

Force and Pressure

Chapter 5

With respect to

Force and Pressure

at a certain point of time.

⇒ State of an object w.r.t. a reference frame h

State of rest

⇒ A body is said to be in the state of rest or stationary if it does not change its position w.r.t. its immediate fixed surrounding with passage of time.

State of motion

⇒ A body is said to be in state of motion if it change its position w.r.t. its immediate fixed surrounding with passage of time.

Force :

"Force is a cause (push, pull, stretch, squeeze) which changes or tends to change, state of rest, uniform motion, direction of motion, shape and size of the body".

Types of force

Contact force

- The force which is exerted by an object at the point of contact is called contact force.

eg.

- Muscular force / Mechanical force
- Frictional force

Non-contact force

- Force is said to be non-contact force if the object exerting it is at a distance from other object on which it is applied.
- eg. magnetic force, gravitational, electrostatic force

Muscular force / Mechanical force

⇒ The force exerted by an object ~~at~~ to make another object move is called mechanical force.

- ex.
- (i) Fixing a nail in a wall using hammer.
 - (ii) Closing and opening of a door.
 - (iii) Movement of sail boat due to wind.

② Frictional Force

→ The force which slows down the motion of a moving body when it moves over the other body.

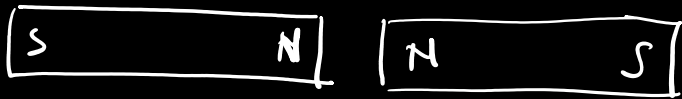
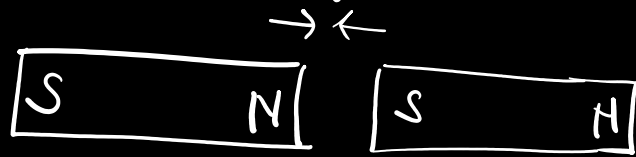
eg: ① when we drag a chair, an opposing force is applied by the floor onto the chair.

① Magnetic force :

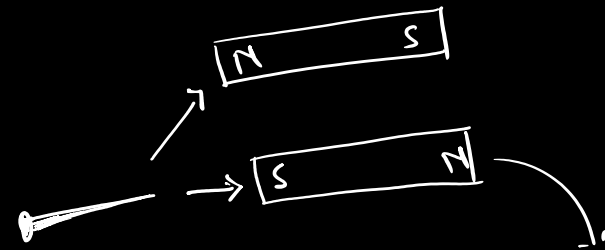
The force exerted by a magnet on another magnet
or any other magnetic material.

eg. iron

Magnetic attraction



Magnetic Repulsion




Iron nail

magnetic material

Magnet
Magnetic attraction.

② Gravitational force

→ The force of attraction between any two objects having mass is called gravitational force.

→ eg.  Every object in our surrounding is attracted by the earth.

Electrostatic Force

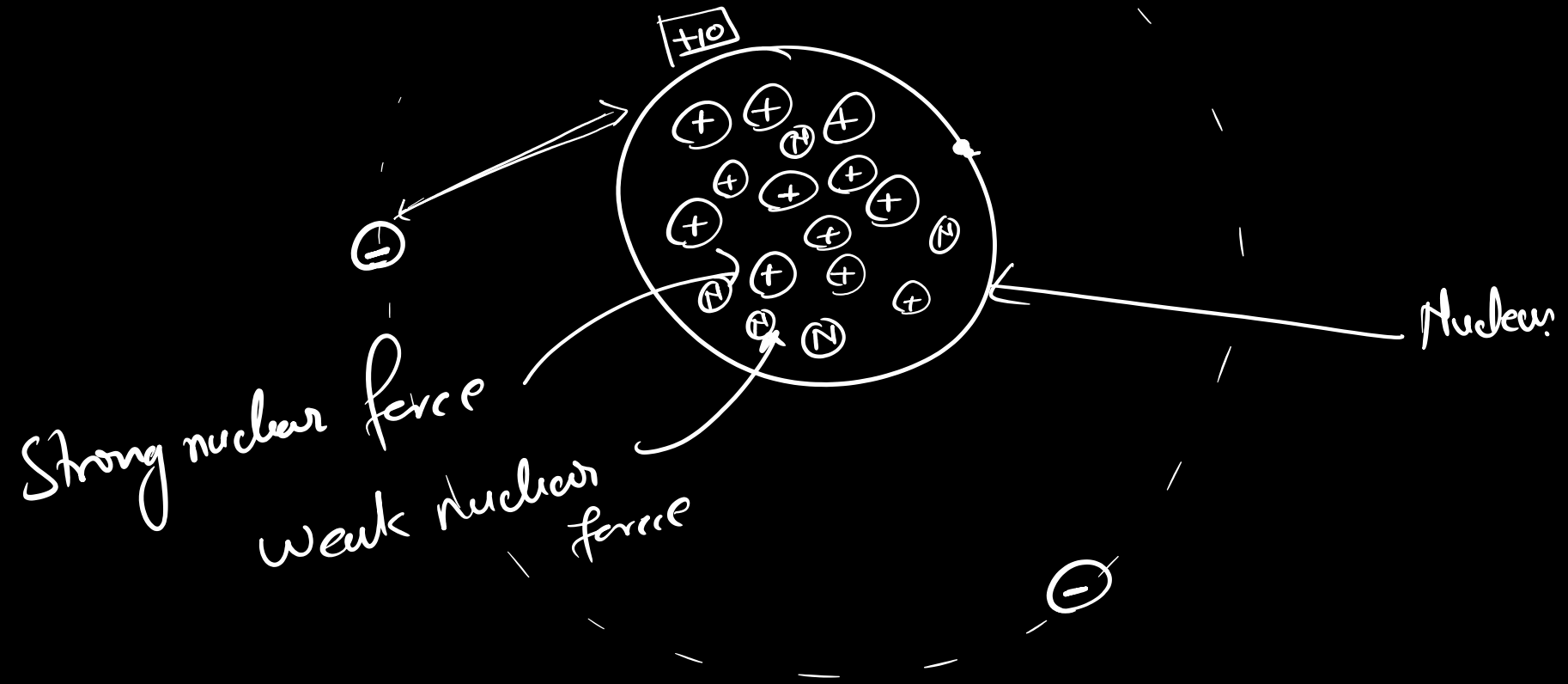
→ Force acting between two electrically charged object.

Electric charge ⇒ Two types

- Positive Charge (+)
- Negative Charge (-)

⇒ Electrostatic attraction acts between unlike charges. $\oplus \rightarrow \leftarrow \ominus$

⇒ Electrostatic Repulsion acts between like charge. $\oplus \leftarrow \rightarrow \oplus$
 $\ominus \leftarrow \rightarrow \ominus$



Size of nucleus = $\underline{\underline{10^{-15} \text{ m}}}$ = $\underbrace{0.000000000000001}_{10^{-15}} \text{ m}$

Units of force :

A force is represented by two parameters:

- (a) magnitude (Numerical value)
- (b) direction.

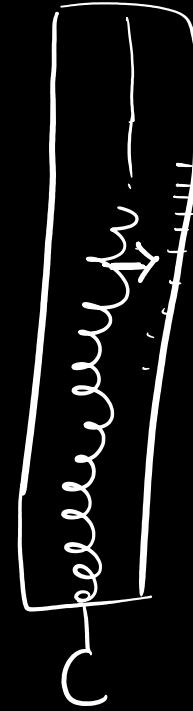
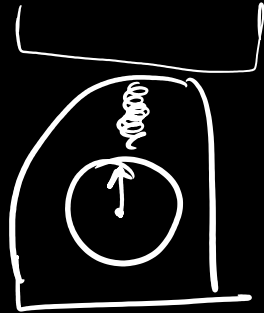
SI ~~is~~ unit of force is newton (N)

Kgf (Kilogram force) \Rightarrow unit of force

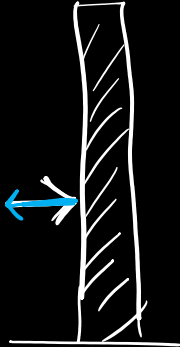
(Kilogram) \Rightarrow unit of mass

Instruments used to measure force.

⇒ Spring balance ⇒ force / weight



Action and Reaction Force

- If \bullet body 1 applies a force on another body 2,
the ~~latter~~ ^{body 2} exerts the same amount of
force on the ~~former~~ ^{body 1}, exactly in the 100N 
opposite direction.

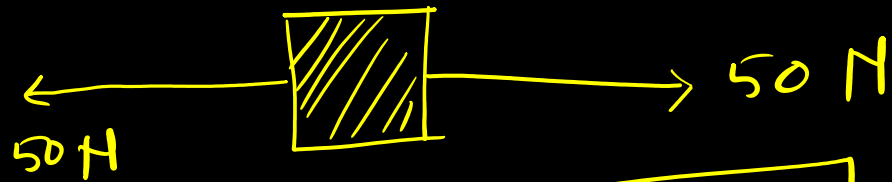
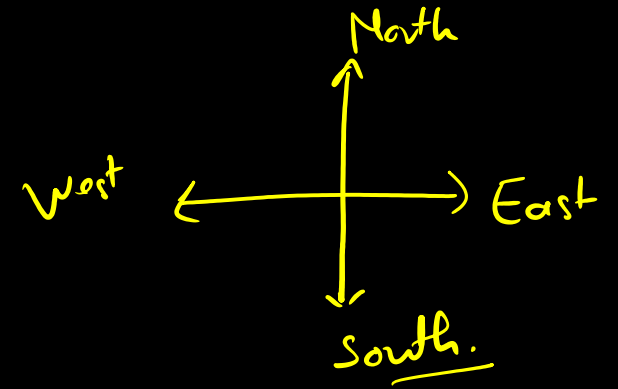
This is called action and reaction force.

" To every action force there is an equal and opposite reaction force."

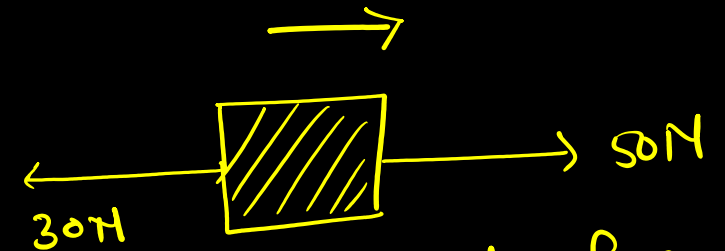
Newton's 3rd law of motion



Net effect of a force



Net effective force = 0



Net effective force
= 20 N towards east.

It can stop a moving object

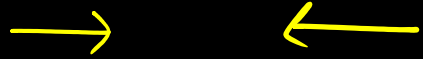
It can make stationary object move.

It can change the direction of moving object

Effects of force

It can change the speed of moving object.

It can change the shape and size of ^{an} object

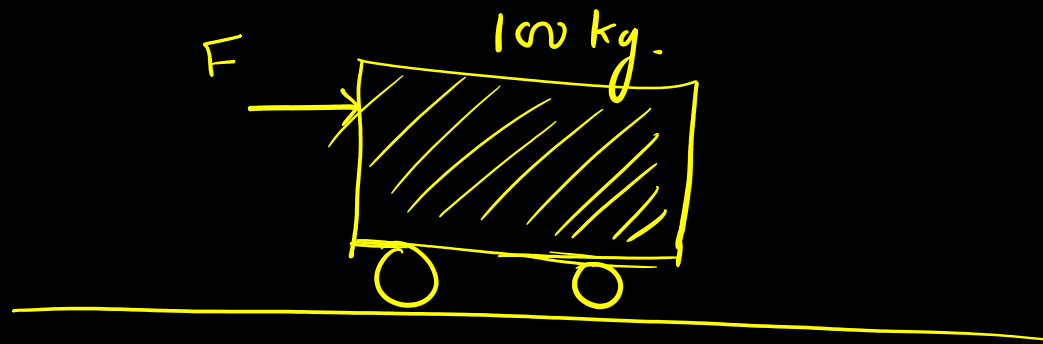


eg.

Friction

Frictional force

⇒ Resisting (opposing) force between two bodies in contact.
It prevents either body to move smoothly.



Advantages of friction

- ① We do not slip while walking because of friction.
- ② Lighting a matchstick.
- ③ we can hold pencil/pen and can write because of friction.
- ④ Cutting wood is possible because of friction between the saw and the wood.

Disadvantages of friction.

- ① Difficulty in movement.
- ② Wastage of energy to overcome friction.
- ③ Loss of energy in the form of heat.
- ④ Moving parts wear away rapidly because of friction.

Friction between two solid > Friction between two liquids > Friction between two gases.

Types of Friction

Static Friction

• exist between stationary objects.

Sliding Friction

- friction between the object sliding and the surface.

eg. Sliding on a garden slide.

Rolling friction

⇒ friction between the rolling object and the surface.

eg. A ball rolling on a ground.

Order of different types of friction.

Static friction > Sliding friction > Rolling friction

Methods to Reduce friction

- ① Use of lubricant (oil, grease, etc.)
- ② Use of ball bearings between two moving surfaces.
- ③ By polishing the surface.
- ④ Sprinkling a soft, slippery fine powder on the surface.
- ⑤ Using wheels or rollers (they reduce the contact area).

Methods to increase friction

- (i) by making the surface rough.
- (ii) by increase the mass of the object.
- (iii) by increasing the contact area between surfaces.

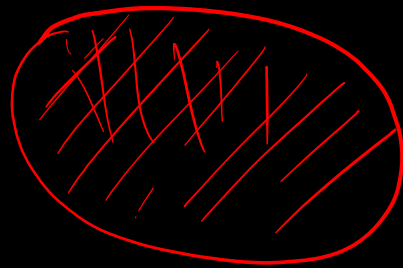
Pressure

$$\begin{array}{r} 489 \\ \times 27 \\ \hline \end{array}$$

⇒ Impact of force.

⇒ Force per unit area.

⇒ Force acting on a unit area of surface.



$$\text{Pressure (P)} = \frac{\text{Force (F)}}{\text{Area (A)}}$$

* Pressure ~~change~~ can be changed by changing force or area or both.

Pressure can be increased by increasing the force and or by decreasing the area.

→ Examples:

- ① A camel has broader feet, and hence can walk on sand more conveniently than human or horse.
- ② Knife is made sharper, hence it can cut easily.
- ③ Foundations of high rise buildings are wide.

SI Unit of pressure : $\boxed{\text{N/m}^2}$ \equiv newton per meter square.

$$\boxed{P = \frac{F}{A}} \rightarrow \frac{\text{N}}{\text{m}^2}$$

$$\boxed{\text{N m}^{-2}} \Rightarrow \underline{\text{pascal (Pa)}}$$

~~1 N/m²~~ $\boxed{1 \text{ N/m}^2 = 1 \text{ Pa}}$

End of the Chapter