

Class 11 - Important Formulas

Chapter 5 - Laws of Motion

Laws of Motion

S.No.	Term	Description
1	Newton's first law of motion	'A body continues to be in state of rest or uniform motion unless it is acted upon by some external force to act otherwise'
2	Newton's second law of motion	'Rate of change of momentum of a body is proportional to the applied force and takes place in the direction of action of force applied Mathematically, $\mathbf{F} = \frac{d\mathbf{p}}{dt} = m\mathbf{a}$ where, $\mathbf{p} = m\mathbf{v}$, momentum of the body \mathbf{a} = acceleration
3	Impulse	Impulse is the product of force and time which is equal to the change in momentum $\text{Impulse} = \mathbf{F}\Delta t = \Delta\mathbf{p}$
4	Newton's third law of motion	'To every action there is always an equal and opposite reaction' $\mathbf{F}_{AB} = -\mathbf{F}_{BA}$
5	Law of conservation of linear momentum	Initial momentum = final momentum $m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = m_1\mathbf{v}_1' + m_2\mathbf{v}_2'$ For equilibrium of a body $\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 = 0$

Points to Note

S.No.	Point
1	An accelerated frame is called non inertial frame while an non accelerated frame is called inertial frame
2	Newton first law are valid in inertial frame only
3	Apparent weight of a body in the lift Going Upward with acceleration a $W = m(g + a)$ Going Down with acceleration a $W = m(g - a)$
4	Always draw free body diagram to solve the force related problems

Friction and Frame of Reference

S.No.	Term	Description
1	Friction	Frictional force acts between the bodies whenever there is a relative motion between them. When bodies slip, frictional force is called static frictional force and when the bodies do not slip, it is called kinetic frictional force.
2	Kinetic Frictional force	When bodies slip over each other $f = \mu_k N$ Where N is the normal contact force between the surface and μ_k is the coefficient of kinetic Friction. Direction of frictional force is such that relative slipping is opposed by the friction
3	Static Frictional force	Frictional force can also act even if there is no relative motion. Such force is called static Frictional force. Maximum Static friction that a body can exert on other body in contact with it is called limiting Friction. $f_{\max} = \mu_s N$ Where N is the normal contact force between the surface And μ_s is the coefficient of static Friction f_{\max} is the maximum possible force of static Friction. Note that $\mu_s > \mu_k$ and Angle of friction $\tan\lambda = \mu_s$
4	Inertial Frame Of reference	Inertial frame of references is those attached to objects which are at rest or moving at constant Velocity. Newton's law are valid in inertial frame of reference. Example person standing in a train moving at constant velocity.
5	Non Inertial Frame Of reference	Inertial frame of references is attached to accelerated objects for example: A person standing in a train moving with increasing speed. Newton's law are not valid. To apply Newton's law ,pseudo force has to be introduced in the equation whose value will be $F = -ma$