నమస్తే తెలంగాణ
నిపుణ II
Guide to Excellence
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పోటీపరీక్షల ప్రత్యేకం
శనివారం 7 అక్టోబర్ 2023

దేశంలో ఉన్న అతి పురాతన ఇంజిన్ కలిగిన రైలు పేరు?
ఫెయిరీ క్వీన్

దేశంలో మొదటి సూపర్ ఫాస్ట్ ఎక్స్‌ప్రెస్ ఏది?
రాజధాని ఎక్స్‌ప్రెస్

దేశంలో మొదటి ఎలక్ట్రికల్ రైలు ఏది?
దక్కన్ క్వీన్

దేశంలో మొట్టమొదటి గ్లాస్ రూఫ్ సీలింగ్ (విస్టాడోమ్ కోచ్) రైలు?
అరకు ఎక్స్‌ప్రెస్

For every action there is always?

PHYSICS

IIT/NEET Foundation

Dynamics

- The branch of physics that deals with study of bodies in motion with reference to force causing it is called **Dynamics.**
- The relation between force and motion caused by them was described by Sir Issac Newton in 1686. These are the basic laws of mechanics, known as Newton law of motion.

Newton's First Law : Every body continues to be in its state of rest or of uniform motion in a straight line unless it is compelled by an external force to change that state.

- Newton's First law of motion gives the concepts of force and inertia.

Force : Force is that which changes or tends to change the state of rest or uniform motion of a body.
Force can be measured as F = ma
Units for force : newton (N)

Inertia : Inertia of a body is that property by which
It opposes any change in its state
or
It is unable change its own state.
The inertia is of three types

- Inertia of rest
- Inertia of motion
- Inertia of direction

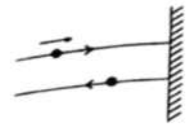
Note : More the mass, more is Inertia.

- **Newton's Second Law :** The rate of change of momentum of a body is directly proportional to the external force acting on it and takes place in the direction of the force.
- **Importance of Newton's II Law :** By Newtons second law we can measure the force. Newton's second law of motion introduces the concept of 'momentum'.
- **Momentum (P) :** Momentum is the measure of motion of a body and its magnitude. It is given by the product of the mass and velocity.
 P = mv   Units : kg m/sec
- i.e., Momentum (P) = mass x velocity and $\vec{p} = m\,\vec{v}$
- where $\vec{p}$ is called the mome - ntum of the body. Momentum is a vector having the same direction as velocity.

Units : C.G.S system → gm. cm/sec.
S.I. system → kg. m/sec.

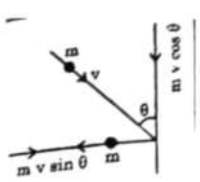
To find the change in momentum :

Case I : When a ball of mass 'm' moving with a velocity 'v' strikes a wall normally and rebound with the same speed in opposite direction, then Change in momentum
 $= P_f - P_i = mv\ (-mv) = 2mv$



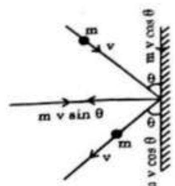
Case II: When a ball of mass 'm' moving with a velocity 'v' strikes a vertical wall making an angle 'θ' with it and rebounds with the speed parallel to the horizontal axis, then change in momentum along the horizontal axis

- $= P_f - P_i$ $mv\sin\theta - (-mv) = mv(\sin\theta + 1)$
- Change in momentum along the vertical axis $= P_f - P_i$
 $= mv\cos\theta - 0 = mv\cos\theta$



Case III : When a ball of mass 'm' moving with a velocity 'v' making an angle 'θ' with the vertical wall strikes the wall and rebounds with same speed make an angle θ with the wall as shown in fig. then

- Change in momentum along the horizontal axis $= P_f - P_i$
 $= mv\sin\theta - (-mv\sin\theta)$
 $= 2mv\ \sin\theta$
 Change in momentum along the vertical axis $= P_f - P_i$
 $= mv\cos\theta - mv\cos\theta = \theta$



➢ If two bodies have momenta P_1 and P_2 making an angle θ with each other than resultant momentum of the system is given by
$P = \sqrt{P_1^2 + P_2^2 + 2P_1\,P_2\,Cos\,\theta}$

- Newton's 1st and 3rd law can be derived from Newton's 2nd law.
- **Resultant Force :**
 When a number of forces act simultaneously on a body they can be added vectorially to give a single force, which is called the resultant force.
- If two force 'P' and 'Q' are acting on a body in the same direction their resultant is given by R = P + Q . The direction of 'R' is same as that of either 'P' or 'Q'.

- If two forces 'P' and 'Q' are acting on a body in opposite directions, their resultant is given by R = P – Q . The direction of 'R' is same as that of 'P'. Here, it is assumed that 'P' has more magnitude than 'Q'.
- If two forces 'P' and 'Q' are acting on a body in different directions that are inclined to each other at angle 'θ' , the resultant is calculates by parallelogram law.

$R = \sqrt{P^2 + Q^2 + 2PQCos\,\theta}$ If α is the angle between 'R' and 'P' , then $\tan\alpha = \frac{Q\sin\theta}{P + Q\cos\theta}$.

- If two forces each of magnitude 'F' are acting on a body in different directions that are inclined to each other at an angle 'θ', the resultant is given by

$$R = 2F\cos\left(\frac{\theta}{2}\right)$$

 and the direction is along the bisector of the angle between them.

- **Impulse :** It is defined as the product as the force and time. For a variate force
 $I = \int F.dt$
- If the force changes linearly from F1 to F_2 in a time interval Δt , then impulse $(i) = \left(\frac{F_1 + F_2}{2}\right)\Delta t$
- i.e., Impulse = force x time, I = f x t

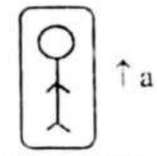
Units : kg m/sec (or) N. second
Impulse is a vector quantity. It is in the direction of the force.

- **Force–Time graph :** The area under F–t graph gives the impulse due to a variable force.
- If a force 'F_1' acts on a body at rest for time 't_1' then another force 'F_2' brings the body to rest in time 't_2' then $F_1t_1 = F_2t_2$
- a) The ratio of times when same force act on two different bodies which are initially at rest
 i) $\frac{t_1}{t_2} = \frac{m_1}{m_2}$ when they have same final velocity.
 ii) $\frac{t_1}{t_2} = \sqrt{\frac{m_1}{m_2}}$ when they have same displacement.

b) The ratio of accelerations of two different bodies when same force act on them is given by $\frac{a_1}{a_2} = \frac{m_1}{m_2}$

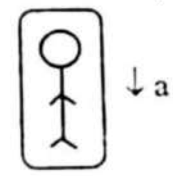
- **Newton's Third Law :** For every action there is always an equal and opposite reaction.
- Newton's third law motion leads to the formulation of the law of conservation of linear momentum.
- When the resultant external force acting on a system is zero, the total momentum of the system remains constant. This is called the "law of conservation of linear momentum".
- When a shot is fired from a gun, while the shot moves forward, the gun moves backwards. This motion of gun is called recoil of the gun. When gun of mass 'M' fires a bullet of mass 'm' with a velocity 'v' the gun recoils with a velocity 'V' given by V = mv/ M
- When a shot is fired from a gun, the kinetic energies of the shot and gun are in the inverse ratio of their masses. $\frac{K.E\ of\ the\ shot}{K.E\ of\ the\ gun} = \frac{M}{m}$
- where M is mass of the gun and m is mass of the shot.
- If gravel is dropped on a conveyor belt at a rate of $\frac{dm}{dt}$, the extra force required to keep the belt in motion
- If a liquid of density 'd' rushes out of a pipe of cross sectional area 'A' with a velocity v horizo -ntally and strikes a vertical wall. The force exerted on the wall by the impact of water is given by F= Adv² (Assume water does not rebound).

Case I : If water rebounds with same speed, the force exerted on the wall is given by, F = 2Adv²
$W^1 = m(g + a)$ (or) $W^1 = W\left(1 + \frac{a}{g}\right)$.



i.e., Apparent weight of the man increases.

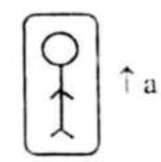
Case II : If water rebounds with a velocity v1 the force exerted on the wall is given by
$W^1 = m(g - a)$ (or) $W^1 = W\left(1 - \frac{a}{g}\right)$



i.e., Apparent weight of the man decreases.

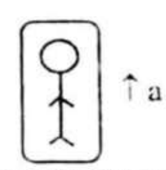
Case III : If the tube is bent at an angle θ the force exerted on the wall is given by F= Adv²sinθ.

Apparent Weight of a body in a lift :When a man of mass 'm' is inside the left, the force exserted by the floor of the lift on the man is called apparent weight. In different cases its value is given by
$W^1 = m(g + a)$ (or) $W^1 = W\left(1 + \frac{a}{g}\right)$.



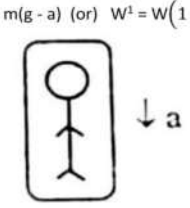
e., Apparent weight of the man increases.

Case I : When the lift is moving upwards with uniform acceleration 'a' , the apparent weight of the man is given by
$W^1 = m(g + a)$ (or) $W^1 = W\left(1 + \frac{a}{g}\right)$.



i.e., Apparent weight of the man increases.

Case II : When the lift is moving down with the uniform acceleration 'a' , the apparent weight of the body is given by
$W^1 = m(g - a)$ (or) $W^1 = W\left(1 - \frac{a}{g}\right)$



i.e., Apparent weight of the man decreases.

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