NAME: **MARK GUIDE** **STREAM: S3**

PHYSICS DEPARTMENT

S3 END OF YEAR EXAM 2023 TERM 3.

PAPER ONE

Attempt All Questions in Sections A and B and only one question In Section C.

TIME ALLOWED 2:30HRS

Where necessary use:

Acceleration due to gravity, $g=10ms^{-2}$

Density of water at 4^oC $=1000kgm^{-3}$

Speed of sound in air= $340ms^{-1}$

Speed of sound in water= $1450ms^{-1}$

Specific heat capacity of water = $4.2x10^3Jkg^{-1}K^{-1}$

Specific heat capacity of iron = $462 \times 10^0Jkg^{-1}K^{-1}$

Specific latent heat of fusion of water: $3.4x10^5$ $Jkg^{-1}K^{-1}$

Specific latent heat of vaporization of water: $2.26x10^6$ $Jkg^{-1}K^{-1}$

SECTION A(35marks) (ATTEMPT ALL QUESTIONS IN THIS SECTION)

1. Match the following definitions with the respective definitions (5marks)

Adhesion	The force of attraction binding molecules of similar kind
Surface tension	The tendency of a liquid surface to possess an elastic property
capillarity	The haphazard movement of fluid molecules due to collision with air molecules
Cohesion	The force of attraction binding molecules of different kind
Brownian motion	The tendency of liquid molecules to rise or fall in a narrow tube

2. Fill in the phenomenon responsible for the following observations. (5marks)

   a. Smoke particles moving in a ***zig zag*** way in a smoke kitchen

      Brownian motion

   b. A 20litre jerry full of water **is lighter** when lifted in water and **heavier** when lifted in air.

      Upthrust/ Bouyancy

   c. Music played in an **empty small room** sounds louder

      Reverberation

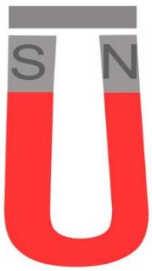
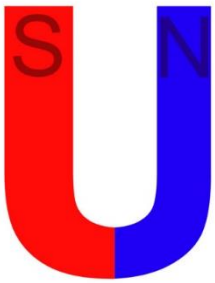
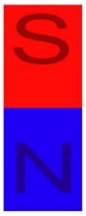
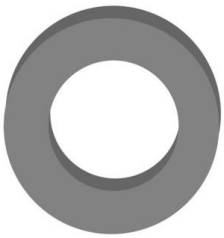
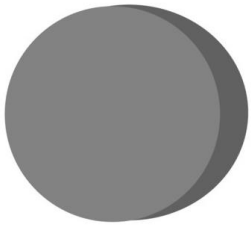
   d. A rain bow is formed in the sky.

      Dispersion of white light

   e. Ice is able to **float on sea water** in winter season

      Anomalous expansion of water/Abnormal expansion of water

3. a) Name the magnet types below (5marks)

		
Horse shoe magnet	**u-shaped magnet**	**Bar magnet**
		
Ring magnet	**Circular magnet**	

4. a) Water has a density of 1000kgm^{-3} .What does the statement mean? (1mark)

Answer: 1m^3 volume of water weighs 1000kg

Or Every 1000kg mass of water occupies a space of 1m^3

b) Calculate the mass in kg of 250cm^3 of oil whose relative density is 0.81 (4marks)

Answer: mass = ρV

$$V = 250cm^3 = \frac{250}{1000000}m^3 = 2.5 \times 10^{-4}m^3$$

$$from\ relative\ density = \frac{density\ of\ substance}{density\ of\ equal\ volume\ of\ water}$$

So $0.81 = \frac{\rho}{1000}$

$\rho = 0.81 \times 1000 =$

$\rho = 810kgm^{-3}$

Mass= $(810 \times 2.5 \times 10^{-4})kg$

Mass of oil =0.2025kg

From questions 5 to 8 Explain the observations and occurences below

5. A mango is thrown vertically up to 20m by a boy standing in the region at the North pole of the earth. Assuming the boy was at the equator, and throws the same mango up to the same height. In which of the two cases will the mango hit the ground first and why? (5marks)

The mango thrown at the north pole hits the ground first. This is because of the greater gravitational pull at the poles of the earth as compared to that at the equator.

This is due to the fact that the earth is not a perfect sphere i.e it's narrow at the poles and bulged at the equator. This means that the poles are nearer to the centre of the earth than equator and Since gravitational force increases as bodies get closer to the earth's center so the mango thrown at the north pole hits the ground first

5. A long ruler placed in water appears bent. (5marks)

Light rays from the base of the ruler are refracted away from the normal as they reach the water surface. They then reach the observer's eye and to the observe they appear to have come from a point above the actual base of the ruler. This point is where a virtual image of the ruler is formed. The ruler thus appears bent

6. The word **AMBULANCE** appears as shown below on ambulance vehicles (5marks)

The word is laterally inverted. To the driver in front of the ambulance observing the word in the front mirror of the car or side mirror, the word appears as a right oriented/rightly written word. This is due to the fact that side mirrors and front mirrors form laterally inverted images

The driver will then quickly give way to the ambulance

SECTION B (30marks) (ATTEMPT ALL QUESTIONS)

7.Kawagga carried out an experiment using a concave mirror which was cut from a sphere of diameter 40cm. In the experiment he placed a wire gauze illuminated from the back and placed it at different locations infront of the mounted mirror as he obtained a clear sharp image of the gauze on the screen and recorded the observations in the table below.

a) Complete the table (7.5marks)

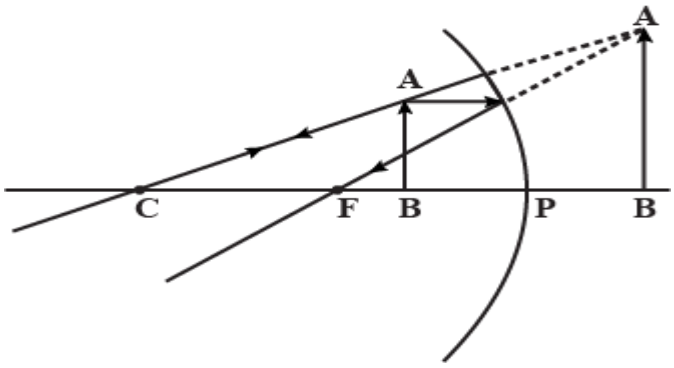
N.B The centre of curvature is 20cm and the focal length is 10cm

Distance of object from mirror	**Nature of image Obtained on screen (magnified, diminished, upright, inverted, real virtual)**
30cm	**diminished, inverted, real**
20cm	**Same size as object, inverted and real**
15cm	**magnified, inverted, real**

10cm	**Highly magnified, inverted, real**
5cm	**magnified, upright, virtual**

b. With the help of a ray diagram, identify the case in which the mirror is used by **dentists to check faults in teeth**. (2.5marks)

This case is when the object is placed between pole and focus of the mirror



7. a)i) Define the term **atmosphere.** (1mark)

<u>This is the blanket of gases arranged in layers above the earth's surface</u>

ii) The atmospheric pressure at sea level is **$101350Nm^{-2}$.** What does the statement mean? (1mark)

<u>This means that the earth's atmosphere exerts a force of $101350N$ on every $1m^2$ area of earth at sea level</u>

b. Explain the effect of **atmospheric pressure** using a **can crush experiment.**

(5marks)

<u>The air inside the can is driven out by the vapour after boiling some water in the can. A partial vacuum is created inside the can. When the can is placed in cold water, the vapour condenses rapidly which drastically lowers the vapour pressure inside . the excess atmospheric pressure outside the can crushes it inward</u>

c) The pressure at the base of a mountain is 76cm of mercury and at the top it is 65cm of mercury.
Calculate the height of the mountain given that the density of air is 1.25kgm^{-3} and that of mercury is 13600kgm^{-3} (3marks)

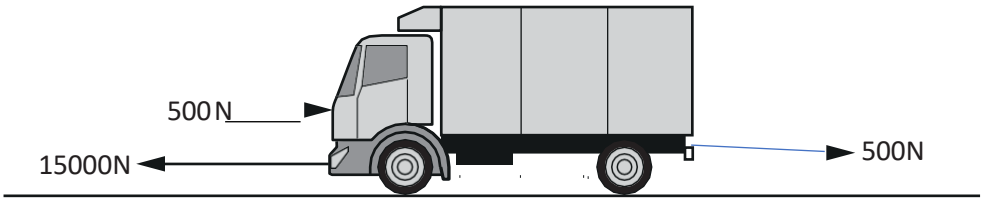
Let H be the height of the mountain

Difference in pressure of air at top and bottom of mountain = difference in barometric pressure at top and bottom of the mountain

$$\mathbf{1.25 \times 10 \times H = 13600 \times 10\left[\frac{76}{100} - \frac{65}{100}\right]}$$

H=1196.8m

8. Fig. 1.1 shows a truck moving on a straight smooth road. The arrows represent the horizontal forces acting on the truck. These forces act on the truck to move it from rest through a distance of 0.1km in 6s.



i) Calculate the size of the **resultant horizontal force** on the truck. (2marks)

Sum of Forces to the left =15000N

Sum of forces to the right = (500+ 500)N =1000N

Resultant force, F= (15000-1000)N

F= 14000N to the left

ii) Determine the mass of the truck. (4marks)

From $\boldsymbol{the\ second\ law\ of\ motion, F = ma}$

$\boldsymbol{so\ m = \frac{F}{a}}$

Using $\boldsymbol{equation\ two\ of\ linear\ motion}$: $\boldsymbol{S = ut + \frac{1}{2}at^2}$

$\boldsymbol{s = 100m, t = 6s\ , u = 0}$

$\boldsymbol{100 = \frac{1}{2} \times a \times 6^2}$

$\boldsymbol{a = \frac{200}{36}}$

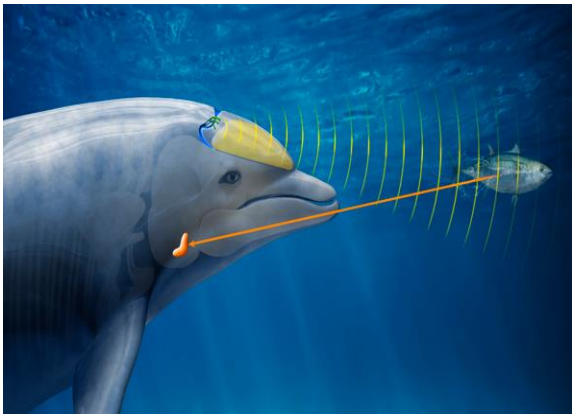
$$a = 5.56ms^{-2}$$

$$so\ m = \frac{14000}{5.56}kg$$

$$m = 2520kg$$

SECTION C (15marks) (ATTEMPT ONLY ONE QUESTION ON A RULED SHEET OF PAPER)

9. a) Echo location is a fundamental phenomenon used by creatures like bats, whales, dolphins etc. to find direction, food and also evade enemies. Dolphins and bats can make sounds up to 130KHz.



i) Why are humans unable to hear such sounds from bats and dolphins? (2marks)
Human ears are only able to detect sound signals in the human audible range. The frequency range of these signals is 20Hz to 20KHz

ii) Explain how echolocation works in dolphins (2marks)

Dolphins produce high-frequency clicks which create sound waves that travel quickly through the water around them

When the sound waves bounce off from objects, they return to the dolphins as echoes. Dolphins pick up those echoes which are interpreted to know the size of prey or predator, texture of obstacle or direction of the prey

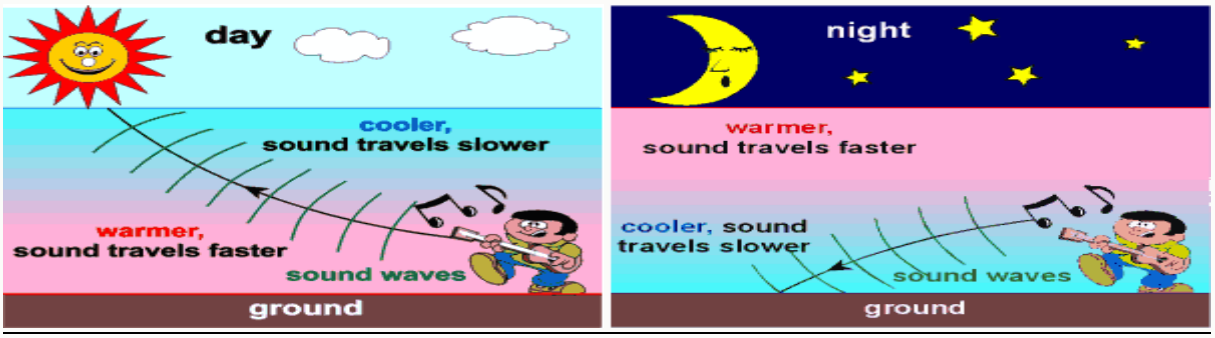
iii) A dolphin takes 4s to receive an echo from a fish in water and a bat takes 2.5s to receive an echo from a wall. Which of the two fish or wall is more distant from the sound source? (3marks)
Answer: $V = \frac{2d}{t}$
$d = \frac{Vt}{2}$
$for\ the\ dolphin, d_1 = \frac{1450 \times 4}{2} = 2900m$

$$for\ the\ bat, d_2 = \frac{340 \times 2.5}{2} = 425m$$

$$since\ d_2 < d_1\ so\ the\ fish\ was\ more\ distant\ from\ the\ source\ of\ source\ than\ the\ wall$$

b. i) You have noticed on several occasions that your friend's voice is clearer during night time than during day time. This is a bit puzzling to some people.
Give a detailed explanation of this (diagrams are a must) (6marks)
Answer:

On a clear day, the lower layer of the atmosphere is hotter than the layers above. Since sound travels faster in a hotter medium, its speed is greater near the surface. As a result, the waves are bent away from the surface. Thus, the intensity of the sound waves diminishes and does not seem to travel a long distance.



On a clear night, the lower layer of the atmosphere is colder than the air above. Now, the sound waves travel faster at the higher layers than at the lower layers. Thus, the waves are bent towards the earth's surface. The intensity of the sound increases and seems to travel a greater distance.

ii) identify any two uses of micro waves (2marks)

- ***They are used in microwave ovens for cooking***
- ***They are used in telephone and satellite communication***

10. a) It's a common problem that after testing a newly bought vacuum flask, you realize it can't keep hot water hot for 2hours.
What can be the cause of this problem.? (4marks)

- ***The wooden cork/plastic cover may not be well fitting so heat is possibly lost by evaporation***
- ***The vacuum seal may have a crack so heat may be lost by convection and conduction***
- ***The glass walls may not be well silvered (may be dull) so heat may be lost by radiation***
- ***The space between the glass walls may be too small that heat may be conducted with in that space and thus lost from the water.***

b) Hossanah said that "Water having a specific heat capacity of 4189Jkg^{-1}K^{-1} means that water can change its heat by 4189K when 1kg is heated by 1J".
Is Hossanah right? If yes, define the term specific heat capacity, if no, correct her. (2marks)
Answer: She was not right. The statement means that for 1kilogram of water to raise its temperature by 1Kelvin, 4200J of heat energy should be supplied to it.

OR: For 1kilogram of water loses 4200J of heat to drop its temperature by 1Kelvin

c) 250ml of water at 8°C is heated in an Iron kettle of mass 300g to 80°C
i) Determine the amount of heat that is required to do this. (4marks)
Heat energy supplied = heat energy gained by kettle + heat energy gained by water
Heat energy = mass x specific heat capacity x temperature change

$$Q = mc\Delta\theta$$

$$for\ the\ kettle\ Q = \frac{300}{1000} \times 462 \times (80 - 8)$$

$$Q = 9,979.2\ J$$

$$for\ the\ water\ Q = \frac{250}{1000000} \times 1000 \times 4200 \times (80 - 8)$$

$$Q = 75,600\text{J}$$

$$Q = (75,600 + 9,979.2)\text{J}$$

Q= 85,579.2J

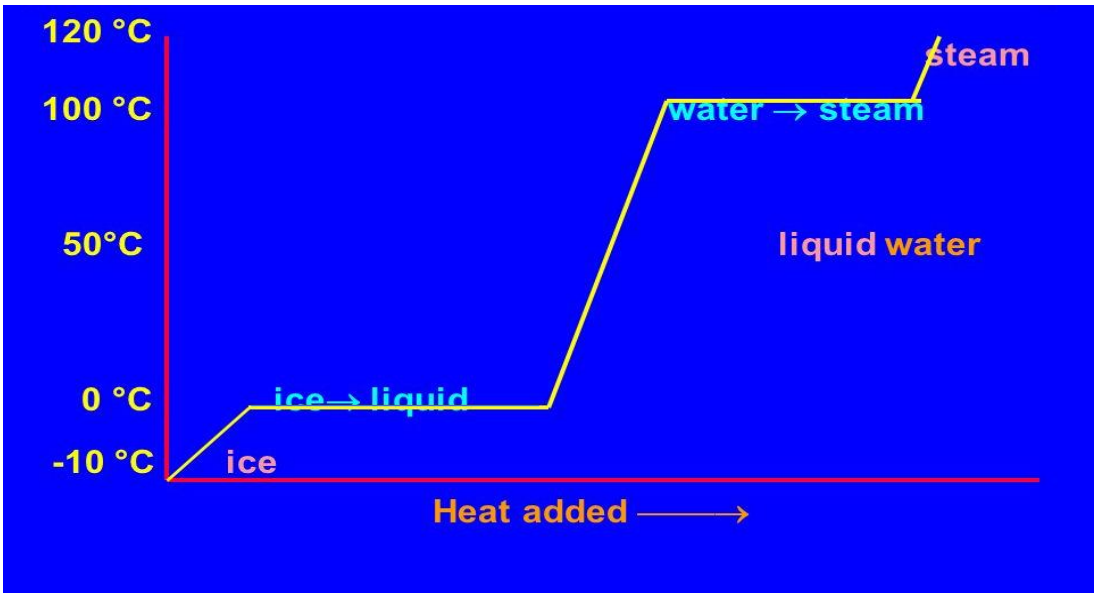
ii) The percentage of the heat energy in ii) above that is absorbed by water. (2marks)

Percentage= $\frac{heat\ absorbed\ by\ water}{total\ heat\ supplied}$

Percentage$= \frac{75,600}{85,579.2} \times 100\%$

Percentage = 88.3%

c. Sketch a heating curve of water from -10°C to 120°Cto and label the heat energies involved up to when the water starts turning to steam (3marks)



Changing From -10oC to 0oC heat capacity is absorbed
Changing from ice to water Latent heat of fusion is absorbed
Changing from 0°C to 100°C heat capacity is absorbed
Changing from water to steam latent heat of vaporization is absorbed

END

Be positive