OPENER EXAMINATION: TERM 2 2024

FORM 4 PHYSICS PAPER 1

MARKING SCHEME

SECTION A (25 MARKS)

1. The figure below shows a Vernier caliper scale.

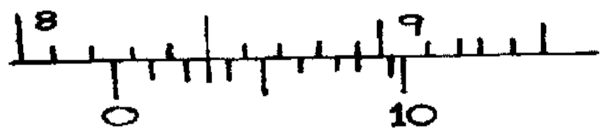


Fig. 1

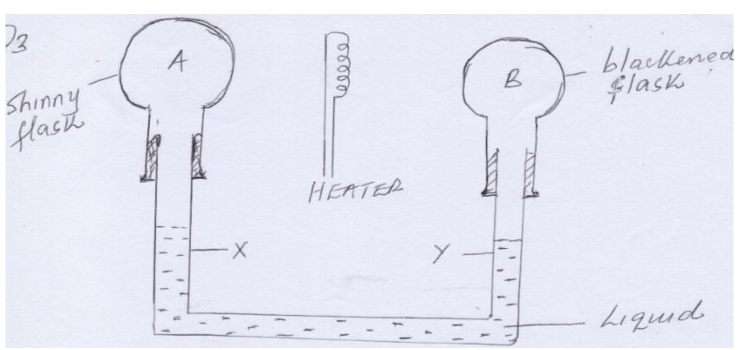
If the Vernier calipers used had a zero error of -0.02 what is the actual reading of the scale. (2mks)

8.20
+ 0.03
8.23
+ 0.02
8.25

2. Find the total pressure experienced by a diver 8 metres below the sea surface.
Take; Atmospheric pressure = 103 360N
Density of sea water = 1030 kg/m^3 (3mks)

Pressure experienced by diver = Atmospheric pressure + Pressure due to sea water
= 103360 + ρgh
= 103360 + 1030 x 10 x 8
= 185760 N/m^2

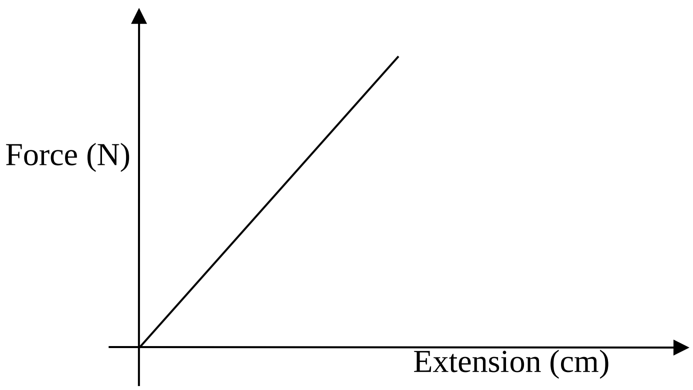
3. The figure below shows an electric heater placed midway between flask A and B. flask A is shinny on the outside and flask B is blackened on the outside.



a) Name the process by which heat travels from heater to the flask. (1mk)
Radiation

b) State the observation that will be made. (1mk)
Level of the liquid in Y decreases and level of liquid in X rises.

4. The following is a graph of force against extension for a spring



On the same axes, sketch a graph of force against extension for a spring double the length, same thickness, same material as the spring above (1MK)

5. Water flows steadily along a horizontal pipe at a volume rate of 8.0 x 10^{-3} m^3/s. if the area of cross section of the pipe is $20cm^2$. Calculate the velocity of the fluid. (3mks)

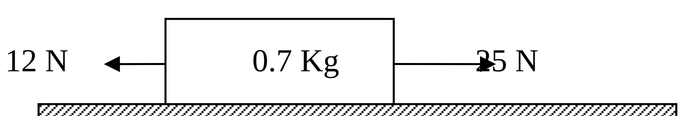
Flow rate = area x speed

$8.0 \times 100^{-3} = \frac{20}{100 \times 100} \times v$

$V = \frac{8.0 \times 10^{-3} \times 10^{4}}{20}$

= 4 m/s

6. Two parallel forces are acting on a body of mass 0.7 kg as shown in the figure below.



Calculate the acceleration of the 0.7Kg mass (3MK)

Accelerating force = 25 – 12 = 13N

F = ma

3N = 0.7a

a = 3/0.7

= $4.286m/s^2$

7. State pressure law. (1mk)

Pressure of a fixed mass of a gas is directly proportional to its absolute temperature provided the volume is kept constant.

b) Air is compressed at a constant temperature until the its pressure rises from 82cmHg to 140cmHg. If the initial volume of air is 85cm^3, find the final volume of air. (3mks)

$P_1V_1 = P_2V_2$

$V_2 = \frac{P_1V_1}{P_2}$

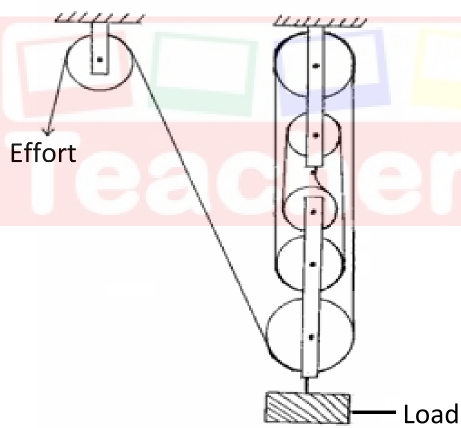
$= \frac{82 \times 85}{140}$

$= 49.786$ cm^3

8. Explain the cause of random motion of particles as observed in Brownian motion in a smoke cell experiment. (1mk)

Large particles are bombarded by the smaller invisible particles of the surrounding medium.

9. The figure **below** shows a machine being used to raise a load. Use the information given in the figure to answer questions **below**.



(a) Determine the velocity ratio (V.R) of the machine. (1 mark)

Velocity Ratio V.R. = 6

(b) If a load of 800N is raised by applying an effort of 272N, determine the efficiency of the machine. (3 mark)

M.A = $\frac{L}{E} = \frac{800}{272} = 2.941$

Efficiency $= \frac{M.A}{V.R} \times 100$

$= \frac{2.941}{6} \times 100$

$= 49.02\%$

10. Figure below shows a liquid in a long cylindrical tube closed at one end with a cork. The cork is tight fitting but movable.

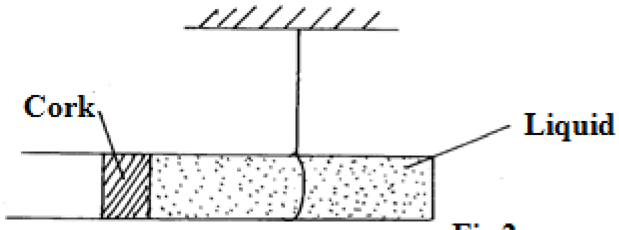


Fig 2

State and explain the observation that would be made when the tube is heated uniformly. (2mks)

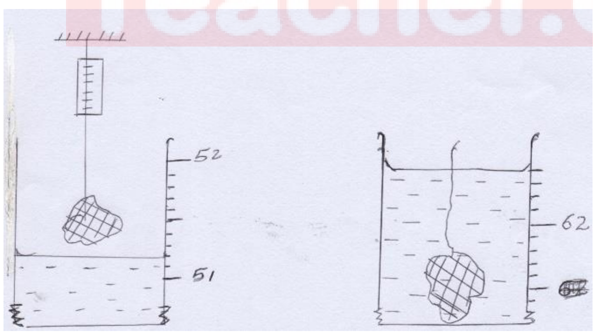
The tube tilt in anticlockwise direction. The liquid moves towards left pushing the cork resulting to anticlockwise moment being greater than clockwise moment.

SECTION B (55 MARKS)

11. A) State Archimedes principle. (1mk)

When a body is partially or totally immersed in a fluid, it experiences an upthrust equal to the weight of the fluid displaced.

b) Figure below shows an experiment used to determine the density of an irregular piece of metal. The mass of metal in air is 200g.



i) Determine the volume of the stone in cubic metres. (2mks)

Volume = $62.4cm^3 - 51.2cm^3$

$= 11.2\ cm^3$

$= 11.2/1000000 = 0.0000112m^3$

ii) Calculate the density of the metal to 3 significant figure. (2mks)

Density = Mass/Volume

= 200/11.2

= $17.9\ g/cm^3$ or $17900kg/m^3$

c) Given that the density of water is $1g/cm^3$, determine;

i) The mass of water displaced. (2mks)

Mass = density x volume

= 1 x 17.9

= 17.9g

ii) The upthrust acting on water. (2mks)

Upthrust = weight of the displaced fluid.

= 17.9/1000 x 10

= 0.179N

iii) The relative density of the metal. (2mks)

$R.D = \frac{Density\ of\ substance}{Density\ of\ water}$

$= \frac{17.9g/cm^3}{1\ g/cm^3}$

= 17.9

d) A solid displaces 5.5cm3 of paraffin when floating and 20.5cm^3 when fully immersed. Given that the density of paraffin is 800kg/m^3, determine the density of the solid. (3mks)

Weight of solid = volume when floating x density of paraffin.

= 5.5/1000000 x 800

= 0.0044N

Mass = 0.0044N/10 x 1000

= 4.4g

$density = \frac{mass}{volume}$

$= \frac{4.4}{20.5}$

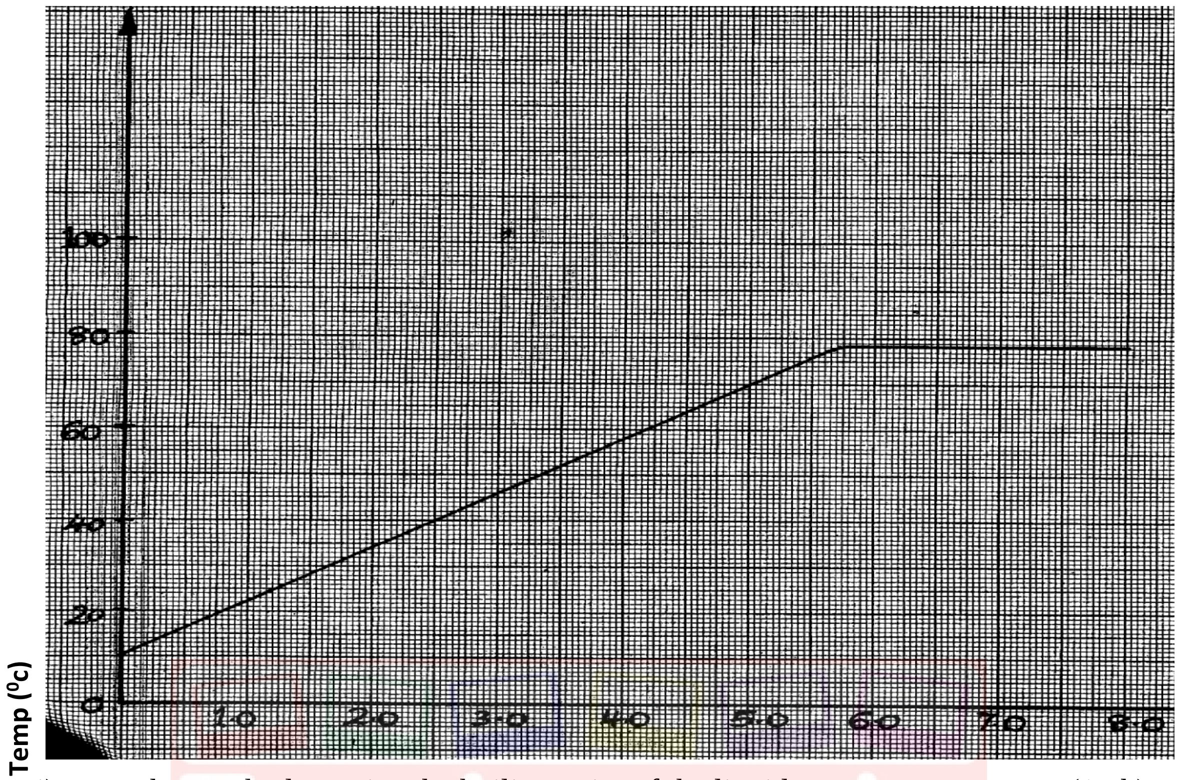
= 0.215 g/cm^3

12. a) State **one** factor that affect the boiling point of a liquid. (1mk)

Temperature

Pressure

b) 100g of a liquid at a temperature of 10°C is poured into a well lagged calorimeter. An electric heater rated 50W is used to heat the liquid. The graph in Figure 8 below shows the variation of the temperature of the liquid with time.



i) From the graph, determine the boiling point of the liquid. (1mk)

79^0c

ii) I) Determine the heat given out by the heater between the times t=0.5 minutes and t=5.0 minutes. (2mk)

50 x 60 x 4.5 = 1350 Joules

II) From the graph determine the temperature change between the times t=0.5 minutes and t=5.0 minutes. (1mk)

70 – 13 = 57^0

III) Hence determine the specific heat capacity of the liquid. (3mk)

H = mc$\boldsymbol{\theta}$

225 x 60 = 100/1000 x c x 57

C = $\frac{225 \times 1000 \times 60}{100 \times 57}$ = 39.474 x 60

= 2368.44 J/Kgc

iii)1.8g of vapor was collected from the liquid between the times t=6.8 minutes and t=7.3 minutes. Determine the specific latent heat of vaporization of the liquid. (4mks)

pt = mLv

50 x 0.5 x 60 = 1.8/1000 x Lv

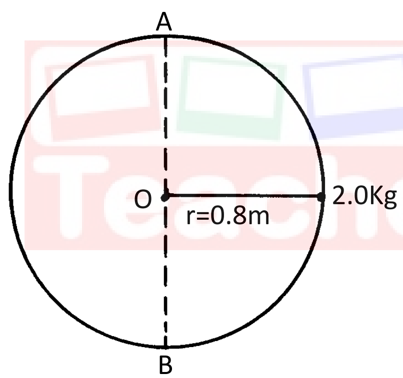
Lv = $\frac{50 \times 0.5 \times 60 \times 1000}{1.8}$

= 833333.33 J/Kg

13. a) Define angular velocity. (1mk)

Angular Velocity is the rate of change of angular displacement with time.

b) The diagram below shows an object of mass 2.0kg whirled in a vertical circle of radius 0.8m at a uniform speed of $50ms^{-1}$.



Determine;

i) The centripetal force on the object. (3mks)

F = $\frac{mv^2}{r}$

= $\frac{2 \times 50^2}{0.8}$

= $\frac{2 \times 2500}{0.8}$

= 6250N

ii) The tension in the string when the object is at **A.**

(2mks)

$T = \frac{mv^2}{r} - mg$

= 6250 – 2 x 10

= 6250 – 20 = 6230

= 6230

iii) The tension in the string when the object is at **B**. (2mks)

$T = \frac{mv^2}{r} + mg$

= 6250 + 20 = 6270

= 6270

c) The speed of rotation is gradually increased until the string snaps. At what point is the string likely to snap? Explain. (2mks)

At the bottom, point B.

Tension is the greatest.

14. a) State the principle of parallel forces. (1mk)

Sum of upward forces is equal to the sum of downward forces.

b) A uniform plank of wood weighing 50N and of length 5m is suspended by two ropes A and B, 1.5m a part A is 2m from end and B is 1.5m from the other end, as shown in fig. 1 below. A concrete block of weight 100N is suspended from the center of the plank.

Calculate the tension, $\mathbf{T_A}$ on the string **A** (3mks)

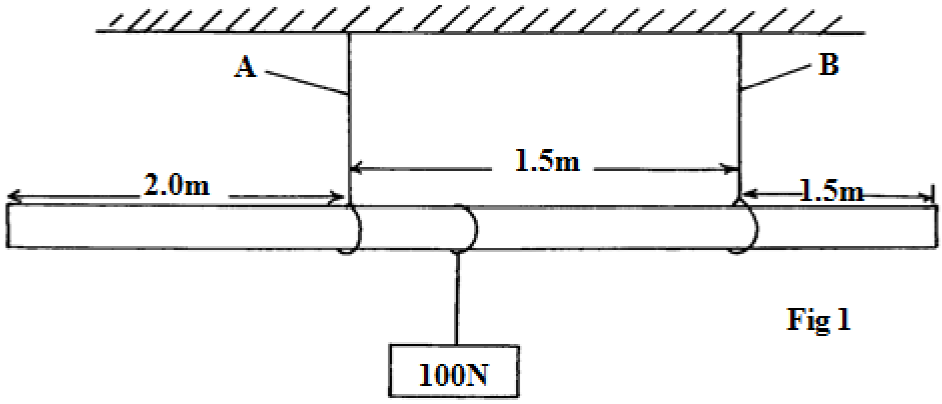


Fig 1

$T_A + T_B = 100$

Taking movement about A

Clockwise moments = 100 x 0.5 = 50

Anticlockwise moments = T_B x 1.5

At Equilibrium T_B x 1.5 = 100 x 0.5

T_B x 1.5 = 50

T_B = 50/1.5 = 33.33 N

But $T_A + T_B = 100$

T_A + 33.33 = 100

T_A = 100 – 33.33

= 66.67 N

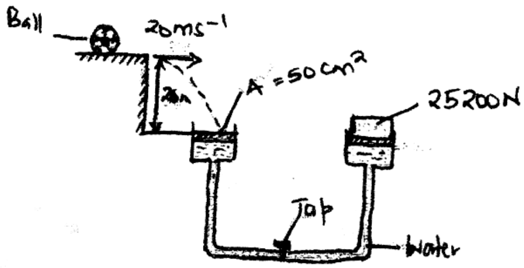
c) I) state two ways in which the stability of a body can be increased. (2mks)

- Broadening of the base.
- Lowering of the Centre of gravity.

II) State one way in which vehicle assembling companies enhances stability in vehicles. (1mks)

- The heavy engine is placed as low as possible.
- Tires are fixed far apart for a wide base.
- Heavy chassis placed at the base.
- Light material used for the upper part of the vehicle.
- Luggage compartment placed at lower part of vehicle.

15. The figure below shows a ball of mass 50kg being thrown from a top of wall 20m high with a horizontal velocity of 20m/s. It stuck the piston A of hydraulic lift and no water splashed out. The other piston B had a weight of 25200N placed on it. Assuming the tap was opened at the time the ball stuck the piston A.



-5-

Determine;

(i) The time taken by the ball to strike the surface of piston A. (3 mks)

$S = ut + 1/2qt^2$ but u = 0

$S = ½ qt^2$

$20 = ½ x 10t^2$

t = 2 sec

(ii) The distance from the foot of the wall to where it hit piston A. (2 mks)

R = Ut

= 20 x 2 = 40m

(iii)The vertical velocity with which the ball struck piston A. (2 mks)

V = u + gt but u = 0

V = gt = 10 x 2 = 20m/s

(iv)The force with which the ball struck piston A. (2 mks)

F = ma

$a = \frac{v-u}{t} = \frac{20-0}{2} = 10m/s^2$

F = 50 x 10

= 500N

(v) The area of piston B if the load on the piston B did not move and that the two pistons were initially at the same level. (3 mks)

$\frac{F1}{A1} = \frac{F2}{A2}$

$A2 = \frac{A1\ x\ F2}{F1}$

$= \frac{50\ x\ 25200}{500}$

$= 2520\ cm^2$