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Impulse:-Impulse of a force means the large amount of force applied on a body in a short time. This is measured by the product of force and time for which it is applied.

$$I = \int F\,dt$$

Impulse of a force is a vector quantity and its SI unit is 1 Nm.
— If force of an impulse is changing with time, then the impulse is measured by finding the area bound by force-time graph for that force.
— Impulse of a force for a given time is equal to the total change in momentum of the body during the given time. Thus, we have

$$I = \int_{t_1}^{t_2} \vec{F}\,dt = \vec{P}_2 - \vec{P}_1 \qquad \text{(Impulse-momentum theorem)}$$

**• Law of Conservation of Momentum**
The total momentum of an isolated system of particles is conserved.
In other words, when no external force is applied to the system, its total momentum remains constant.

*i.e.*, If $F_{ext} = 0$, $\sum_{i=1}^{n} P_i = \text{constant}$ or $P = \text{constant}$

• Recoiling of a gun, flight of rockets and jet planes are some simple applications of the law of conservation of linear momentum.
• When a bullet of mass $m_b$ is fired with a velocity $\vec{v}_b$, the gun of mass $m_g$ will acquire a velocity $\vec{v}_g$ which is given by

$$\vec{v}_g = -\frac{m_b\,\vec{v}_b}{m_g}$$

The negative sign shows that direction of $\vec{v}_g$ is opposite to the direction of $\vec{v}_b$ *i.e.*, the gun recoils.
• The rocket sent up in space will acquire a velocity ($v$) which is given by

$$v = v_0 + u \log_e \frac{m_0}{m} \qquad \text{(Instantaneous velocity of the rocket)}$$

Usually, initial velocity of the rocket at $t = 0$ is zero *i.e.*, $v_0 = 0$

Thus, $$v = u \log_e \frac{m_0}{m}$$

→ Exhaust speed ($u$) of the gases.
→ Log of the ratio of initial mass ($m_0$) of the rocket to its mass ($m$) at that instant of time.

Speed of the rocket at any instant depends upon these two factors discussed above.
where, $m_0$ = initial mass of the rocket and fuel.
$\vec{v}_0$ = initial velocity of rocket
$m$ = mass of the rocket at any instant $t$ during its flight
$\vec{v}$ = velocity acquired by the rocket at that instant w.r.t. ground
• The instantaneous acceleration of the rocket is given by

$$a = -\frac{u}{m}\frac{dm}{dt}$$

where $\frac{dm}{dt}$ is the rate at which the fuel is consumed.

**• Concurrent Forces and Equilibrium**
"A group of forces which are acting at one point are called concurrent forces."
Concurrent forces are said to be in equilibrium if there is no change in the position of rest or the state of uniform motion of the body on which these concurrent forces are acting.
For concurrent forces to be in equilibrium, their resultant force must be zero. In case of three concurrent forces acting in a plane, the body will be in equilibrium if these three forces may be completely represented by three sides of a triangle taken in order. If number of concurrent forces is more than three, then these forces must be represented by sides of a closed polygon in order for equilibrium.