11 Force and Pressure

Lesson at a Glance

- **Force:** A push or pull on an object is called a *force*. Force may impart motion to an object.
- Forces applied on an object in the *same direction add* to one another.
- When two forces act in the opposite direction on an object, the *net force acting on the object is the difference between the two forces.*
- **Magnitude:** The strength of a force is usually expressed by its magnitude.
- While talking about a force we have to specify the *direction in which a force is acting* and also its magnitude.

  If the direction or the magnitude of the applied force changes, its effect also changes.
- **State of Motion:** The state of motion of an object is described by its *speed* and *the direction of motion.* At rest the state of the object is considered the state of zero speed.
- **Muscular Force:** The force resulting due to the action of muscles is known as the *muscular force.*
- **Contact Force:** Force that can be applied *only when it is in contact with an object* is called a *contact force.* For example, muscular force can be applied only when it is in contact with an object. *Friction* is also an example of *contact force.*

  The force of friction always acts on all the moving objects and its direction is always opposite to the direction of the motion.
- **Non-Contact Force:** The force exerted on an object without touching it known as *non-contact force.* For example, the force exerted by a magnet on a piece of iron.

  Another example is *Electrostatic Force.* It is *the force exerted by a charged body on another charged or uncharged body.*
- **Gravitational Force:** The attractive force of the earth which acts upon all the objects is known as the *force of gravity* or just

gravity. Every object in the universe, whether small or large, *exerts a force on every other object.* This force is called as the *gravitational force.*

- **Pressure:** The force acting on a unit area of a surface is called *pressure.* It is especially true for those *forces which* act *perpendicular* to the surface on which the pressure is to be computed.

  Pressure = Force/Area on which it acts

  Lesser the area, greater is the effect of force.

  Actually, *force per unit area* is called pressure.

  A porter places a round folded long piece of cloth on his head while carrying heavy load. By doing this he *increases the area of contact* of the load with his head. So, the pressure on his head at a particular place of head is distributed to adjoining areas. As a result, he finds easier to carry the load (Fig. 11.1).

  The base of the dam is made quite wide. This reduces pressure exerted by the enormous amount of stored water (Fig. 11.2).

  For the similar reason, it is easier to push *pointed nail* into a wooden plank than the blunt edged nail. The pointed nail reduces the surface for the force acted upon it.

  For the same reason the foundation of the walls of a building is made wider than the wall to be erected on them (Fig. 11.3).

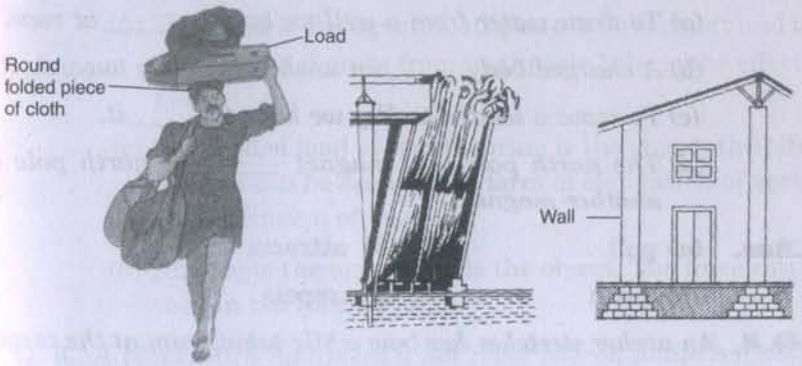

Fig. 11.1 A porter carrying a heavy load. **Fig. 11.2** Dam **Fig. 11.3** Foundation of walls.

- A liquid exerts pressure on the wall of a container.
- Gases also exert pressure on the walls of their containers.

- **Atmosphere:** The envelop of air all around us is known as *atmosphere*. The atmospheric air extends up to many kilometres above the surface of the earth.
- **Atmospheric Pressure:** The pressure exerted by atmospheric air is termed as *atmospheric pressure*. This is the weight of air column over a unit area (1 cm^2). For example, the area of head of a boy is 10 cm × 10 cm. Then the weight of air column of the height of the atmosphere and area 10 cm × 10 cm is as large as 1000 kg. This heavy weight does not crush us because the pressure inside our bodies is also equal to the atmospheric pressure as it cancels the pressure outside.

TEXTBOOK QUESTIONS SOLVED

Q. 1. *Give two examples of each of situation in which you push or pull to change the state of motion of objects.*

Ans. (*i*) We push a bicycle to move it.

(*ii*) We pull the table to change its position.

Q. 2. *Give two examples of situations in which applied force causes a change in the shape of an object.*

Ans. (*i*) When we press the foam, its shape is changed.

(*ii*) When we stretch the rubber band, its shape is changed.

Q. 3. *Fill in the blanks.*

(a) To draw water from a well we have to _____ at rope.

(b) A charged body _____ an unchanged body towards it.

(c) To move a loaded trolley we have to _____ it.

(d) The north pole of a magnet _____ the north pole of another magnet.

Ans. (*a*) pull (*b*) attracts

(*c*) push (*d*) repels

Q. 4. *An archer stretches her bow while taking aim at the target. She then releases the arrow, which begins to move towards the target. Based on this information fill up the gaps in the following statements using the following terms:*

muscular, contact, non-contact, gravity, friction, shape, attraction

(a) To stretch the bow, the archer applies a force that causes a change in its _____.

(b) The force applied by the archer to stretch the bow is an example of _____ force.

(c) The type of force responsible for a change in the state of motion of the arrow is an example of a _____ force.

(d) While the arrow moves towards its target, the forces acting on it are due to _____ and that due to _____ of air.

Ans. (*a*) shape (*b*) muscular

(*c*) contact (*d*) gravity, friction

Q. 5. *In the following situations identify the agent exerting a force and the object on which it acts. State the effect of the force in each case.*

(a) Squeezing a piece of lemon between the fingers to extract its juice.

(b) Taking out paste from a toothpaste tube.

(c) A load suspended from a spring while its other end is on a hook fixed to a wall.

(d) An athlete making a high jump to clear the bar at a certain height.

Ans. (*a*) The fingers are the agents, lemon is the object. The effect of force is the lemon juice being expelled by squeezing.

(*b*) The hand is the agent, toothpaste tube is object and the coming out of paste from toothpaste tube is the effect of force.

(*c*) Suspended load is agent, spring is the object, the effect of force can be seen in the form of elongation of spring on suspension of load.

(*d*) Athlete is the agent, bar is the object. The force can be seen in the form of jump.

Q. 6. *A blacksmith hammers a hot piece of iron while making a tool. How does the force due to hammering affect the piece of iron?*

Ans. The force due to hammering causes the change in shape of iron and iron can be moulded in the shape of the required tool.

Q. 7. *An inflated balloon was pressed against a wall after it has been rubbed with a piece of synthetic cloth. It was found that the balloon sticks to the wall. What force might be responsible for the attraction between the balloon and the wall?*

Ans. Electrostatic force.

Q. 8. *Name the forces acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.*

Ans. Muscular and gravitational forces act on plastic bucket. The force acting on the bucket do not bring a change in state of motion because they are acting in opposite direction with equal magnitudes. Therefore the net force on bucket remains zero.

Q. 9. *A rocket has been fired upward to launch a satellite in its orbit. Name the two forces acting on the rocket immediately after leaving the launching pad.*

Ans. (*i*) Gravitational force (*ii*) Force of friction.

Q. 10. *When we press the bulb of a dropper with its nozzle kept in water, air in the dropper is seen to escape in the form of bubbles. Once we release the pressure on the bulb, water gets filled in dropper. The rise of water in the dropper is due to*

(a) pressure of water *(b) gravity of the earth.*

(c) shape of rubber bulb. *(d) atmospheric pressure.*

Ans. (*d*) atmospheric pressure.