Toppersnotes®
Unleash the topper in you

GROUP - D

RAILWAY RECRUITMENT BOARD

General Science

SIERRA INNOVATIONS

Contents

Toppersnotes
Unleash the topper in you

PHYSICS

Quantity & Measurement :→

Quantity →

Anything which is expressed in number is called quantity.

Physical Quantity

Scalars

Quantities which have magnitude only

Exp:- Mass, Temperature, Density, Volume, electric current, work etc.

Vectors

Quantities which have both magnitude and direction. and represented by (→) sign. and called vectors

Exp:- Displacement, linear momentum, angular Velocity, Torque, magnatic field intensity electric displacement, current density etc.

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measurement :→

To measure any quantity

Fundamental Units

Units of

Exp:- Length, Mass, time, Temperature, Electric current, luminous Intensity, Amount of Substance.

Derived Units

Units of

Exp:- Area, Speed, density, Volume, momentum, force, acceleration etc.

System Of Units :→

Usually physical quantities are measured in 4 system of Units –

(i) CGS System (centimeters, Gram, Second)
(ii) FPS System (Foot, pound, Second)
(iii) MKS System (Meter, Kilogram, Second)
(iv) SI System (International System of Unit)

↳ Supplementary Units of SI System :→

(i) **Radian** ⇒ All plane angles are measured in radian. Symbol = rad.

(ii) **Steradian** ⇒ All the solid angles are measured in 'steradian' Symbol = 'Sr'

Fundamenta Unit			Derived Units	
Physical Quantity	SI Units	Symbol	Physical Quantity	SI Units
Length	Metre	m	Area	m^2
Mass	Kilogram	Kg	Volume	m^3
Time	Second	S	Density	Kg/m^3
Electric current	Ampere	A	Velocity	m/s
Temperature	Kelvin	θ or K	Force	Kg/m^2 or Newton
Luminous Intensity	Candela	Cd	Momentum	Kg. m/s

Amount of substance	mole	mol	Pressure	N/m^2 or Pascal
			work or Energy	N/m or Jule
			megnatic field intensity	$N\text{-}amp^{-1}m^{-1}$ or Tesla or weber/m^2
			Power	$kg\ m^2/s^3$ or Watt
			charge	amp - sec or coulomb
			Resistance	Volt/ampere or ohm

Units Of Length Or Distance :→

1 km = 1000m
1 fermi = 10^{-15}m
1 light year = 9.46×10^{15} meters
1 Angstrom = 10^{-10}m

Unit Of Mass :→

1 ounce - oz = 28.35 gm
1 pound - lb = 16 oz
1 Quintal = 100 kg
1 metric ton = 1000 kg

Units Of Time :→

1 lunar month = 28 days = 4 weeks
1 Solar month = 30 or 31 days
28 or 29 days (Feb)
1 leap year = 366 days

Units Of Area :→

1 acre = 4840 Sq. yard
= 43560 Sq. feet
= 4046.94 Sq. metre

1 hectare = 2.5 acr

Motion :→

A body is said to be in Motion. If the position of body changes with time. But if the position of body does not change with time then it is said to be in rest.

Types Of Motion :→

1. Rectilinear and Translatory Motion :→

If a body (particle) moves along a straight line then the motion is called translatory motion.
for Exp :→ Motion of a train.

2. Circular and Rotatory motion :→

If a body move along a circular path It is called circular motion But if a body rotates ~~Circular~~ about a line (axis) passing through it is called rotatory motion.

3. Oscillatory and Vibratory Motion :→

In motion in which a body (particle) moves to and fro/back and forth repeatedly about a fixed point is called Oscillatory motion.
If in Oscillatory motion the amplitude is very small then the motion of the body is called Vibratory motion.

Distance ⇒ Speed × Time
SI Unit ⇒ meter

Displacement :→

The least distance travelled by a body between the initial and final points of a straight line motion in a definite direction is called displacement.
It is a vector quantity and can be (-ve), (+ve) or Zero, its SI Unit is meter.

Velocity :→

Velocity of a body is the rate of change of its position in a fixed direction. It is a vector quantity, its value may be +ve, -ve or zero and its SI Unit is m/s

Speed :→

Total distance covered by a body between the initial and final points of a straight line in unit time is called speed of the body.

It is a scalar quantity and its SI Unit is ms^{-1}

$$\text{Average Speed} = \frac{\text{Total distance travelled}}{\text{Total time elapsed}}$$

$$\boxed{V_{av} = \frac{d}{t} \text{ m/sec}}$$

∵ d = distance
t = change in time

$$\text{Average Velocity} = \frac{\text{Total displacement}}{\text{Total time}}$$

$$V_{av} = \frac{\Delta x}{\Delta t} \frac{m}{sec}$$

∵ change in position
∵ $\Delta x = x_2 - x_1$
change in time
$\Delta t = t_2 - t_1$

Instantaneous Velo-city ⇒

Velocity of a body at a particular instant or moment of time is called instantaneous velocity.

$$\vec{V} = \lim_{\Delta t \to 0} \frac{\Delta \vec{r}}{\Delta t}$$

Acceleration :→

The rate of change of the body is called acceleration of the body. Acceleration is a vector quantity and its SI unit is ms^{-2} $\left[\frac{d\vec{v}}{dt} = \frac{d^2\vec{x}}{dt^2}\right]$

Positive Acceleration :→

If the Velocity of an object increases in the same direction the object has a positive acceleration.

Negative Acceleration :→

If the Velocity of a body decreases in the same direction the body has a negative acceleration.

Eg:- A train slows down

Relative Motion and Relative Velocity :→

The motion of an object B with respect to object A which is a moving or stationary is called as relative motion.

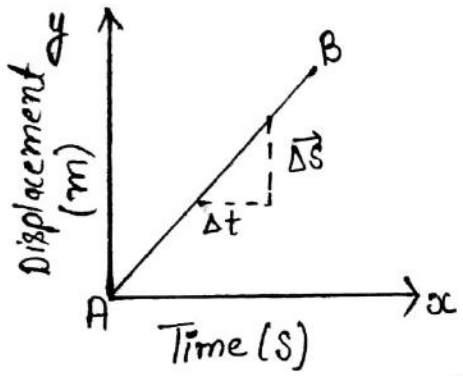
Relative Velocity of an object B with respect to object A when both are in motion is the rate of change of position of object B with respect to A.

relative Velocity $\vec{V}_{BA} = \vec{V}_B - \vec{V}_A$

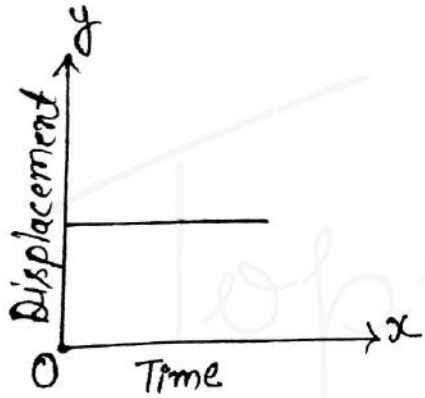
and $\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$

Graphical representation of Motion is A straight line:→

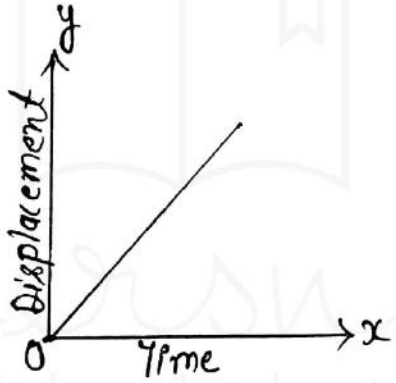
1) Displacement - time Graphs :→



$\frac{\Delta \vec{S}}{\Delta t}$



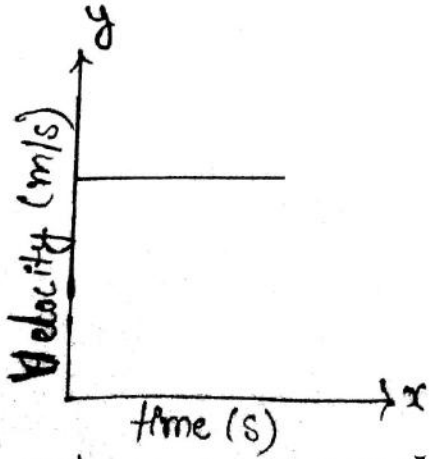
(a) Constant Velocity



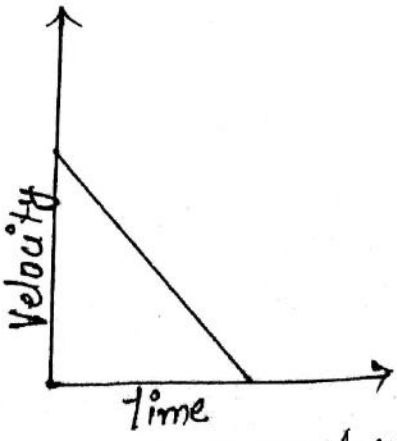
(b) Uniformly Accelerated motion

(c) Constant Accelerated motion

2) Velocity - time Graphs :→

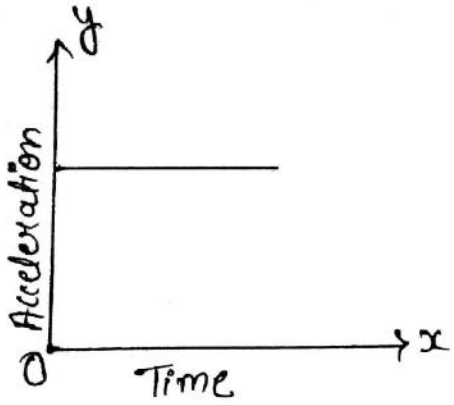


(zero) constant acceleration

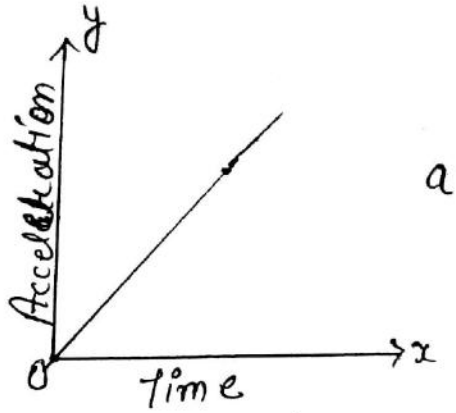


-ve acceleration

3). Acceleration - Time Graph :→



Constant acceleration



$a = \frac{\Delta V}{\Delta t}$

Rate of change of acceleration with time

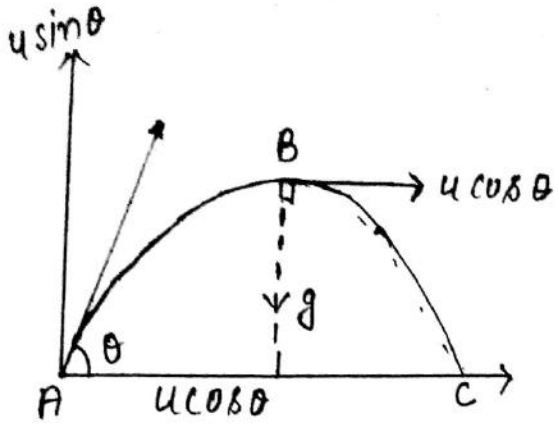
Equation of motion are -

1. $V = u + at$
2. $S = ut + \frac{1}{2}at^2$
3. $V^2 = u^2 + 2aS$

[u = initial velocity
v = final velocity
a = acceleration
t = time interval
S = Displacement]

Projectile Motion :→

Projectile refers to an object that is in flight after being thrown or projected. The motion of a projectile is called projectile motion.



Eg. • Throwing a Ball
• The motion of the earth around the Sun

Time of Ascent

$$t_a = \frac{u\sin\theta}{g}$$

Time of flight

$$t_f = \frac{2u\sin\theta}{g}$$

maximum height $H = \frac{u^2\sin^2\theta}{2g}$

Laws of Motion :→

In 1687 Sir Issac Newton propounded the 3 laws of motion.

1. First law (law of Inertia) ⇒

An object Continues in a state of rest or a state of motion unless some external force is applied to it

$$\boxed{\Sigma F = 0 \Leftrightarrow \frac{dv}{dt} = 0}$$

Eg. leaning in the opposite direction when train suddenly starts.

2. Second law (law of measurement of force) :→

The rate of change of linear momentum(P)

$$F = \frac{dP}{dt} = \frac{d(mv)}{dt} = m\frac{dv}{dt} = ma$$

of a body is directly proportional to the force applied.

3. Third law (law of the Action and Reaction) :→

The third law states that to every action, there is an equal and opposite reaction.

Exp:-

- During firing of a bullet the gun recalls back with a great force.
- Motion of rocket
- Swimming in a pond

Force :→ A force is that physical quantity which tries to change the state of rest of a body.

Units of force :→

SI Unit = Newton
CGS System = dyne
MKS System = Kilogramme force
1 Newton = 10^5 dyne

Momentum :→

momentum = product of mass and Velocity

$\vec{p} = m\vec{v}$

SI Unit = kg m/s

Example ⇉ • To hit nail in depth, a heavy hammer is used

• To avoid injuries in cricket players taking a catch move their hands in the direction of the motion of the ball.

Elastic and Inelastic Collision :→

A collision in which there is no loss of kinetic energy is called elastic collision and In an inelastic collision kinetic energy is lost during collision

Gravitational force :→

Everybody in our Universe interacts (attracts) with each other which is called Gravitation. The gravitational force is the weakes among all exiting forces.

Frictional Force :→

Friction is a resistance to the relative motion between two object in Contact.

An opposing force retards its motion and this force is called frictional force.

Types of frictional force ⇒

(a). Static frictional force
(b) Kinetic or Sliding frictional force

Centripetal force (Real force) ⇒

If m be the mass of object then it experiencess a force which directs to words the centre of the circular path and has a magnitude given by

$$F_c = ma = \frac{mv^2}{r}$$

Ex:- planetary motion of Sun and planets.

Centrifugal force / Pseudo force / fictitious force :→

The Virtual force which balances the Centripetal force in uniform circular motion is Called as Centrifugal force. It is not a real force.

Eg:-
- Cream Separator
- Washing Machine dryer
- Merry-go-round.

Moment of Inertia :→

The opposition that the body exhibits to having its speed of rotation about an axis altered by the application of a torque

$$I = mr^2$$

SI Unit $= kg\,m^2$

Radius of Gyration :→

The radius of gyration can be mathematically expressed as

$$I = MK^2$$

Redius of Gyration $K = \sqrt{\left(\frac{I}{m}\right)}$

Momentum Of Inertia of Bodies :—

1.	Circular ring	$I = MR^2$
2.	Thin circular ring	$I = \frac{MR^2}{2}$
3.	Thin rod	$I = \frac{ML^2}{12}$
4.	circular disc	$I = \frac{MR^2}{2}$
5.	circular disc	$I = \frac{MR^2}{4}$
6.	Solid cylinder	$I = \frac{MR^2}{2}$
7.	Hallow cylinder	$I = MR^2$
8.	Solid sphere	$I = \frac{2}{5}MR^2$

Work :→

Work is defined as the product of the force and displacement in the direction of the applied force.

$W = F.x = Fx\cos\theta$

SI Unit = newton-metre or Joule

Energy / Power :→

Energy is capacity to do work.

$$\text{power } (P) = \frac{\text{work done } (w)}{\text{time Interval } (t)}$$

The power of machines are expressed in Horse power (H.P)

1 HP = 74 watt

Unit for electrical-energy = Kilo watt-hour (KWh)

1 kwh = 1kw × 1 hour

= (1000 watt) × (3600 s)

= 1000 J/s × 3600 s

= 3600000 Joules = 3.6×10^6 Joule

Kinetic Energy	potential Energy
Kinetic energy of an object is the energy that it passed due to its motion. $KE = \frac{1}{2}mv^2$	potential energy is that energy which an object has because of its position $U = PE = mgh$