Chapter-3

FORCE AND PRESSURE

STUDY NOTES

FORCE

- Pushes and pulls that act on objects are called forces.
- It is denoted by F.
- It is a vector quantity
- It is having both magnitude and direction.

UNITS OF FORCE

- Kilogram force: kgf: The force required to lift an object of mass 1 kg vertically upwards is known as 1 kgf.
- Gram force: gf: The force required to lift an object of mass 1g vertically upwards is known as 1 gf.
- 1 kgf = 1000 gf.
- The SI unit of force is newton.
- 1 newton: It is the force required to move an object of mass 1 kg with an acceleration of 1 m/s^2 .
- 1 kgf = 9.8 N.
- CGS unit of force: dyne
- 1 newton = 10^5 dynes.

EFFECTS OF FORCE:

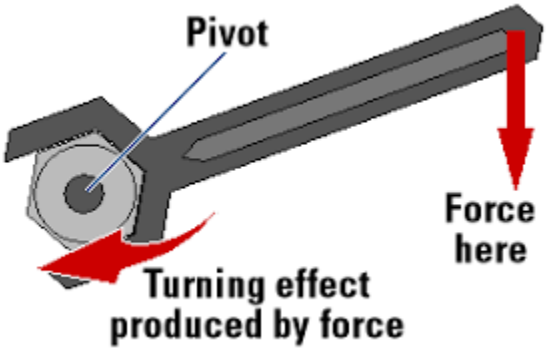
- A force can move a stationary object.
- A force can stop a moving object.

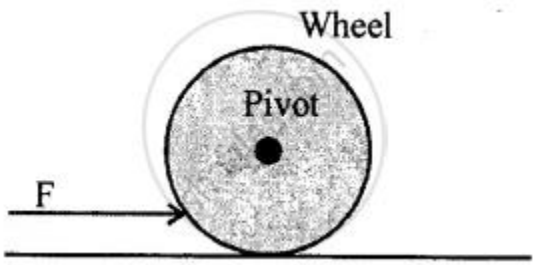
- A force can change the speed of a moving object.
- A force can change the direction of a moving object.
- A force can change the shape and size of an object.
- Force can therefore be defined as the physical quantity which changes or tends to change the state of rest, the state of uniform motion or the shape of an object.

TURNING EFFECTS OF FORCE:

A force (push or pull) has a turning effect on body which is not free to move in a straight line but is pivoted at a point about which it can turn.

- A **force** may cause an object to turn about a pivot.
- The **turning effect** of a **force** is called the moment of the **force**.
- Moments act about a pivot in a clockwise or anticlockwise direction.
- The anticlockwise moment acts downward on the left, and the clockwise moment acts downwards on the right.





Factors affecting the turning of a body:

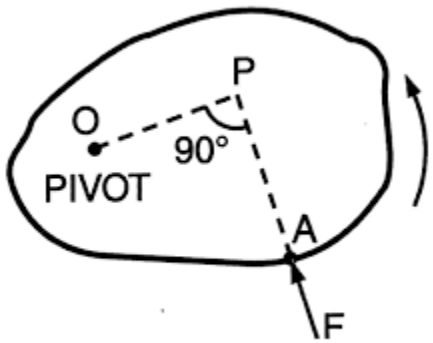
1. The magnitude of the force applied.
2. The perpendicular distance of the force from the pivoted point.

Examples:

- A person pushing a swing will make the swing rotate about its pivot.
- A worker applies a force to a spanner to rotate a nut.
- A person removes a bottle's cork by pushing down the bottle opener's lever.
- A force is applied to a door knob and the door swings open about its hinge.

Moment of a force:

The moment of a force is equal to the product of the magnitude of the force and the perpendicular distance of the force from the pivoted point.



Moment of a force

Moment of force about the point O

= F x OP

Unit of moment of force:

- SI unit: newton x metre
- CGS Unit: dyne x cm
- Nm = 10^7 dyne cm.
  - 1 kgf m = 9.8 Nm.
  - 1 gf cm = 980 dyne cm.

Pressure:

Thrust:

- The force acting normally on a surface is called thrust.
- SI unit of thrust: newton.

Effect of thrust:

- Smaller the area, larger is the effect.

Examples:

- If you stand on loose sand, your feet will sink deeply into sand, but when you lie on sand; your body does not sink much into the sand.

Definition of pressure:

- Pressure is defined as the thrust per unit area.
- P = Thrust/Area
- It is denoted by the letter P
- If the force increases, the pressure increases.
- If the area over which the force act decreases, the pressure increases.

Units of pressure:

- The SI unit of pressure is pascal.

  Pa

- It is the pressure exerted by a force of 1N acting over an area of 1 sq m.

- 1 pa = 1N/sq.m
- The atmospheric pressure is expressed in a unit atm
- 1 atm = 76 cm of mercury = 1.013 x 10^5 pa.

Factors affecting pressure:

1. On area of the surface on which thrust acts.
2. On magnitude of thrust acting on the surface.

Examples of pressure in our daily life:

- **It is easier to cut an apple with a knife.**

  The sharper the knife, the smaller is the area of contact.

  So, it exerts greater pressure, and it makes easier to cut that apple.

- **School bags have broad straps.**

  Because the area is more. So, it applies less pressure. So, the pain is less.

- **The tip of a sewing needle is very sharp.**

  So that it will have lesser area and it will exert more pressure and it will become easy to pierce a cloth.

- **Snow shoes stop you from sinking into snow.**

  Because their area of cross section is more. So they apply less pressure and prevent us from sinking into the snow.

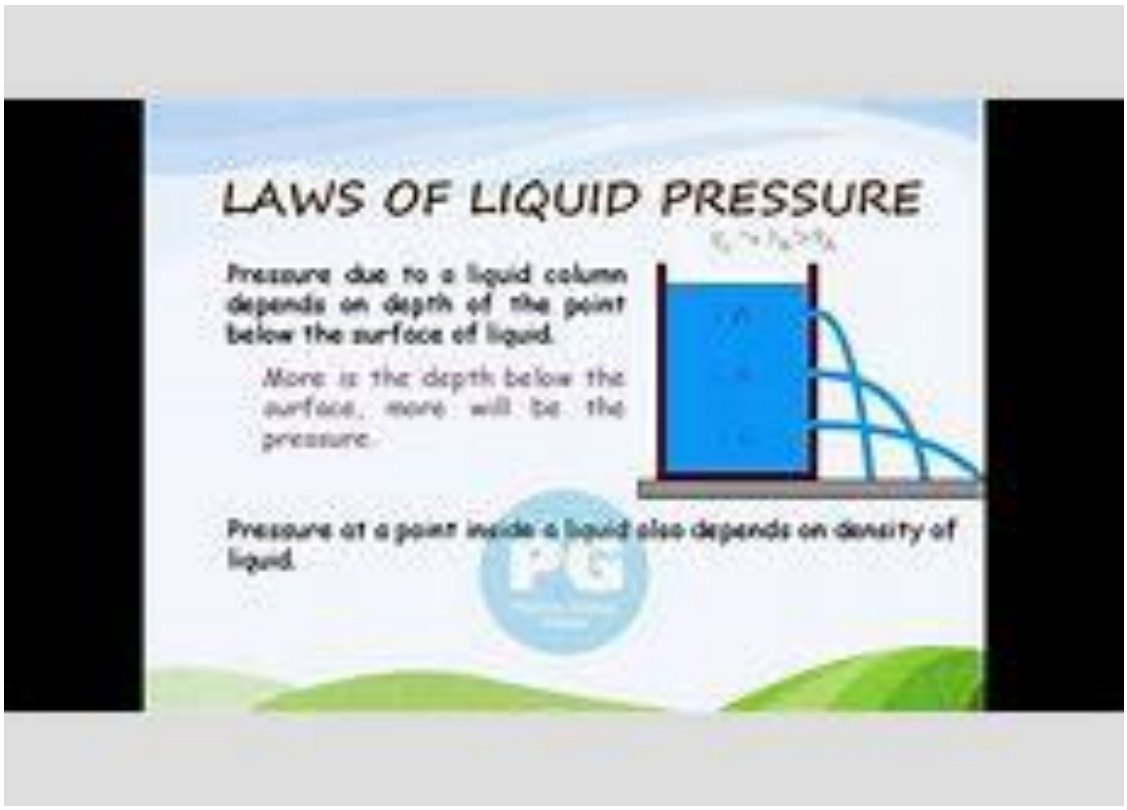
- **War tanks move on caterpillar tracks which are broad chain like covers on the wheels.**

  This causes a large increase in the area of

  Contact with the ground. Due to this, the pressure on the ground reduces so much that the tanks can even move on soft wet grounds without sinking.

Liquid Pressure

- The pressure exerted by liquid is called as liquid pressure.
- Activity to observe liquid pressure:



- A liquid exerts pressure in all directions.(downwards, upward, sideways.)
- The pressure is the same in all directions at the same depth.
- Pressure increases with depth.

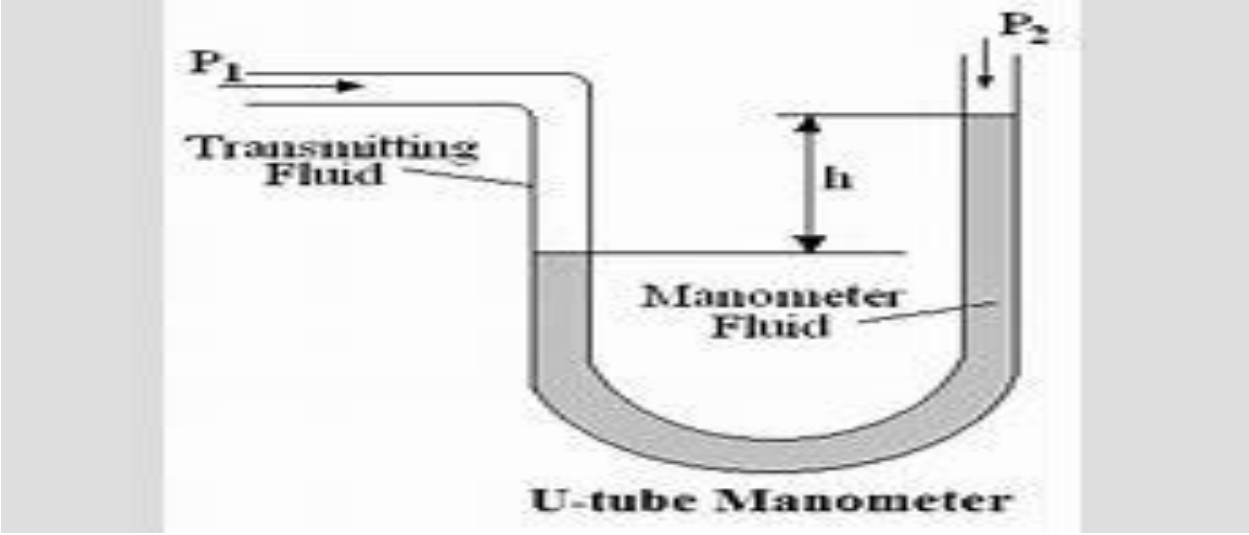
Factors affecting liquid pressure:

1. Height of the liquid column.
2. The density of the liquid.

Consequences of liquid pressure:

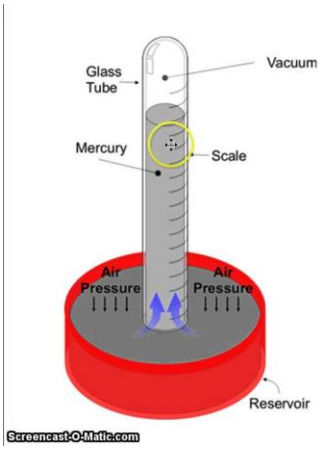
Thickness of walls of a dam is increased towards the bottom.

- Pressure is measured by using an instrument called a manometer.



Atmospheric Pressure:

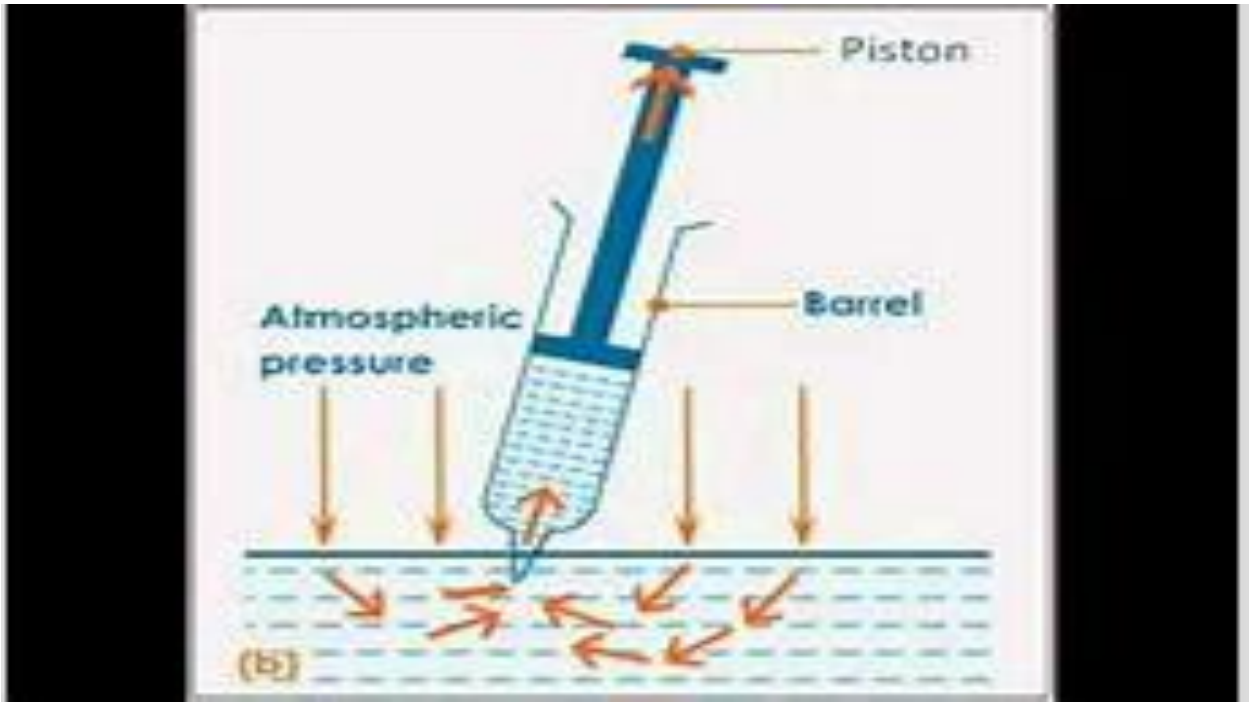
- Atmosphere: Earth is surrounded by air and this covering of air is known as the atmosphere.
- The force exerted by the atmosphere on unit area is called atmospheric pressure.
- It is measured by using a barometer



Barometer

- The drinking straw, The dropper, the syringe and different kinds of pumps use the fact: air exerts pressure.

When the air inside them is pushed out, atmospheric pressure forces the drink, ink or medicine into their barrels.



- The atmospheric pressure is maximum at sea level and reduces as we go higher up, since air becomes thinner.
- The rubber suction hooks stick to walls due to atmospheric presure.The cup is pressed against the smooth surface of a wall to drive out the air from underneath.