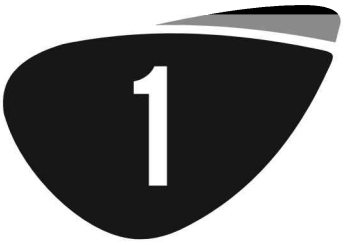

Force, Friction and Pressure

Force

- Any action which causes pull, hit or push on a body is called force.
- Unit of force in SI system is Newton and in CGS system is dyne.
- One Newton (1N) is equivalent to 10^5 dyne.

Effects of Force

Many effects of force are as given below:

(i) A force can move a stationary body.

(ii) A force can stop a moving body.

(iii) A force can change the direction and speed of a moving body.

(iv) A force can change the shape and size of a body.

Types of Forces

Forces are of two types i.e. Balanced and unbalanced forces.

(i) Balanced Forces

If the net effect of all the forces acting on an object is zero then the forces are called balanced forces.

e.g. In a tug of war (gane) when both the teams apply similar force from both sides, rope does not move either side, i.e. resultant force is zero. Hence, it is a balanced force.

(ii) Unbalanced Forces

If the net effect of all the forces acting on an object is not zero, than these forces are called balanced forces.

e.g. A boy want to relocate refrigerator in his house. He pushes the refrigerator with a small force, the refrigerator does not move due to frictional force acting in a direction opposite to the push. If he pushes the refrigerator harder, then the pushing force becomes bigger than the friction and due to this the refrigerator starts moving in the direction of push. Hence it is an unbalanced force.

Friction

- If we slide or try to slide a body over a surface, the motion is resisted by a bonding between the body and the surface. This resistance is called **friction**.
- The opposite force that comes into play when one body tends to move over the surface of another body but actually motion has yet not started is called **static friction**.
- The maximum value of the static frictional force which comes into play when a body just begins to slide over the surface of another body is called **limiting frictional force**.
- When a body moves over the other body, then the force of friction acting between two surfaces in contact in relative motion is called **kinetic friction.**
- When two bodies actually roll on each other (as in case of ball bearing), the **rolling friction** comes into play.
- When two bodies actually slide over each other, **sliding friction** comes into play.

Density

The density d of a substance is defined as the ratio of its mass to its volume. Its units is kg/m^3.

$$d = \frac{m}{V}$$

Pressure

The force acting perpendicularly on unit area of a surface is called pressure. Its unit is N/m^2 or pascal (Pa).

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} \Rightarrow p = \frac{F}{A}$$

Some Daily Life Applications of Pressure

- The handles of bags, suitcases, etc., are made broad, so that less pressure is exerted on the hand.
- Buildings are provided with broad foundations, so that the pressure exerted on the ground becomes less.
- Railway tracks are laid on cement or iron sleepers, so that the pressure exerted by train could spread over the larger area and thus pressure decreases.
- Pins, needles and nails are provided with sharp pointed ends to reduce the area and hence to increase the pressure.
- Cutting tools have sharp edges to reduce the area, so that with lesser force, more pressure could exerted.
- Pressure on ground is more when a man is walking than when he is standing because in case of walking, the effective area is less.
- Depression is much more when a man stands on the cushion than when he lies down on it because in standing case, area is lesser than in case of lying.
- The tractors have broad tyres, to create less pressure on the ground, so that tyres do not sink into comparatively soft ground in the filed.

Pressure in Fluids

- All liquids and gases are collectively called **fluids**.
- Fluids exerts pressure in all directions.
- An upward force which acts on an object when it is immersed in a liquid is called **buoyant force**.
- It is also called upthrust.

e.g. a piece of cork is held below the surface of water. When we apply a force by our thumb, the cork immediately rises to the surface. This is due to the fact that every liquid exerts an upward force on the objects immersed in it.

Floating or Sinking of Objects in Liquid

There are three conditions of floating and sinking of objects. These are

(i) If the buoyant force or upthrust exerted by the liquid is less than the weight of the object, the **object will sink** in the liquid.

(ii) If the buoyant force is equal to the weight of the object, the **object will float** in the liquid.

(iii) If the buoyant force is more than the weight of the object, the **object will rise** in the liquid and then float.

Atmospheric Pressure

- The air in our atmosphere extends upto 300 km from the surface of the earth as the air has weight.
- The whole atmosphere contains a tremendous amount of weight which in turn exerts a pressure on the surface of the earth and this pressure is known as atmospheric pressure.
- On the surface of the earth, the atmospheric pressure is maximum at the sea level. It is due to reason that the column of air above the earth is largest at sea and the magnitude of atmospheric pressure at the sea level is 101.3 kilopascal which is equal to weight of 10 elephants on each 1 m^2 area.
- As we go up from the surface of the earth then the atmospheric pressure goes on decreasing.

  It is because the weight of air above us goes on decreasing. So, the atmospheric pressure at the top of a high mountain is much less than at its base.
- A device called barometer is used to measure atmospheric pressure.

Sometimes, the pressure is expressed in terms of millimetre of mercury (mm of Hg), e.g., then atmospheric pressure on the surface of the earth at sea level is 760 mm of Hg (or 0.76 m of Hg).

Practice Exercise

1. Force is due to
(a) motion (b) an interaction
(c) collision (d) None of these

2. The CGS unit of force is
(a) Newton (b) Pascal
(c) Dyne (d) Watt

3. 1 Newton is equivalent to
(a) 10^5 dyne (b) 1 kg m/s^2
(c) Both (a) and(b) (d) 10^3 dyne

4. Which of the following is/are the examples of effects of force?
(a) A toy car starts moving when pushed
(b) Shape of dough ball changes when rolled
(c) Falling of leaves or fruits from trees
(d) All of the above

5. The force applied by the archer to stretch the bow is an example of ..... .
(a) gravitational force (b) muscular force
(c) frictional force (d) normal force

6. Force can change in
(a) length (b) volume
(c) area (d) All of these

7. Which one of the following force is a contact force?
(a) Force of gravity
(b) Force of friction
(c) Magnetic force
(d) Electrostatic force

8. The wear and tear in the machine part is due to
(a) electrostatic force
(b) muscular force
(c) frictional force
(d) gravitational force

9. If we apply oil on door hinges, the friction will
(a) increase
(b) decrease
(c) disappear altogether
(d) will remain unchanged

10. We slip on muddy road due to
(a) gravitational force (b) lack of friction
(c) excess of friction (d) density

11. The force required to overcome ..... at the instant an object start moving from ..... is a measure of ..... . On the other hand, the force required to keep the object moving with same speed is a measure of ..... Choose the correct order to fill up the blanks.
(a) friction, rest, static friction, sliding friction
(b) rest, static friction, sliding friction, friction
(c) sliding friction, rest, friction, static friction
(d) friction motion, static friction, sliding friction

12. An atmosphere
(a) is a unit of pressure
(b) is a unit of force
(c) gives us an idea of composition of air
(d) is the height above which there is no air

13. Force of 200 N is applied to an object of area 4 m^2. The pressure will be
(a) 50 Nm^{-2} (b) 30 Nm^{-2}
(c) 40 Nm^{-2} (d) 25 Nm^{-2}

14. The pressure exerted by a liquid ..... with depth.
(a) increases
(b) decreases
(c) remain same
(d) None of the above

15. The density of sea water increases as
(a) depth and salinity decrease
(b) depth decreases and salinity increases
(c) depth increases and salinity decreases
(d) depth and salinity increase

16. When a ship enters a sea from a river
(a) it rises a little
(b) it sinks a little
(c) it remains at the same level
(d) it rises or sinks depending on the material it is made of

17. The standard values of atmospheric pressure is
(a) 78 cm of Hg (b) 70 mm of Hg
(c) 45 cm of Hg (d) 76 cm of Hg

18. Inside an aeroplane, flying at a high altitude
(a) the pressure is the same as that outside
(b) normal atmospheric pressure in maintained by the use of air pumps
(c) the pressure inside is less than the pressure outside
(d) normal humidity and partial vacuum are maintained

19. Atmospheric pressure is measured with a
(a) hydrometer
(b) barometer
(c) hygrometer
(d) altimeter

20. The atmosphere exerts enormous pressure on us. But we do not feel it because
(a) we are used to it
(b) our bones are very strong and can withstand this pressure
(c) the surface area of our head is very small
(d) our blood exerts a pressure slightly more than that of the atmosphere

Answers

1	*(b)*	2	*(c)*	3	*(a)*	4	*(d)*	5	*(b)*	6	*(d)*	7	*(b)*	8	*(c)*	9	*(b)*	10	*(b)*
11	*(a)*	12	*(c)*	13	*(a)*	14	*(a)*	15	*(d)*	16	*(a)*	17	*(d)*	18	*(b)*	19	*(b)*	20	*(d)*