NAME: .....ADM NO: .....CLASS.....

SCHOOL.....DATE: .....

PHYSICS

Paper 1

Time: 2 HOURS

April 2023.

M/Scheme.

MOMALICHE 2 EXAMINATIONS CYCLE 10 2023.

Instructions to candidates

- Write your name, admission number, class and date in the spaces provided at the top of the page.
- This paper consists of two sections A and B.
- Answer all the questions in the two sections in the spaces provided after each question
- All working must be clearly shown.
- Electronic calculators, mathematical tables may be used.
- All numerical answers should be expressed in the decimal notations.
- This paper consists of 14 printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.

Take $g = 10 m/s^2$ and Specific Heat Capacity of Water $= 4200 JKg^{-1}K$

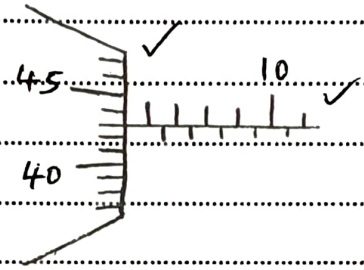
SECTION	QUESTION	MAX MARKS	CANDIDATE'S SCORE
A	1 – 13	25	
B	14	11	
	15	13	
	16	12	
	17	08	
	18	11	
TOTAL		80	

This paper consists of 11- printed pages

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

SECTION A: 25 MARKS *Answer All the Questions in this Section.*

1. On the space provided below sketch a micrometer screw gauge clearly showing the reading **14.43mm.** (*Take the pitch of the screw gauge as 0.5mm*) (2mks)



▹ ½ mm divisions a must
▹ Accept marks on same side of sleeve scale

2. Distinguish between Cohesive and Adhesive forces. (2mks)

Cohesive forces are forces of attraction between particles of the same kind. ✓

Adhesive forces are forces of attraction between particles of different kinds. ✓

3. The **fig.1** below shows a liquid-in-glass thermometer.

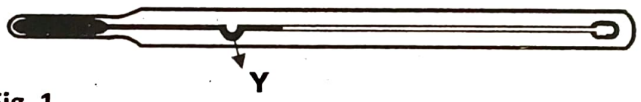


Fig. 1

a) Name the: Thermometer..... clinical ✓ (1mk)

: Part labeled..... constriction ✓ (1mk)

b) State the change that can be made to the capillary bore in order to make the thermometer more sensitive. (1mk)

Make it narrower / reduce diameter ✓ / make it more narrow

▹ do not accept narrow only or small diameter

4. A form four student lifts on his palm a mass of 1Kg as shown in as shown in **fig.2**

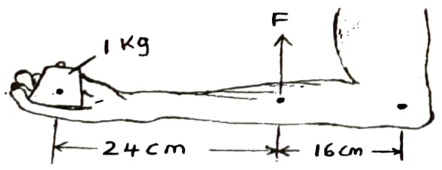


Fig.2

Determine force F required to keep holding the mass horizontally as shown. (3mks)

Clockwise moment = Anticlockwise moments

or $F_1 d_1 = F_2 d_2$ ✓

$\frac{16}{100} F = \frac{40}{100} \times 10$ ✓

$F = 25N$ ✓

5. Give a reason why pollen grains placed on the surface of clean water are seen moving continuously and randomly. (1mk)

They are bombarded by (invisible) water particles which are in continuous random motion ✓ or wtte

6. In the **Fig.3** below, the cardboard is pulled suddenly. State the reason why the coin falls into the beaker. (1mk)

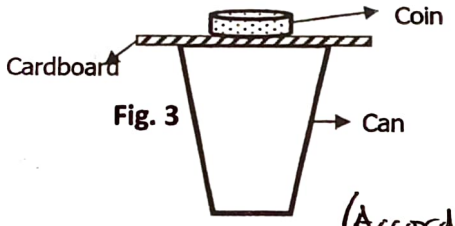


Fig. 3

(According to Newton's First Law of motion) the stationary coin remains since no force ✓ changes its state of rest (and falls due to the pull of gravity on it)

7. **Fig.4** below shows a single movable pulley used to raise a load of 50N.

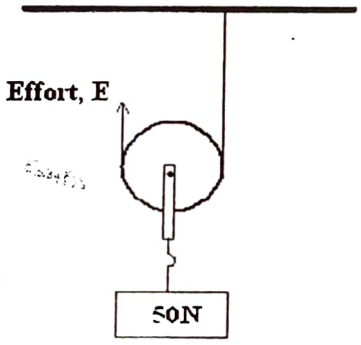


Fig.4

i) State the velocity ratio of this arrangement. (1mk)

2 ✓

ii) Assuming that friction experienced is negligible and the weight of the pulley wheel is 7.5N, determine the minimum force required to raise the load at a constant speed. (1mk)

$E = (50 + 7.5)N = 57.5\,N$ ✓

8. State the pressure law of gases. (1mk)

The pressure of a fixed mass of a gas is directly proportional to its absolute temperature at constant volume. ✓

▸ Do not accept converse

9. A block of copper mass 0.5Kg and specific Heat capacity $400JKg^{-1}K^{-1}$ initially at 80°C is immersed in water at 20°C. If the final temperature is 21°C, determine the mass of the water. (3mks)

Heat lost by hot copper = Heat gained by water ✓

$m_c\theta_c C_c = m_w\theta_w C_w$

$0.5 \times 59 \times 400 = 4200 \times 1 M_w$ ✓

$m_w = 2.8095\,Kg$ (4dp) ✓

10. State the reason why heat transfer by radiation is faster than conduction. (1mk)

Electromagnetic waves (radiation) travels at speed of light $3.0 \times 10^8 m/s$ while vibration of particles (conduction) is slower due to their inertia. ✓

11. A dripless candle is weighted slightly on the bottom so that it floats upright in a container filled with water as shown in **Fig. 5** below.

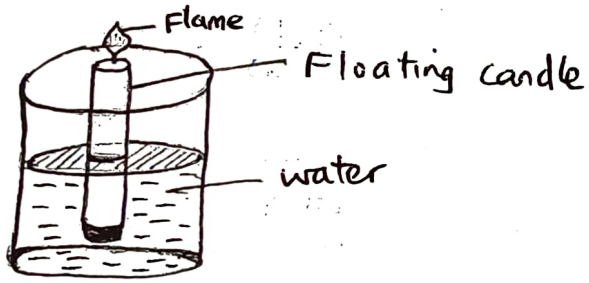


Fig.5

State and explain what happens as the candle burns. (2mks)

- Candle floats more or rises ✓
- As it burns, its total weight reduces, thus needing less upthrust force ✓ in order to float

12. Determine the least pressure that can be exerted by a 20kg solid of dimensions 10cmx20cmx40cm on a horizontal surface. (3mks)

Least Pressure $= \frac{\text{Force}}{\text{Max Area}}$ ✓

$P_{min} = \frac{mg}{L \times W} = \frac{20 \times 10}{0.2 \times 0.4}$ ✓

$= 2500 N/m^2$ ✓

13. State the SI unit of the quantity 'amount of substance'. (1mk)

mole ✓

SECTION B: 55 Marks.

14. a) State the Archimedes' principle. (1mk)

A body (partially or fully) immersed in a fluid experiences an upthrust force equal to the weight of displaced fluid. ✓

b)Fig.6 below shows a simple hydrometer.

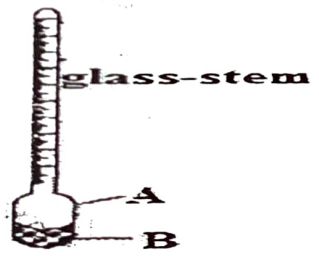


Fig.6

A. Bulb ✓ (1mk)

B. Lead shots ✓ (1mk)

i) Identify the parts labelled A and B.

ii) State the purpose of part labelled B. (1mk)

Enable it to float upright ✓

iii) How the hydrometer would be made more sensitive. (1mk)

Making the stem narrower. ✓

c) A weather balloon of volume $1.2m^3$ is tied to a rigid support while being filled with helium gas. The mass of the fabric making the balloon is 0.30kg. Determine the maximum tension on the string trying the balloon to the rigid support.
(Density of air is $1.25kgm^{-3}$ and density of helium is $0.18kgm^{-3}$). (4mks)

Upthrust = wt of displaced air = wt of fabric + wt of Helium + Tension

$\rho_a V_a g = mg + \rho_h V_h g + F$

$1.25 \times 1.2 \times 10 = 0.3 \times 10 + 0.18 \times 1.2 \times 10 + F$

$F = 15 - (3 + 2.16) = 9.84\,N$

d) Explain how a submarine can be made to float and sink in water. (2mks)

To sink, water is let into air chambers as the air is compressed but not released. ✓ (increasing total weight)
To float, the air in the chambers is released and water driven out ✓ (reducing its total weight)

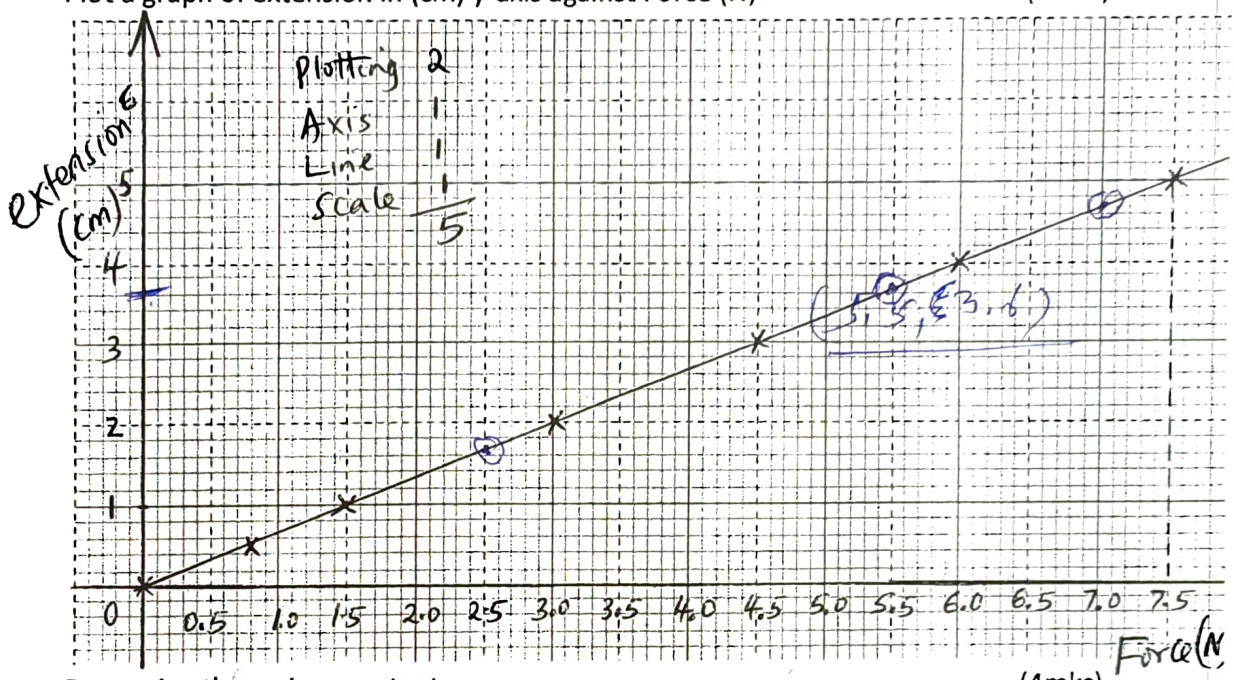
15. a) State Hooke's law. (1mk)

For any elastic material, the extension is directly proportional to the stretching force provided the elastic limit is not exceeded. ✓

a) A student carried out an experiment to investigate the relationship between the force and extension produced on a spiral spring. The student tabulated his results as shown below.

Force (N)	0	0.8	1.5	3.0	4.5	6.0	7.5
Extension (cm)	0	0.5	1.0	2.0	3.0	4.0	5.0

i) Plot a graph of extension in (cm) y-axis against Force (N) (5mks)



ii) Determine the spring constant. (4mks)

Gradient: $\frac{\Delta \text{ extension}}{\Delta \text{ Force}}$ ✓

must show evidence on graph.

$= \left(\frac{5-0}{7.5-0}\right)$ cm/N

$= 0.6667$ cm/N 4sf

$= 6.667 \times 10^{-3}$ m/N

But spring constant $K = \frac{1}{\text{Gradient}}$

$K = (6.667 \times 10^{-3})^{-1}$

$= 150$ N/m ✓

iii) What force would be required to produce an extension of 2.5cm? (1mk)

Allow T.E $F = Ke = 150 \times \frac{2.5}{100} = 3.75$ N ✓

iv) What extension is produced by:

Allow T.E

i) A force of 5.5N $e = F/K = \frac{5.5}{150} = 0.03667$ m or 3.667 cm ✓ (1mk)

ii) A mass of 700g $e = \frac{7}{150} = 0.04667$ m ✓ or 4.667 cm (1mk)

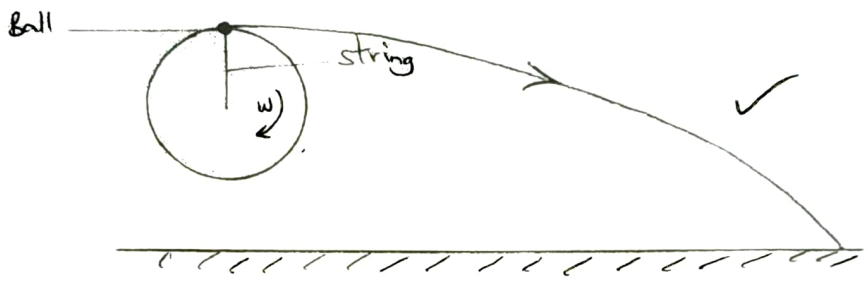
16. a) Define a radian as applied in circular motion. (1mk)

A radian is the angle subtended at the centre of a circle by an arc length equal to the radius of the circle. ✓

b) A car negotiating a corner at a constant speed is said to have a change of momentum. Explain this observation. (1mk)

(Constant) change in direction causes (constant) change in velocity ✓
(hence constant change in momentum).

b) The **Fig.7** below shows a ball being whirled in a vertical plane.



Sketch on the same figure the path followed by the ball if the string cuts when the ball is at the position shown in the figure. (1mk)

c) State the purpose of banking roads at bends. (1mk)

To allow users to negotiate the bend at a higher velocity without ✓
skidding (by reducing the dependency on friction for centripetal force)

d) A boy whirls a stone of mass 0.2kg tied to a string of length 0.4m in a vertical plane at a constant speed of 2rev/s. (Take g=10ms^{-2})

i) State two forces acting on the stone when it is at the highest point. (2mks)
Centripetal force ✓ Weight ✓ Accept pull of gravity
reject gravity

ii) Determine the :
I angular velocity of the stone; (3mks)

$\omega = 2\pi f \checkmark = 2\pi \times 2 \checkmark = 12.568\ rads^{-1} \checkmark$

II tension in the spring when the stone is at the highest point; (3mks)

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

$= 0.2 \times 0.4 \times 12.568^2 - 0.2 \times 10$ ✓

$= 10.636\ N$ ✓

17. a) State Bernoulli's principle. (1mk)

Provided a fluid is non viscous, incompressible and its flow is streamline, an increase in its velocity causes a corresponding decrease in the pressure it exerts. ✓

b) **Fig.8** below shows a tube of varying cross-sectional area. $V_1V_2V_3$ and V_4 represents the velocities of water as it flows steadily through the sections of the tube.

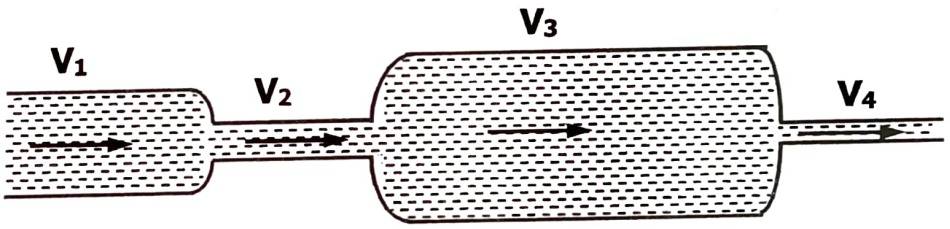
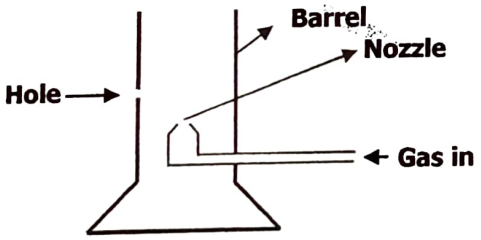


Fig. 8

Arrange the velocities V_1, V_2, V3 and V_4 in descending order. (1mk)

$V_4 > V_2 > V_1 > V_3$ ✓

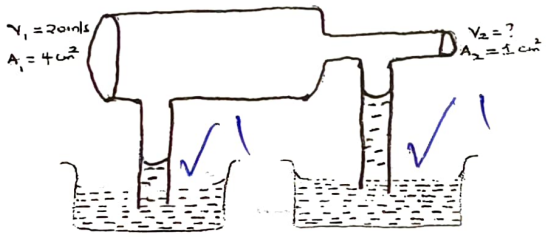
e) The diagram below shows a Bunsen burner



Explain how air is drawn into the barrel (2mks)

At the nozzle, gas jets in at very high velocity reducing the pressure in the barrel. ✓ The higher/greater atmospheric pressure outside push air into the barrel through the hole. ✓

f) The figure below shows air being blown through a tube of a varying cross-sectional area.



Using the information in the diagram

i) Calculate the outlet velocity v_2. (2mks)

(1mk - Either formula or correct substitution, earliest opportunity)

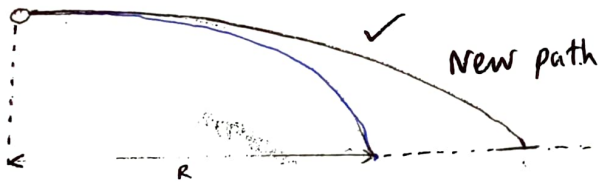
$A_1V_1 = A_2V_2$ ✓

$4 \times 10^{-4} \times 20 = 1 \times 10^{-4} V_2$ ✓

$V_2 = 80m/s$ ✓

ii) Show the relative water levels in the two capillary tubes. (2mks) ✓✓

18. a) Fig 1 below shows the path of a light ball projected horizontally.



The ball is then made to spin in an anticlockwise direction as it moves; On the same axis, sketch the new path of the ball. (1mk) (1mk)

b) Using the definition of impulsive force, show that F=ma. (3mks)

Impulsive force $F = \frac{mv - mu}{t}$ (ie $\frac{\text{change in momentum}}{\text{time taken}}$) ✓

$F = m\left(\frac{v-u}{t}\right)$ ✓ But $\frac{v-u}{t} = a$

$F = ma$ ✓

c) Two stationary trolleys A and B are separated by a compressed spring and held together by a thread. The mass of trolley A is 2.0kg and that of B is 1.0kg. When the thread is cut the trolleys move rapidly apart.

i) What is the cause of movement of trolleys when the thread is cut? (1mk)

The elastic potential energy stored in the spring converted to K.E ✓

ii) What is the total momentum of the trolleys just before the thread is cut. (3mks)

Zero ✓(3)

0

$m_1u_1 + m_2u_2$ ✓

$(2 \times 0) + (1 \times 0)$ ✓

$= 0$ ∴ ✓

0 Kgms^{-1} (2mks) B

iii) If trolley A moves off with a speed of 0.25m/s. Calculate the speed with which trolley B moves off. (3mks)

Momentum before = momentum after ✓

$0 = m_1v_1 + m_2v_2$

$0 = 2 \times 0.25 + 1 \times v_2$ ✓

$v_2 = -0.5$m/s ➤ reject -0.5m/s

speed $= 0.5$m/s ✓

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