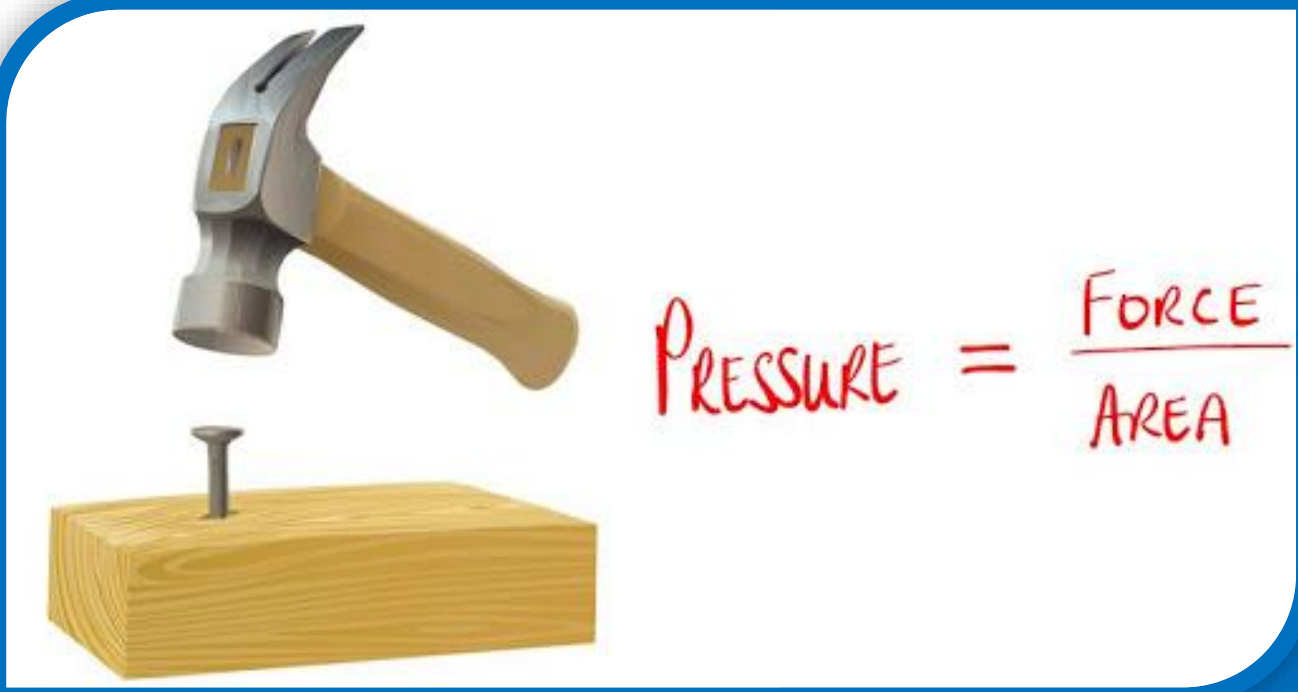
2020

PRESSURE



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

TEACHERS OF PHYSICS
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PRESSURE IN SOLIDS

1. Define pressure and state its SI units. (2 marks)
   - Force acting normally per unit area
   - SI unit is newton per square metre
2. Ploughing tractors have very wide tyres. Explain why. (2 marks)
   - Pressure in solids decreases with increase in area of contact. These tractors have wide tyres to reduce the pressure exerted by the tractor on the ground
3. What is the reason why a trailer carrying heavy loads have many wheels? (2 marks)
   - The many wheels increases the area of contact between the lorry and the road which reduces the pressure exerted by the lorry on the road. This prevents the trailer from sinking as it moves and also minimises road damage.
4. A student wearing sharp pointed heeled stiletto shoes is likely to damage a soft wooden floor. Explain. (2 marks)
   - Sharp pointed heels have small area of contact hence the pressure exerted on soft wooden floor is large thus damaging it.
5. A block of dimension **0.2m** by **0.1m** by **5cm** has a mass of **500g** and rests on a flat surface. Determine the least pressure that can be exerted by the block on the surface. Least pressure is exerted by maximum area.

   Maximum area = $10\ cm \times 0.5\ cm = 5\ cm^2$

   Area in $m^2 = 5 \times 10^{-4}\ m^2$

   Force = $\frac{500}{1000} \times 10 = 5N$

   Pressure = $\frac{F}{A} = \frac{5}{5\times10^{-4}}$

   $= 1 \times 10^4\ Nm^{-2}$

6. A box of mass **720kg** is placed on a table. If the area of contact in the table is 1.8 m^2. Calculate the pressure it exerts on the table.

   Force = $mg = 720 \times 10 = 7200\ N$

   Pressure = $\frac{Force}{area} = \frac{7200}{1.8} = 4\ 000\ N/m^2$

7. A metallic block of mass **50kg** exerts a pressure of **10N/m2** on the surface. Determine the area of contact between the block and the surface. Area = $\frac{Force}{pressure}$

   Force = $50 \times 10 = 500\ N$

   Area = $\frac{500}{10} = 50\ m^2$

8. A block measuring **20cm** by **10cm** by **4cm** rests on a flat surface. The block has a weight of **6N**. Determine:

i. The minimum pressure it exerts on the surface. (2 marks)

$= Pressure_{min} = \frac{Force}{maximum\ area}$

Maximum area = $\frac{20\ cm \times 10\ cm}{10\ 000} = 0.02\ m^2$

$P_{min} = \frac{6\ N}{0.02\ m^2} = 300\ Nm^{-2}$

ii. The density of the block in kg/m^3 (3 marks)

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

Mass = $\frac{6}{10} = 0.6\ kg$

Volume = $0.2 \times 0.1 \times 0.04 = 0.0008\ m^3$

Density = $\frac{0.6}{0.0008} = 750\ kg/m^3$

9. A block of mass **60kg** measures **6cm** by **5cm** by **4cm**. Calculate

i. The maximum pressure it can exert.

$$P_{max} = \frac{Force}{Area_{min}}$$

$$minimum\ area = \frac{5 \times 4}{10\ 000} = 0.002\ m^2$$

$$force = mg$$

$$= 60 \times 10 = 600N$$

$$P_{max} = \frac{600}{0.002} = 300\ 000\ N/m^2$$

ii. The minimum pressure.

$$Pressure_{min} = \frac{Force}{Area_{max}}$$

$$maximum\ area = \frac{6 \times 5}{10\ 000} = 0.003\ m^2$$

$$minimum\ pressure = \frac{600}{0.003} = 200\ 000Nm^{-2}$$

10. A man of mass **80kg** exerts a pressure of **200,000Pa** on the ground while standing on both feet.

i. Calculate the area of each foot.

Force = $mg = 80 \times 10 = 800N$

Area = $\frac{Force}{Pressure} = \frac{800}{200\ 000} = 0.004\ m^2$

Area of each foot = $\frac{0.004}{2} = 0.002\ m^2$.

ii. How much pressure would be exert if he stands on one foot?

$$Presure = \frac{Force}{Area}$$
$$= \frac{800}{0.002}$$
$$= 400\ 000\ \ Nm^{-2}$$

11. (a) A woman wearing shoes with sharp pointed heels exerts more pressure than an elephant. Explain? (1 mark)

- ➢ Shoes with sharp pointed heels have small area of contact with the ground which results to large pressure being exerted on the ground unlike the broad feet of an elephant which results to low pressure being exerted on the ground due to large area of contact.

(b) If the weight of the woman is 600N and her heel have an area of 1.0 cm^2 each and the elephant has a weight of 30,500N and each feet has an area of 730 cm^2, Calculate by how much more the woman exerts pressure on the ground than the elephant. (2 marks)

Pressure exerted by woman

Force = 600 N

Area = $2 \times 1.0 = 2.0\ cm^2 = 0.0002\ m^2$

Pressure = $\frac{600}{0.0002} = 3 \times 10^6\ Nm^{-2}$

Pressure exerted by elephant

Force = 30 500 N

Area = $\frac{730 \times 4}{10\ 000} = 0.292\ m^2$

Pressure = $\frac{30\ 500}{0.292} = 104\ 452.05 Nm^{-2}$

Difference in pressure = $3\ 000\ 000 - 104\ 452 = 2\ 895\ 548\ Pa$

12. A pick – up carrying stones weighs 20,000N. The weight is evenly spread across the four tyres. The area of contact of each tire with the ground is $0.025 m^2$. Calculate the pressure exerted by each tire on the ground.

Pressure = $\frac{Force}{Area}$

$= \frac{20\ 000}{0.025}$

$= 800\ 000 Nm^{-2}$

13. A pickup of mass 2 000 kg has four similar tyres. If the pressure exerted by each tyre on the ground is $500{,}000 Nm^{-2}$, calculate the area of each tyre in contact with the ground.

Area = $\frac{Force}{Pressure}$

Force = $2000 \times 10 = 20\ 000N$

Area = $\frac{20\ 000}{500\ 000} = 0.04\ m^2$

PRESSURE IN FLUIDS

1. Name **two** factors that affect pressure in fluids. (2 marks)
   - Depth/ height of fluid column
   - Density of the fluid
2. State **two** true facts about pressure in liquids. (2 marks)
   - Pressure increases with increase in depth
   - Pressure increases with increase in density
3. Other than the density and the depth, state any other factor that affects the pressure of a fluid. (1 mark)
   - Gravitational field strength
4. A cylindrical container has a base area of $150cm^2$ and is filled with water to a depth of 25 cm. Find the pressure due to water on the base (2 marks)

   Pressure due to liquid = ρhg

   Density of water, $\rho = 1\ 000kgm^{-3}$

   Height, $h = 0.25m$

   Gravitational field strength, $g = 10NKg^{-1}$

   Pressure = $1000 \times 0.25 \times 10 = 2\ 500\ Nm^{-2}$
5. Explain why a hole in a ship near the bottom is more dangerous than near the surface. (1 mark)
   - Since pressure increases with depth, a hole near the bottom will let in water at a higher pressure than the one near the surface.
6. Water dams are built with thicker walls at the bottom than at the top. Explain why. (2 marks)
   - Pressure exerted by water at the bottom is larger than at the surface. Thicker walls makes the dam able to counter the pressure.
7. Water tanks in houses are erected as high as possible. Explain. (1 mark)
   - To increase pressure of water coming out of the tap.
8. Explain why a hole in a ship near the surface is less dangerous than one near the bottom. (1 mark)

9. A drum which is **2m** high contains water to a depth of **0.5 m** and oil of density **0.5 g/cm³** extends to the top. Find the pressure exerted at the bottom of drum by the two liquids. (3 marks)

Total pressure = pressure due to water + pressure due to oil

$$= (1000 \times 0.5 \times 10) + (500 \times 1.5 \times 10)$$

$$= 5000 + 7500$$

$$= 12\,500 Nm^{-2}$$

10. The reading of mercury barometer is at **70.0cm**. What is the pressure at the place in N/m^2. {Assume density of mercury is 1.36×10^4 **kg/m³**} (3 marks)

Pressure = ρhg

$$= 1.36 \times 10^4 \times 0.7 \times 10$$

$$= 95\,200\ N/m^2$$

11. A submarine is **30m** below sea water of density $\mathbf{1}\boldsymbol{g/cm^3}$. If the atmospheric pressure at the place is equivalent to **760mmHg**. Find the total pressure acting on the submarine (Take density of mercury **=13600kg/m³**) (4 marks)

Total pressure = atmospheric pressure + pressure due to column of water

$$= (\mathbf{13600 \times 0.76 \times 10}) + (\mathbf{1000 \times 30 \times 10})$$

$$= \mathbf{103\,360 + 300\,000}$$

$$= \mathbf{403\,360}\boldsymbol{Nm^{-2}}$$

12. A submarine is **40m** below sea water of density **1020 kg/m³**. If the atmospheric pressure at the place is **103,000Pa**, calculate the total pressure acting on the submarine. (4 marks)

Total pressure = atmospheric pressure + pressure due to column of water

$$= \mathbf{103\,000} + (\mathbf{1020 \times 40 \times 10})$$

$$= \mathbf{103\,000 + 408\,000}$$

$$= \mathbf{511\,000}\boldsymbol{Nm^{-2}}$$

13. A submarine is **20m** below sea water of density **1000 kg/m3**. If the atmospheric pressure at the place is **102,000Pa**, calculate the total pressure acting on the submarine.

Total pressure = atmospheric pressure + pressure due to column of water

$$= \mathbf{102\,000} + (\mathbf{1000 \times 20 \times 10})$$

$$= \mathbf{102\,000 + 200\,000}$$

$$= \mathbf{302\,000}\boldsymbol{Nm^{-2}}$$

14. A boy is swimming **25m** below water level of density **1g/cm^3**. The atmospheric pressure at this place is equivalent to **72cmHg**. Calculate the total pressure on his body in **N/m^2** (take **ρ** for mercury = **13600kg/m^3)**

$$\text{Total pressure} = \text{atmospheric pressure} + \text{pressure due to column of water}$$

$$= (\mathbf{13600 \times 0.72 \times 10}) + (\mathbf{1000 \times 25 \times 10})$$

$$= \mathbf{97\,920 + 250\,000}$$

$$= \mathbf{347\,920} \boldsymbol{Nm^{-2}}$$

15. A water tank of height **4.8m** is ¾ full. Determine the force exerted on a thin metal plate resting flat at the bottom of the tank if the plate has an area of **2cm^2**. The density of water is **1000kg/m^3** and the atmospheric pressure =**104,000 Pa.**

$$\text{Total pressure} = \text{atmospheric pressure} + \text{pressure due to column of water}$$

$$= \mathbf{104\,000} + (\mathbf{1000 \times 3.6 \times 10})$$

$$= \mathbf{104\,000 + 36\,000}$$

$$= \mathbf{140\,000} \boldsymbol{Nm^{-2}}$$

$$\boldsymbol{Force = Pressure \times area}$$

$$= \mathbf{140\,000 \times 2 \times 10^{-4}}$$

$$= \mathbf{28} \boldsymbol{N}$$

16. A water tank of height **6m** is $\frac{44}{55}$ full. Determine the force exerted on a thin metal plate resting flat at the bottom of the tank if the plate has an area of **0.5m^2**. Take acceleration due to gravity, g = **10m/s^2**, the density of water to be **1000kg/m^3** and the atmospheric pressure **P =100,000 Pa** (3 marks)

$$\text{Total pressure} = \text{atmospheric pressure} + \text{pressure due to column of water}$$

$$= \mathbf{100\,000} + (\mathbf{1000 \times 4.8 \times 10})$$

$$= \mathbf{100\,000 + 48\,000}$$

$$= \mathbf{148\,000} \boldsymbol{Nm^{-2}}$$

$$\boldsymbol{Force = Pressure \times area}$$

$$= \mathbf{148\,000 \times 0.5}$$

$$= \mathbf{74\,000} \boldsymbol{N}$$

17. The height of mercury column in a barometer is found to be **76cm** at a certain place. What would be the height on a water barometer in the same place? (Density of water is **1000kg/m³** and density of mercury is **13600kg/m³**).

$$Pressure\ due\ to\ column\ of\ water = pressure\ due\ to\ column\ of\ mercury$$

$$1000 \times h \times 10 = 13600 \times 0.76 \times 10$$

$$Height\ of\ column\ of\ water, h = \frac{13600 \times 0.76 \times 10}{1000 \times 10}$$

$$= 10.336\ m$$

18. The height of mercury column in a barometer, at a place is **64cm**. What would be the height of a column of paraffin in the barometer at the same place? (Take density of mercury =**13600kgm⁻³ and** density of paraffin = **800 kg /m³**).

$$Pressure\ due\ to\ column\ of\ paraffin = pressure\ due\ to\ column\ of\ mercury$$

$$800 \times h \times 10 = 13600 \times 0.64 \times 10$$

$$Height\ of\ column\ of\ water, h = \frac{13600 \times 0.64 \times 10}{800 \times 10}$$

$$= 10.88\ m$$

19. A hole of diameter **1.0mm** is made in the side of a water pipe. If the pressure of the flow is maintained at **3.0 x 10⁶ Nm⁻²**, calculate the force with which the water jets out of the hole. (3 marks)

Cross sectional area of hole = $\frac{22}{7} \times (5 \times 10^{-4})^2 = 7.857 \times 10^{-7} m^2$

$$Force\ exerted = pressure \times area$$

$$= 3.0 \times 10^6 \times 7.857 \times 10^{-7}$$

$$= 2.3571\ N$$

20. A hole of area **200mm²** at the bottom of a tank **4.0m** deep is closed with a cork. Determine the force due to water (Density of water is **1000kg/m3**, and acceleration due to gravity is **10m/s²**

Pressure due to water = $\rho hg = 1000 \times 4 \times 10 = 40\ 000\ Nm^{-2}$

Force = $pressure \times area$

$$= 40\ 000 \times 2 \times 10^{-4}$$

$$= 8N$$

HYDRAULIC MACHINES

1. State the Pascal's principle. (1 mark)
   - For an enclosed fluid, pressure exerted at one point is equally transmitted to all other parts of the same fluid.

2. Name two properties of a suitable hydraulic fluid. (2 marks)
The fluid should:-
   - Be incompressible
   - Have low freezing point and high boiling point.
   - Not corrode the parts of the hydraulic system.
3. Give a reason why air is not commonly used as the fluid in a hydraulic lift. (1 mark)
   - It is compressible
4. Explain why brakes fail in a hydraulic brake system when air gets in to the system. (2 marks)
   - Air makes the hydraulic fluid compressible. Pressure exerted at the master cylinder is not evenly transmitted to the other parts of the system.
5. Explain why a liquid and not a gas must be used as the 'fluid' in a hydraulic machine. (1 mark)
   - A gas can easily be compressed unlike a liquid.
6. The area of larger piston of a hydraulic press is **4m²** and that of the other piston is **0.05m²**. A force of **100 N** is applied on the smaller piston. How much force is produced on the larger piston?

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{100}{0.05} = \frac{F_2}{4}$$

$$F_2 = \frac{100 \times 4}{0.05} = 8\ 000\ N$$

7. The areas of the piston of the smaller and larger pistons of a Hydraulic press are **4cm²** and **480cm²**. Calculate the force applied on the smaller piston to raise a load of **8400N** on the larger piston.

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{8400}{480} = \frac{F_2}{4}$$

$$F_2 = \frac{8400 \times 4}{480} = 70\ N$$

8. In a hydraulic machine, the pistons of two connected cylinders have radius of **10cm** and **100cm** respectively. A force of **400N** is applied on the smaller piston. Calculate the force on the larger piston.

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{400}{100\pi} = \frac{F_2}{10000\pi}$$

$$F_2 = \frac{10\ 000\pi \times 400}{100\pi} = 40\ 000\ N$$

9. The figure 1 below shows a mass of 6 kg on piston B balanced by force F acting on piston A.

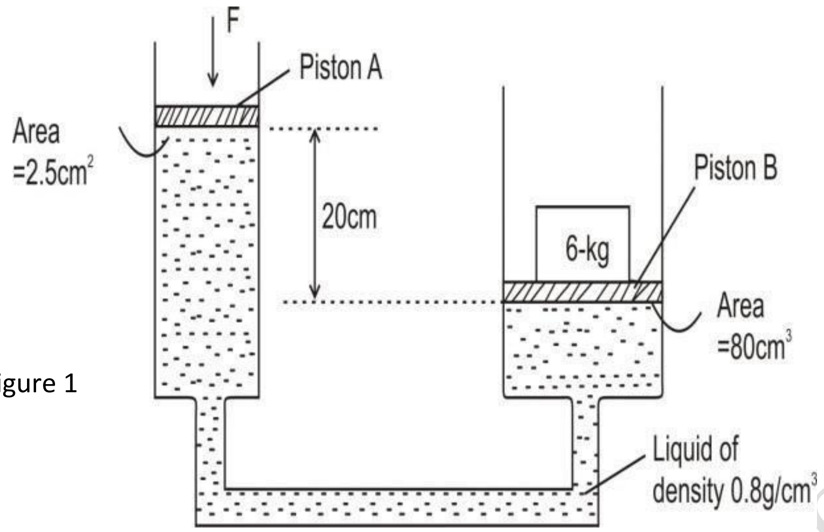


Figure 1

Determine the value of the force F. (3 marks)

Pressure exerted at smaller piston A = Pressure exerted at smaller piston B

$$\frac{F}{0.00025} + (800 \times 0.2 \times 10) = \frac{60}{0.008}$$

$$F = (7500 - 1600) \times 0.00025$$

$$= 1.475\ N$$

10. Figure 2 shows a hydraulic press system using a lever of negligible mass on the side of a small piston pivoted at point **P**. A force of l00N is applied at **R**.

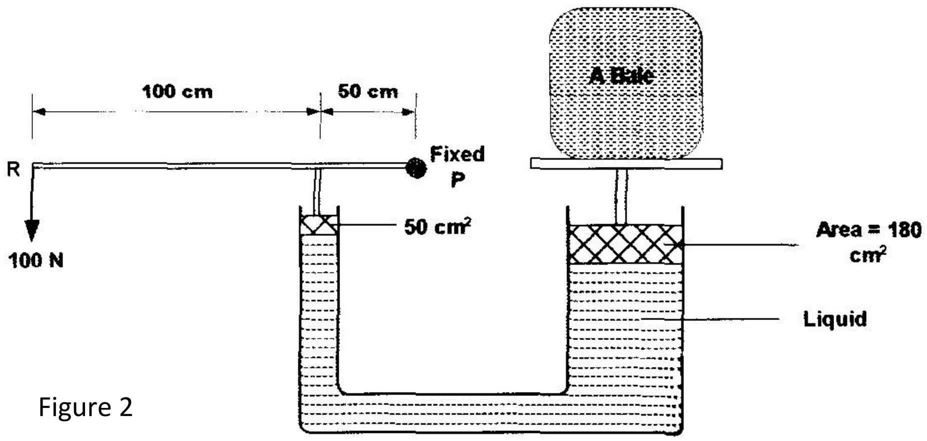


Figure 2

Calculate the force **F** exerted by small piston on the liquid. (2 marks)

Applying principle of moments

$$clockwise\ moments = A.\ clockwise\ moments$$

$$1.5 \times 100 = F \times 0.5$$

$$F = \frac{1.5 \times 100}{0.5} = 300N$$

11. (a) Figure 3 shows one form of hydraulic lifting device. The force A causes a pressure in a liquid. The pressure moves the piston B.

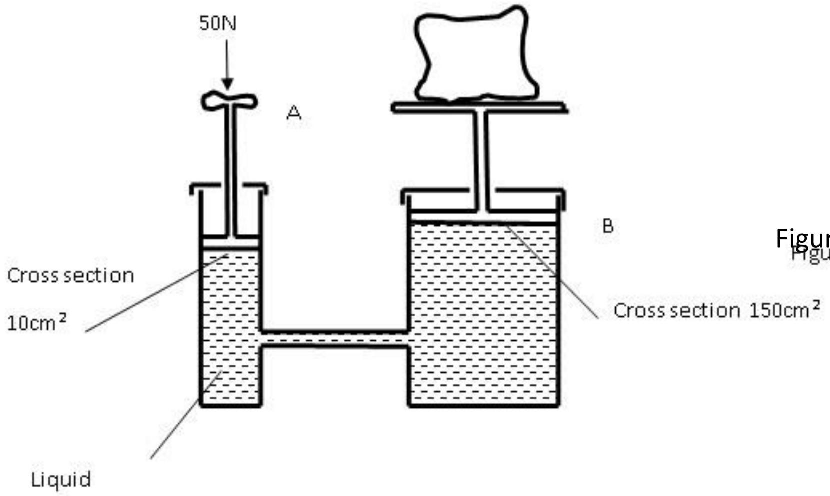


Figure 3

Determine;

i. The pressure in the liquid (3 marks)

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

$$= \frac{50\ N}{10 \times 10^{-4} m^2}$$

$$= 50\ 000 Nm^{-2}$$

ii. The force pushing up on B. (3 marks) Pressure exerted on piston A = Pressure exerted on piston B

$$50\ 000 = \frac{F}{150 \times 10^{-4}}$$

$$F = 50\ 000 \times 150 \times 10^{-4} = 750\ N$$

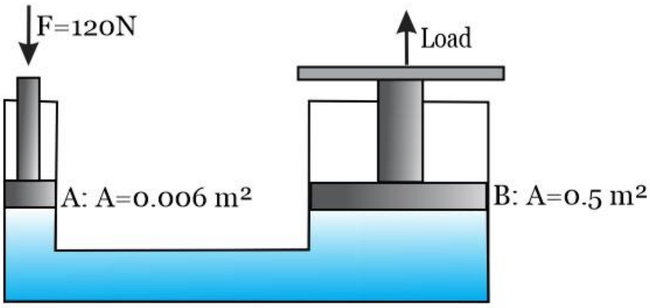
iii. Suggest with a reason what would happen if the liquid was replaced with air. (2 marks)

The object on piston B would be lifted a shorter distance. This is because air is compressible hence pressure transmitted would be less.

(b) State principal of transmission of pressure in liquids. (1 mark)

- For an enclosed liquid, pressure exerted at one point is evenly distributed to all other parts of the same liquid.

12. Figure 4 below is a simple hydraulic machine used to raise heavy loads.



i. Calculate the load (force) raised at B. (3 marks)

$$\frac{120}{0.006} = \frac{F}{0.5}$$

$$F = \frac{120 \times 0.5}{0.006} = 10\ 000N$$

ii. Give two properties which make the oil suitable for use in this machine. (2 marks)

- Should be incompressible
- Does not corrode the parts of the system

U-TUBE

1. A vacuum pump was used to pump out air from the glass tube immersed in liquids as shown in figure 1 below.

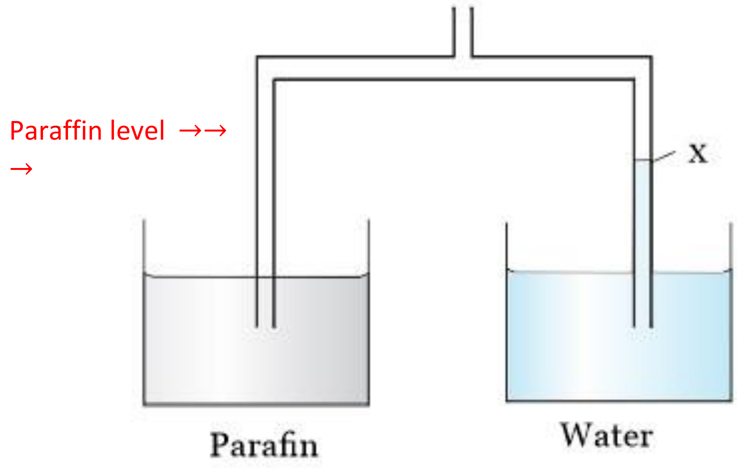
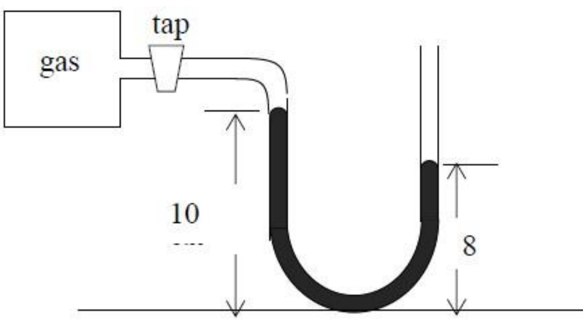


Fig. 1

After sometime the level of water rose to position X. Mark Y the corresponding position for the paraffin level. Give a reason for your answer. (2 marks)

- Y is above X --- paraffin is less dense than water.

2. A U-tube containing mercury is used as a manometer to measure the pressure of a gas in a container. When the manometer has been connected and the tap opened, the mercury in the U-tube settles as shown in the diagram below.



If the atmospheric pressure is 760 mmHg and the density of mercury is 13 600 kg/m3, calculate the pressure of the gas in Pascals. (3 marks)

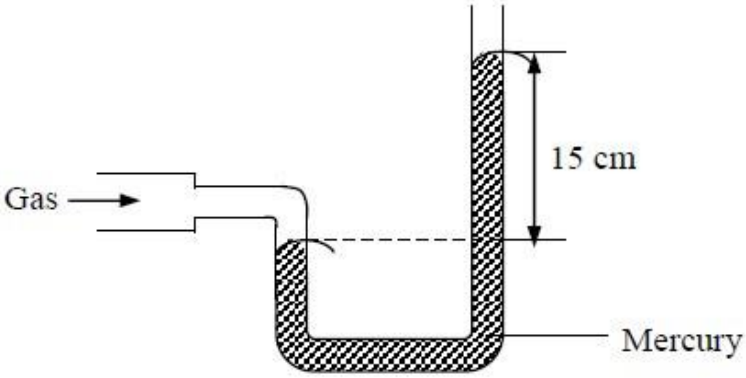
$\boldsymbol{P_g = P_a - \rho h g}$

$= (0.76 \times 13600 \times 10) - (0.02 \times 13600 \times 10)$

$= 10336 - 272$

$= 10064\ Pa$

3. The U tube shown below contains mercury of density 13600 kg/m^3 and is connected to a laboratory gas supply.



If the atmospheric pressure is 75 cmHg, what is the pressure of the gas in:

i. cmHg (2 marks)

$$P_g = P_a + \rho h g$$

$$= 15cmHg + 75cmHg$$

$= 90cmHg$ ii. Pascal (Take g = 10N/kg)

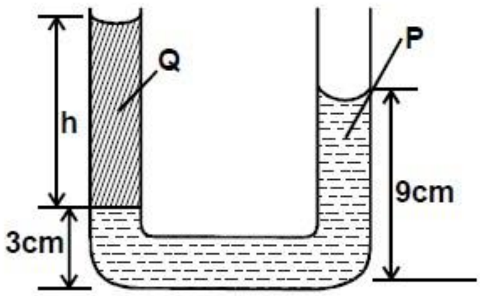
(3 marks)

$$P_g = 0.90 \times 13600 \times 10$$

$$= 122\,400\ Pa$$

4. In the figure 2, below, U-tube contains two immiscible liquids P and Q.

Fig 2



If the density of Q is 900kg/m³ and that of P is 1200kg / m³. Calculate the height of liquid Q. (3 marks)

$$1200 \times 0.09 \times 10 = (0.03 + h) \times 900 \times 10$$

$$1080 = 270 + 9\,000h$$

$$h = \frac{810}{9\,000} = 0.09\ m$$

HEIGHT OF MOUNTAIN

1. The barometric height in a town is 65cmHg. Given that the standard atmospheric pressure is 76cmHg and the density of mercury is 13600kg/m^3, determine the altitude of the town. (Take density of air = 1.25 kg/m^3) (3 marks)

to to Pressure difference due

(Height of the mountain) = of mercury air column Pressure

due column

$$\rho_a h_a g = \rho_m h_m g$$

$$h_a \times 1.25 \times 10 = 13600 \times (0.76 - 0.65) \times 10$$

$$h_a = \frac{13600 \times 0.11 \times 10}{1.25 \times 10} = 1196.8\ m \cong 1197\ m$$

2. A mountain climber with a mercury barometer discovered that the readings of the barometer at the bottom and top of a certain mountain were 750mmHg and 520mmHg respectively. Given that the density of air between the bottom and top of the mountain is uniform and equal to 1.25 Kg/m^3, estimate the height of the mountain. (Take the density of mercury to be 1.36 x 104 Kg/m^3). (3 marks)

Pressure difference due to air column Pressure due to column

(Height of the mountain) = of mercury

$$\rho_a h_a g = \rho_m h_m g$$

$$h_a \times 1.25 \times 10 = 13600 \times (0.75 - 0.52) \times 10$$

$$h_a = \frac{13600 \times 0.23 \times 10}{1.25 \times 10} = 2502.4\ m \cong 1197\ m$$

∴Height of the mountain is 2502.4 metres

3. The height of mercury column in a barometer is found to be **67cm** at a certain place. What would be the height on a water barometer in the same place? (Density of water is **1000kg/m^3** and density of mercury is **13600 kg/m^3**). (3 marks)

Pressure difference due to water column = Pressure to due column of mercury

$$\rho_w h_w g = \rho_m h_m g$$

$$h_w \times 1000 \times 10 = 13600 \times 0.67 \times 10$$

$$h_a = \frac{13600 \times 0.67 \times 10}{1000 \times 10} = 9.112m$$

∴Height on a water barometer would be 9.112 metres

4. The height of mercury column in a barometer density 13600kg/ m^{-3}, at a place is 64cm. What would be the height of a column of paraffin in barometer at the same place? (Density of paraffin = $\mathbf{8.0 \times 10^2}$ kg /m^3). (3 marks)

Pressure difference due to mercury column = Pressure due to column of mercury

$$\rho_m h_m g = \rho_p h_p g$$

$$0.64 \times 13600 \times 10 = 800 \times h_p \times 10$$

$$h_p = \frac{13600 \times 0.64 \times 10}{800 \times 10} = 10.88m$$

∴Height of the paraffin column is 10.88 metres

5. The barometric height at sea level is **76cm** of mercury while that at a point on a highland is **74cm** of mercury. What is the altitude of the point? *Take g =* ***10m/s2****, density of mercury =* ***13600 Kg/m3*** *and density of air as* **1.25 Kg/m³**. (3 marks)

(Altitude of the point) = Pressure difference due to air
Pressure difference due to mercury

$$\rho_a h_a g = \rho_m h_m g$$

$$h_a \times 1.25 \times 10 = 13600 \times (0.76 - 0.74) \times 10$$

$$h_a = \frac{13600 \times 0.02 \times 10}{1.25 \times 10} = 217.6\ m$$

∴Altitude of the point is 217.6 metres

ATM PRESSURE

1. Define the term **atmospheric** pressure and give its **SI** units (2 marks)
   - Pressure exerted on the earth's surface by the column of air above it. SI unit is atmospheres (atm)
2. Explain why it may not be possible to suck a liquid into your mouth using drinking straw on the surface of the moon. (1 mark)
   - At the surface of the moon, the pull of gravity is too low to support a column of a liquid.
3. A barometer was taken from Mount Kenya to Mombasa. Explain the change in mercury level in the barometer. (2 marks)

- The height of the column of mercury supported while on Mount Kenya decreased when the barometer was moved to Mombasa. This is because the atmospheric pressure at Mombasa is greater than at Mount Kenya.

4. Explain why a partially inflated balloon released at sea level would become fully inflated at a higher altitude. (1 mark)
    - At higher altitude, the atmospheric pressure acting on the balloon is less than the gas pressure inside the balloon.

5. Explain how a drinking straw is used to suck a liquid. (3 marks)
    - When you suck the air inside the straw, pressure inside the straw decreases. The atmospheric pressure acting on the surface of the liquid thus pushes the liquid into the straw which in turn rises up the straw.
6. Give a reason why water is not a suitable liquid for use in a barometer. (1 mark)
    - Water has a high freezing point and low boiling point
7. State one applications of atmospheric pressure. (1 mark)
    - Siphon
    - Drinking straw
    - Force pump
    - Lift pump Choose any

6. In an experiment to demonstrate atmospheric pressure, a plastic bottle is partially filled with hot water and the bottle is then tightly corked. After some time, the bottle starts to get deformed.
    a. State the purpose of the hot water. (1 mark)
        - To expel air out of the bottle thus creating a partial vacuum
    b. State and explain the reason why the bottle gets deformed. (2 marks)
        - The bottle crashes inwards. The pressure inside the bottle is less than the atmospheric pressure acting on the outer walls of the bottle as a result the walls are forcefully pushed inwards.

8. Explain why high flying aircraft need to be airtight and have pressurized cabins for people. (1 mark)

9. A tin-can is partially filled with water and heated so that the water boils for some time. Explain what happens to the can when closed tightly and allowed to cool. (2 marks)
    - Boiling water expels the air inside the can creating a near- vacuum. When the can is closed and allowed to cool, it crashes.
    - This is because the atmospheric pressure being greater than the pressure inside the can pushes the walls of the can inwards.

10. Figure 5 shows a flask fitted with a tube dipped into a beaker containing water at room temperature. The cork fixing the glass tube is tight.

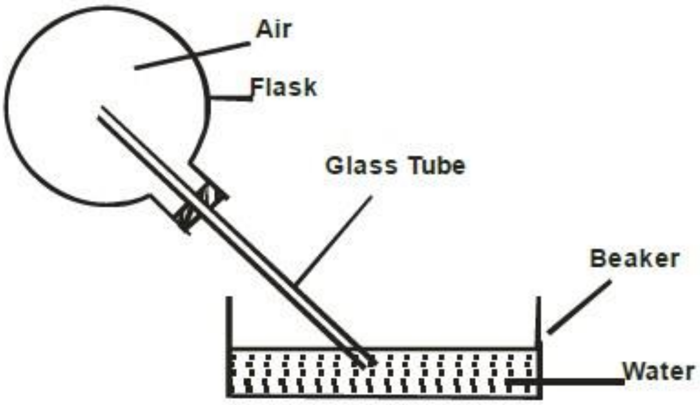


Fig 5

State with reason what would be observed if cold water is poured on to the flask. (2 marks)

- Water rises up the glass tube.
- Air inside the flask cools thus creating a low pressure region. Atmospheric pressure acting on the surface of the water pushes the water into the tube.

11. Water jets out through small holes at the same height in a tall can as shown in figure 6.

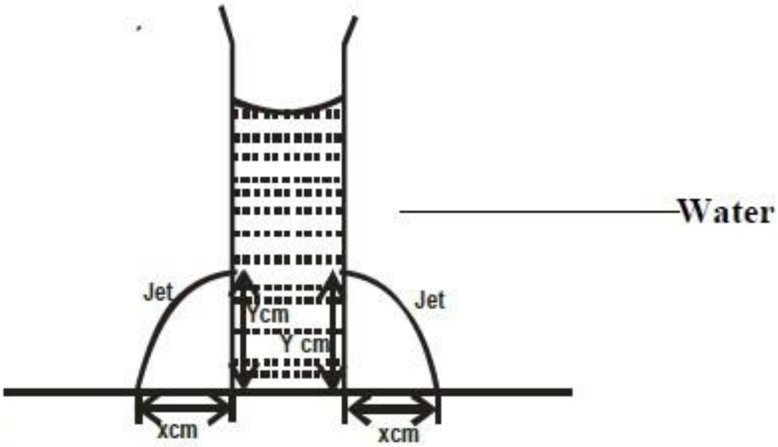


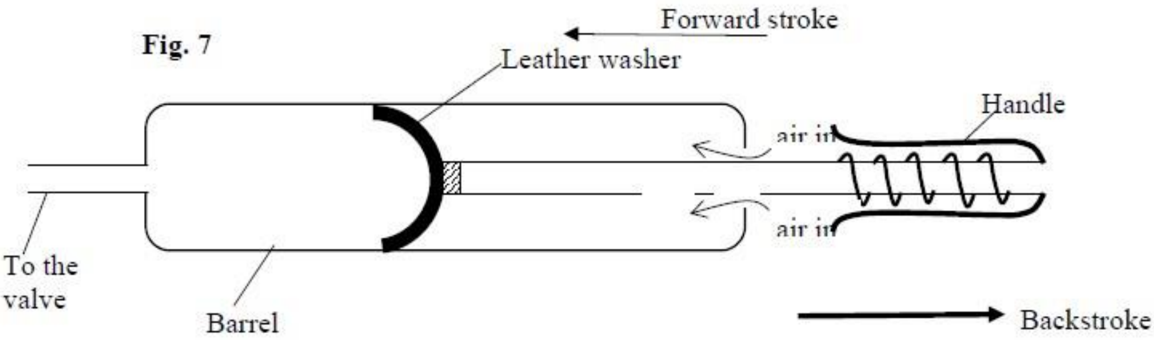
Fig 6

a) State **one** conclusion that can be made from this observation. (1 mark)
   - Pressure on a liquid is equal at the same depth

b) Explain **two** adjustments that can be made to increase the distance **x** without changing the type liquid or the position of the can. (2 marks)
   - Making the size of the hole (jet) smaller.
   - Increasing the amount of liquid in the container.

12. The bicycle pump shown in Figure 7 below is one of the applications of pressure in gases.

Fig. 7



Explain how the leather washer functions during; (2 marks) (a)
Backstroke

- During backstroke the pressure inside the barrel decreases. The washer which acts as a valve opens. The atmospheric pressure being greater pushes air past the leather washer into the barrel.

(b) Forward stroke

- During forward stroke, the pressure between the washer and the valve increases thus pushing the washer backwards. The washer bulges outwards touching the barrel tightly thus pushing the air forward as the piston moves.

13. Fig. 8 shows a siphon setup.

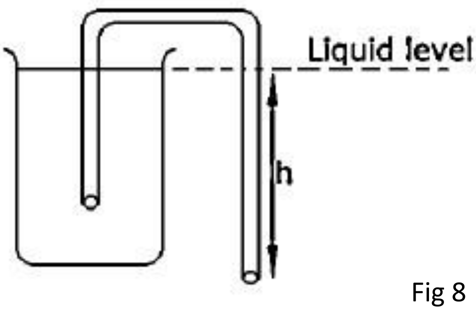


Fig 8

It is observed that as the length **h** reduces, amount of the liquid pouring out also reduces. Explain. (2 marks)

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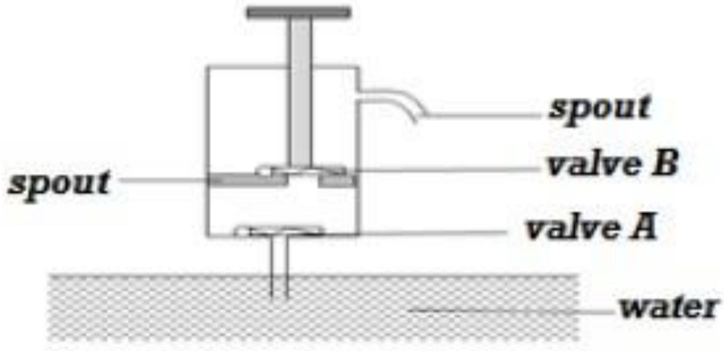
14. The figure below shows a lift pump, use it to answer the questions that follow.



Explain why, when the piston is;

I. Pulled upwards, valve A opens while valve B closes. (2 marks)

 Pressure between A and B decreases. The atmospheric pressure acting on the surface of water pushes the water past A thus opening it.

II. Pushed downwards, valve A closes while valve B opens. (2 marks)

Pressure between A and B increases thus pushing A downwards.

