Dynamics:

The branch of mechanics that deals with the study of the motion of the body along with the cause of motion is known as dynamics.

Force: Force is an external agent that changes or tends to change the state of a body.

Momentum or Linear Momentum:

Momentum of a body is defined as the total quantity of motion contained in the body. Let $'m'$ be the mass of body moving with velocity $'v'$ then,

Mathematically, $momentum\ (p) = mass\ (m) \times velocity\ (v)$

In vector form, $\vec{\boldsymbol{p}} = \boldsymbol{m}\vec{\boldsymbol{v}}$

Hence, momentum of a body is defined as the product of its mass and its velocity.

- Momentum is a vector quantity. Its SI unit is kgm/s.
- Larger the momentum, larger will be the effect of motion (momentum).
- If velocity $'v'$ is constant, $p \propto m$, it means, two objects moving with same velocity, then greater mass will have greater momentum.
- If mass $'m'$ is constant, $p \propto v$, it means, two objects having same mass, then object moving with greater velocity will have greater momentum.
- We know, $E_k = \frac{1}{2}mv^2$ and $E_k = \frac{1}{2}m^2v^2/m = \frac{\boldsymbol{p^2}}{\boldsymbol{2m}} \rightarrow \boldsymbol{p = \sqrt{2mE_k}}$

Questions:

1. *It is easier to catch a moving ball but it is almost impossible to catch a bullet fired from a gun, even the mass of bullet is much smaller than that of ball, why?*
2. *Is momentum a vector quantity? Explain.*
3. *It is easier to catch a tennis ball then a cricket ball, though both are moving with same velocity. Why?*

Impulse:

Large force acts on a body for short period of time is called impulse.

Impulse of a force is defined as the product of the average force and the time for which the force acts.

i.e. $Impulse\ (I) = Average\ force\ (F_{av}) \times time(t)$

$$\boldsymbol{I = F_{av} \times t}$$

- Example of Impulse are kicking a ball, collision of two bodies.
- Impulse gives the measurement of net effect of force.
- Impulse is mathematically equal to the change in momentum.
- Impulse is a vector quantity. Its SI unit is $Newton\ second\ (Ns)$.

Note: $Force\ (F) = \frac{Impulse(I)}{time(t)} = \frac{Cha \quad in\ momentum}{time}$

$$Force\ (F) \propto \frac{1}{time}$$

To change the momentum of a body, if we increase the time of action, less force is required. Hence, as a result it is likely to be less hurt.

Applications of Impulse: