Chapter 6 — Mechanical Properties of Matter

Exercise — Short Answer Questions (with Answers)

Class 9 Physics (New Syllabus) — Board Level

Q 6.1. Why do heavy animals like an elephant have a large area of the foot?

Ans: Pressure P = F/A, so for a given force the pressure is inversely proportional to the contact area. Heavy animals like the elephant have a very large weight. Their large, flat feet provide a large contact area, which reduces the pressure on the ground and on their own bones. If the area were small, the pressure would be so high that their bones would not tolerate it.

Q 6.2. Why do animals like deer that run fast have a small area of the foot?

Ans: A small contact area produces a large pressure on the ground (P = F/A). This large pressure gives a firm grip and lets these animals push hard against the ground, which helps them run fast and change direction quickly.

Q 6.3. Why is it painful to walk bare-footed on pebbles?

Ans: When we walk, the ground exerts a reaction force on the foot. On flat ground this force is spread over the whole area of the foot, so the pressure is low. On pebbles the contact area is very small, so the same force produces a very high pressure (P = F/A) on the foot, which is why it becomes painful.

Q 6.4. State Pascal's law. Give an application of Pascal's law.

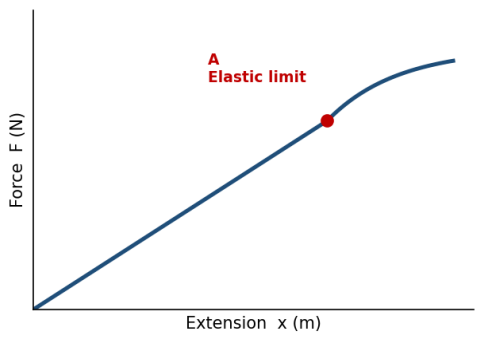
Ans: Pascal's law states that when pressure is applied at one point in an enclosed fluid, it is transmitted equally to all parts of the fluid without loss. Its applications include the hydraulic press, the car lift at service stations, and the hydraulic brakes of vehicles.

Q 6.5. State what you mean by elasticity of a solid.

Ans: Elasticity is the property of solids by which they come back to their original shape and size when the deforming force stops acting. For example, a stretched spring or rubber band returns to its original form on release. This property holds only up to the elastic limit.

Q 6.6. What is Hooke's law? Does an object remain elastic beyond the elastic limit? Give reason.

Ans: Hooke's law states that within the elastic limit, the extension or compression x of a spring is directly proportional to the applied force, i.e. $F = kx$. No, an object does not remain elastic beyond the elastic limit, because beyond this limit the deformation becomes permanent and the object does not regain its original shape or size even after the deforming force is removed.



Force–extension graph: straight line up to elastic limit (A), then curves.

Q 6.7. Distinguish between force and pressure.

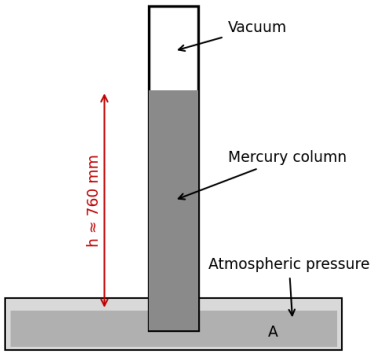
Ans: Force is a push or pull that can change the state or shape of a body; its SI unit is the newton (N). Pressure is the force acting normally on unit area of a surface, $P = F/A$; its SI unit is the pascal (Pa = N m^{-2}). Thus the same force can produce different pressures depending on the contact area.

Q 6.8. What is the relationship between liquid pressure and the depth of the liquid?

Ans: The pressure of a liquid increases with depth. It is given by $P = \rho gh$, where ρ is the density of the liquid, g is the gravitational acceleration and h is the depth. So, the pressure is directly proportional to the depth — the deeper we go, the greater the liquid pressure.

Q 6.9. What is the basic principle to measure the atmospheric pressure by a simple mercury barometer?

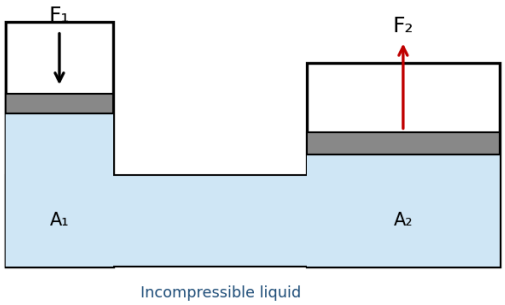
Ans: The basic principle is that the atmospheric pressure is balanced by the pressure of the mercury column it can support. In a simple barometer, the atmospheric pressure acting on the mercury in the dish equals the pressure of the mercury column, P = ρgh. By measuring the height h of the column, the atmospheric pressure is found (about 760 mm of mercury at sea level).



Simple mercury barometer: atmospheric pressure supports a ~760 mm mercury column.

Q 6.10. State the basic principle used in the hydraulic brake system of automobiles.

Ans: Hydraulic brakes work on Pascal's law: pressure applied to an enclosed liquid is transmitted equally in all directions without loss. When the brake pedal is pressed, the piston applies pressure on the liquid in the master cylinder; this pressure is transmitted equally through the liquid to the larger pistons at the wheels, which press the brake pads against the discs or drums and stop the vehicle.



Hydraulic system (Pascal's law): a small force F_1 on A_1 gives a large force F_2 on A_2.