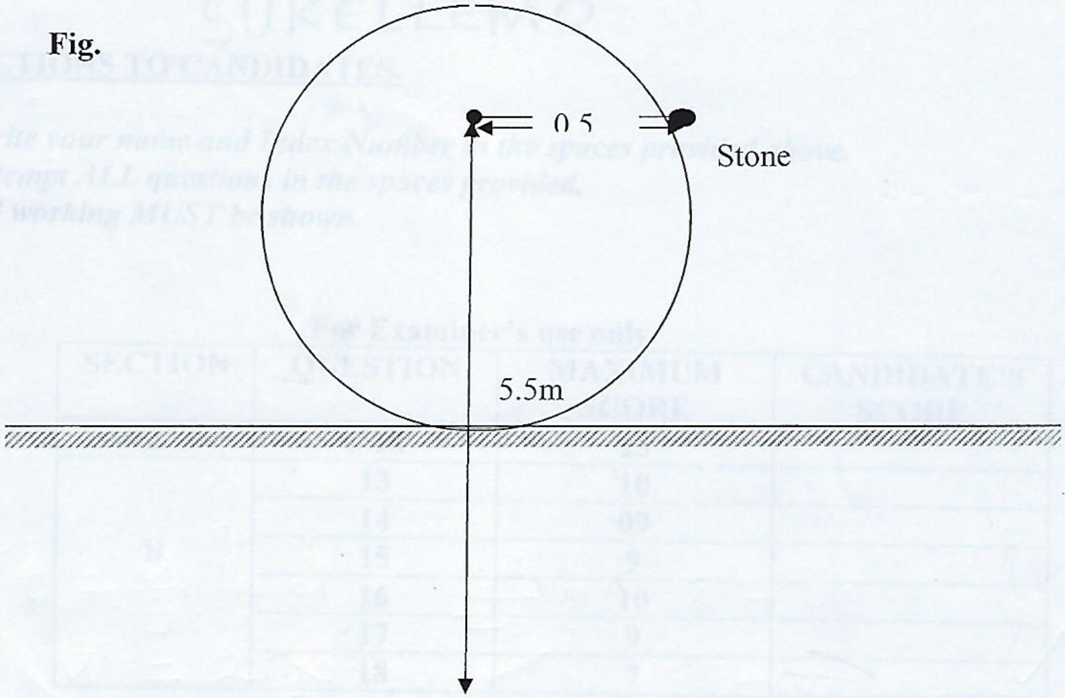
$H_x = U_x t$

$75 = U_x \times 5$

$U_x = 15\,m/s$

(c) A stone of mass 0.5kg is attached to a string of length 0.5m which will break if the tension exceeds 20N. The stone is whirled in a vertical plane, the axis of rotation being above the ground, as shown in the Figure 10 below.

Fig.



The angular velocity is gradually increased until the string breaks.

(a) In what position is the string most likely to break? **(1 mark)**

At the [illegible] where there is maximum force.

(b) At what angular velocity, *w*, will the string break? **(3 marks)**

$F = \frac{Mv^2}{r} = 20N$

$V^2 = \frac{20 \times 0.5}{0.5}$

$V = 4.47 m/s$

$V = wr$

$4.47 = 0.5 \times w$

$w = \frac{4.47}{0.5} = 8.94$ rad/s

$T = M\omega^2 r + mg$ ✓1

$20N = (0.5 \times \omega^2 \times 0.5) + (0.5 \times 10)$ ✓1

$20N = 0.25\omega^2 + 5$

$15 = 0.25\omega^2$

$\omega^2 = 60$

$\omega = \sqrt{60}$ ✓1

$= 7.746$ rad/s