

Chapter six

Pressure:

- Pressure is defined as the force which acts per unit area.
- Its standard unit is newton per metre squared. or the pascal.
- $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$.
- From this above formulae, it can be seen that pressure is directly proportional to the force.
- This means that when the force increases, pressure also increases.
- And also when the force decreases, the pressure also decreases.
- From this same above formulae also, pressure is indirectly proportional to the area.
- This implies that when pressure increases, the area decreases.
- And when the area decreases, the pressure increases.
- For this reason, if a person wearing a shoe with a big sole steps on our feet, we do not feel much pain, since the area is large and as such, the pressure exerted on our feet will be small.
- On the other hand if the same person was to step on our feet wearing a shoe with a small sole, the pain will be more, since the surface area is small which will make the pressure high.

Calculating Pressure:

(Q1) Calculate the pressure exerted by a block of area 100m^2 , if it has a weight of 40kg .
Take 'g' or acceleration due to gravity = 10m/s^2 .

Soln:

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

N/B: To get the force, we must multiply the weight or mass in kg by 'g' or the acceleration due to gravity, i.e 10m/s^2 .

Since weight = 40kg ,

$$\Rightarrow \text{force} = 40 \times 10 = 400\text{N}.$$

$$\text{Area} = 100\text{m}^2$$

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

$$\therefore \text{Pressure} = \frac{400}{100} = 4.$$

$$\Rightarrow P = 4 \text{ NM}^{-2}.$$

(Q2) The area of a bottle is 50 m^2 . If it has a mass of 20 kg , calculate the pressure that it will exert on top of a table.

Soln:

Since mass = 20 kg ,

$$\Rightarrow \text{force} = 20 \times 10 = 200 \text{ N}.$$

$$\text{Area} = 50 \text{ m}^2.$$

$$\text{But Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{200}{50} = 4,$$

$$\Rightarrow \text{pressure} = 4 \text{ pascal}.$$

N/B: If the mass or weight is given in grams, it must be converted into kg (kilogram).

(Q3) A rectangular block of length 18 m and breadth 10 m , lies on the surface of the floor. Calculate the pressure that will exert on the surface of the floor, if it has a mass of 4000 g .

Soln:

$$\text{Mass} = 4000 \text{ g} = \frac{4000}{1000} = 4 \text{ kg},$$

i.e divide the mass in grams by 1000 to convert it into kg.

$$\text{Since mass} = 4 \text{ kg, then force} = 4 \times 10 = 40 \text{ N}.$$

$$\text{Area of rectangle} = \text{Length} \times \text{Breadth}.$$

$$\therefore \text{Area of the rectangle} = 180 \times 10 = 180 \text{ m}^2.$$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{40}{180} = 0.2,$$

$$\Rightarrow \text{pressure} = 0.2 \text{ p}$$

(Q4)A rectangular box of length 20m and breadth 10m, lies on a table. If it has a weight of 8000g, calculate the pressure which it will exert on the table.

(Take 'g' = 10ms^{-2}).

Soln:

Since area of rectangular block = length x breadth,

$$\Rightarrow \text{area} = 20 \times 10 = 200\text{m}^2$$

$$\text{Weight} = 8000\text{g} = \frac{8000}{1000} = 8\text{kg}.$$

$$\text{Force} = 8 \times 10 = 80\text{N}.$$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{80}{200} = 0.4.$$

$$\therefore \text{Pressure} = 0.4\text{NM}^{-2}.$$

(Q4)A square box of side or length 5m, lies on a table. If it has a mass of 25kg, find the pressure it will exert on the table.

Soln:

Length or side of box = 5m.

$$\text{Area of square box} = \text{length squared} = 5^2 = 25\text{m}^2.$$

$$\text{Mass} = 25\text{kg}.$$

$$\text{Force} = 25 \times 10 = 250\text{N}.$$

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

$$= \frac{250}{25} = 10\text{NM}^{-2}.$$

N/B: Area of a square is also given by breadth squared i.e. B^2 .

(Q5)A block which is in the shape of a square of breadth or length 2m has a mass of 8000g. Find the force it exerts on the ground as it lies there.

Soln:

Breadth of the block = 2m.

Area of square block = Breadth squared or length square = $2^2 = 4\text{m}^2$.

Mass = 800g = $\frac{8000}{1000} = 8\text{kg}$.

Force = $8 \times 10 = 80\text{N}$.

Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{80}{4} = 2p$.

N/B: If the mass or weight is given in Newtons (N), then it is force and as such we must not convert it.

(Q6) The weight of a box is 40N. If it has an area of 20m^2 , calculate the pressure it will exert if it lies on a table.

Soln:

Weight = 40N. (i.e Force).

Area = 20m^2 .

Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{40}{20} = 2\text{N}/\text{M}^2$.

(Q7) A rectangular box has a length of 5m and a breadth of 4m. If it has a mass of 80N, calculate the pressure it will exert on a table that it is placed.

Soln:

Area of rectangular block

= $L \times B = 5 \times 4 = 20\text{m}^2$

Weight = force = 80N. (Since it is in newtons).

Pressure = $\frac{\text{force}}{\text{Area}} = \frac{80}{20} = 4p$.