S.3 PHYSICS REVISION QUESTIONS (COVID-19 RECESS PERIOD)

MARKING GUIDE

Time allowed : 1 Hour

1. (a) Define density and state its S.I unit.

<u>Defn:</u> Density is the mass per unit volume

<u>S.I unit</u>: kilogramme per cubic metre (kgm-3)

(b) A man digging up a field discovered a large deposit of a glittering metal underground and suspected it to be gold. Describe an experiment the man can perform to identify this metal.

<u>Soln.:</u> - A small quantity (sample) of the metal is extracted and its mass m determined using a beam balance.

-A certain quantity of water is poured in a measuring cylinder and its volume V_1 recorded.

-Using a suitably long thread, the sample is gently lowered into the measuring cylinder and and the final volume V_2 attained by mixture is recorded.

-The volume V of sample is determined from $V = V_2 - V_1$.

-The density of the sample is determined from; $Density = \frac{mass, m}{volume, V}$ **.**

- The value for density obtained is compared with the theoretical values of density for various metals from which the metal can be identified.

(c) The mass of an empty density bottle is 10g. When fully filled with water its mass is 60g. The mass of the bottle when partially filled with mercury is 282g. When water is added to fill the rest of the space left by the mercury , the total mass increases to 312g. calculate the density of mercury.

<u>Soln.:</u> **Mass of water filling the density bottle = (60 – 10)g = 50g.**

Taking the density of water as 1gcm-3, Volume of water in the density bottle ---

$$Volume = \frac{mass, m}{density} = \frac{50}{1} = 50cm^3$$

Mass of mercury in the mixture = (282 – 10)g = 272g

Mass of water in the mixture = (312 – 282)g = 30g.

Volume of water contained in the mixture $Volume = \frac{mass, m}{density} = \frac{30}{1} = 30cm^3$ **-**

The volume of mercury in the mixture = (50 – 30) cm^3= 20cm^3

Therefore Density of mercury $= \frac{mass, m}{volume, V} = \frac{272}{20} = 13.6gcm^{-3} = 13600kgm^{-3}$

(d) An alloy of mass 588g and volume $100cm^3$ is made of iron of density $8.0gcm^{-3}$ and aluminium of density $2.7gcm^{-3}$. Calculate the mass of iron in the alloy.

Solution: **Let the V_1 and V_2 be the volumes of iron and aluminium respectively.**

Total Volume of the alloy = $V_1 + V_2 = 100cm^3$……………………………(1)

Since Mass = (Volume) x (density)

Mass of iron = $8.0V_1$

Mass of aluminium = $2.7V_2$

Mass of the alloy = $8.0V_1 + 2.7V_2 = 588g$………………………………..(2)

Substituting for V_2 in in equation (2) using equation (1),

$8.0V_1 + 2.7(100-V_1) = 588$ → $8V_1 + 270 - 2.7V_1 = 588$

This gives $V_1 = 60cm^3$

Therefore mass of iron in the alloy = $8.0 V_1 = 8.0 \times 60 = 480g$

2. (a) Define the term pressure and state its S.I unit.

Defn. Pressure is the force acting normally per unit area

S.I unit : newton per square metre (Nm^{-2}) or Pascal (pa)

(b) In a certain community, there is need to provide clean water to all homes to minimize health problems associated with contaminated water. To achieve this, water needs to be pumped from underground a reservoir set up at the top of the highest hill within the community from where it can flow by gravity to all parts of the community. As a physics student describe how you can use a simple barometer to help the community identify the highest hill.

Soln.: The student identifies the possible high hills in the community.

She / He measures the atmospheric pressure P_1 at the bottom and the atmospheric pressure P_2 at the top each hill.

The air pressure $P = P_1 - P_2$ between top and bottom of each hill is determined.

Air pressure $P = \rho gH$

$$\rightarrow \quad \rho gH = P_1 - P_2$$

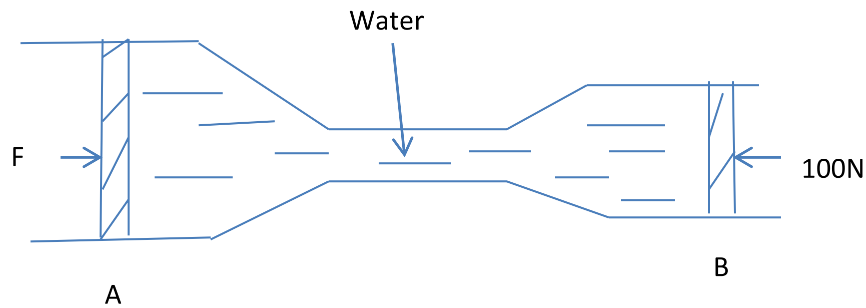
Putting air density $\rho = 1.25kgm^{-3}$ and assuming atmospheric pressure is in cmHg

$$\rightarrow \quad 1.25 \times 10 \times H = \frac{P_1 - P_2}{100} x10x13600$$

$$\rightarrow \quad H = \frac{P_1 - P_2}{100x1.25} x13600$$

This gives the height of each hill and consequently the highest hill can be identified.

(c) The diameter of cylinder A in the figure below is two times that of cylinder B.



Determine the force F necessary to keep the system in equilibrium when a force of 100N is applied on cylinder B

Using Pascal's principle (principle of transmission of pressure,

Pressure on cylinder A = pressure on cylinder B

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{F}{(2D_1)^2} = \frac{100}{D_1} \Rightarrow F = \frac{100x4(D_1)^2}{(D_1)^2} = 400N$$

d) A small hole of cross sectional area $4.0cm^2$at the bottom of a tank of height 5.0m is closed with a cork. Determine the force on the cork when the tank is filled with mercury.

(Density of mercury = $13600kgm^{-3}$)

Pressure at the bottom of the tank =ʃgh = 13600 x 10 x 5.0 = 680,000pa

Force on the cork = (pressure) x (area) =(680,000 x 4.0 x 10^{-4}) = 272N

END