

TOPIC

6

Pressure

Objectives

Candidates should be able to:

- define the term pressure in terms of force and area
- recall and apply the relationship $\text{pressure} = \text{force} / \text{area}$ to new situations or to solve related problems
- describe and explain the transmission of pressure in hydraulic systems with particular reference to the hydraulic press
- recall and apply the relationship $\text{pressure due to a liquid column} = \text{height of column} \times \text{density of the liquid} \times \text{gravitational field strength}$ to new situations or to solve related problems
- describe how the height of a liquid column may be used to measure the atmospheric pressure
- describe the use of a manometer in the measurement of pressure difference

NOTES.....

6.1 Pressure

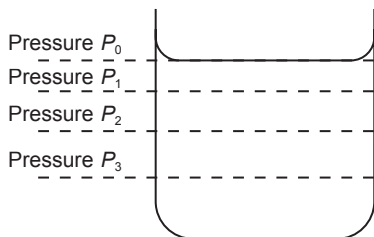
- Pressure is the force acting per unit area.

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

- SI unit: Pascal (Pa) or N m^{-2}

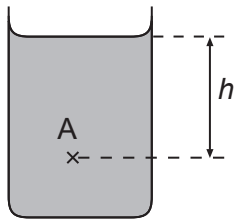
6.2 Liquid Pressure

- An object immersed in a uniform liquid will experience a pressure which depends only on the height of the liquid above the object.



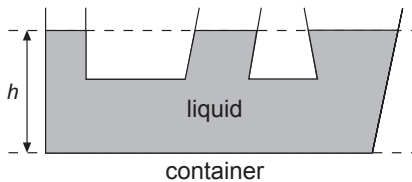
P_0 : Atmospheric pressure
 Pressure increases with depth: $P_0 < P_1 < P_2 < P_3$

2. Pressure at point A due to the liquid, $P = \rho gh$



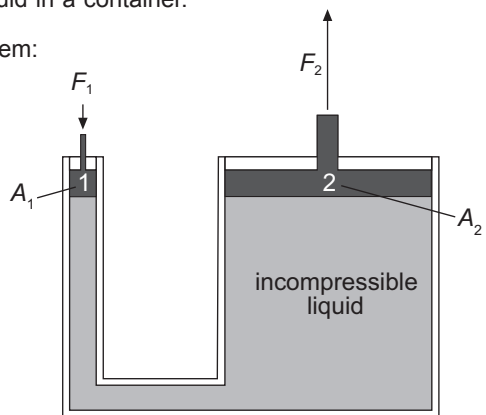
Pressure at point A = $P_0 + \rho gh$
 P_0 – Atmospheric pressure

3. When a liquid is at equilibrium, the pressure is the same at any point along the same horizontal surface. Thus the liquid in the container settles at a common height, h .



6.3 Transmission of Pressure in Hydraulic System

- Pressure can be transmitted in all directions if it is exerted on an incompressible fluid in a container.
- Components of a hydraulic system:
 - Container with two openings
 - A press
 - A piston
 - Incompressible fluid



Hydraulic System

3. In the above figure, if the two pistons at '1' and '2' have the same area, then the force F_1 exerted on one piston will have the same magnitude as F_2 at the other piston.

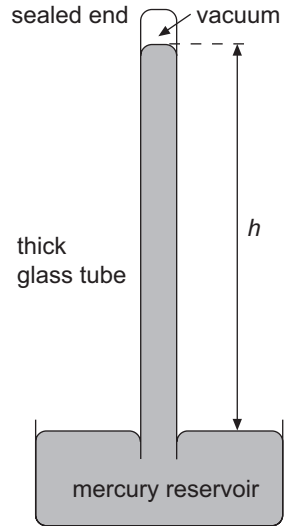
- If the area A_1 is smaller than area A_2 , then the force exerted at '1' will produce a larger force at '2'.

$$\text{Pressure} = P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

- Thus we can use a hydraulic system to lift heavy objects.

6.4 Atmospheric Pressure

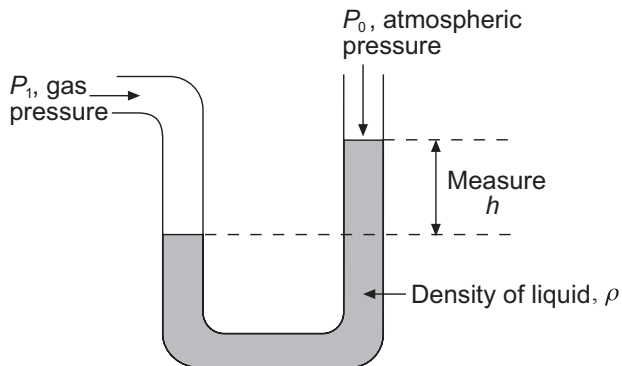
- Defined as the force per unit area exerted against a surface by the weight of air above that surface.
- Instrument to measure atmospheric pressure: mercury barometer
- At sea-level, $h = 760$ mm.
Atmospheric pressure recorded as 760 mm Hg.
- Even if the tube is tilted, h will still remain the same unless it is brought to a different level where the atmospheric pressure is different.



Mercury Barometer

6.5 Manometer

- The manometer is an instrument that is used to measure gas pressure.
- Gas pressure, $P_1 = P_0 + \rho gh$ where h – difference in height.



Manometer