PHYSICS
Class – VII

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KINEMATICS SYNOPSIS - 1

1. **Mechanics :** The branch of physics which deals with the motion of objects in everyday life is called mechanics.
2. **Kinematics :** Kinematics which is derived from a Greek word kinema meaning motion, is a branch of physics, which deals with the motion of a body without taking into account the cause of motion.
3. **Rest:** An object is said to be at rest if it does not change its position with respect to its surroundings.

   Motion :A body is said to be in motion if it changes its position with respect to the surroundings with the passage of time. All moving things are said to be in motion.

   Rest and motion are relative terms.

Tom & Jerry at Rest

Tom & Jerry in Motion

Terms related to motion:

4. **Distance :** It is defined as the actual path followed by a body between the points between which its moves.It is measured in metre.

   Note: i) Distance travelled by a body never decreases with time.

   ii) The distance travelled by the body never should be zero. It is a scalar quantity.
5. **Displacement :** It is the shortest distance between two points. It is a vector quantity and for a moving body it can be positive, negative or zero.

   It is the shortest distance between initial and final point.

Difference between distance and displacement

Distance	Displacement
1. It is defined as the actual path travelled by a body	1. It is the shortest distance between two points between which the body moves.
2. It is a scalar quantity.	2. It is a vector quantity.
3. It can never be negative or zero.	3. It can be negative, zero or positive.
4. Distance can be equal to or greater than displacement. (numerical value)	4. Displacement can be equal to or less than distance. (numerical value)
5. Distance traveled is not a unique path between two points.	5. Displacement is a unique path between two points.
6. The distance between two points gives full information of the type of path followed by the body.	6. Displacement between two points does not give full information of the type of path followed by the body.
7. Distance never decreases with time. For a moving body it is never zero	7. Displacement can decrease with time. For a moving body it can be zero.
8. S.I. unit of distance is meter and C.G.S. unit is centimeter	8. S.I. unit of distance is meter and C.G.S. unit is centimeter

Note: Distance can never be negative. Displacement can be zero, Positive and negative

6) **Speed:-** The rate of change of motion is called speed. The speed can be found by dividing the distance covered by the time in which the distance is covered.

$$\text{Speed} = \frac{\text{Distance covered by an object}}{\text{Time in which the distance is covered by the object}}$$

If 'S' is the distance covered by the object in time t, such that 'v' is its speed, then $v = \frac{S}{t}$.

Speed is a scalar quantity as it has magnitude, but no specific direction.

7) **Units of speed:-** m/s (s.I system) and cm/s (C.G.S system).

8) If the distances covered are fairly large, the speed is expressed in km/h or kmh^{-1}.

9) **Uniform speed:-** When a body covers equal distances in equal intervals of time (however small the time intervals may be), the body is said to be moving with a uniform speed.

10) **Non-Uniform Speed:-** When a body covers unequal distances in equal intervals of time, the body is said to be moving with a nonuniform speed.

11) **Average Speed:-** When a body is moving with a variable speed, then the average speed of the body is defined as the ratio of total distance travelled by the body to the total time taken i.e.,

$$\therefore \text{ Average speed } = \frac{\text{Total distance covered}}{\text{Total time taken to cover the distance}}$$

IT IS A FACT
The speedometer and odometer filled in vehicles, displays the prevalling speed and distance travelled by the vehicle.

CUQ

WORKSHEET-1

1. The actual path followed by a body between two points
   1)Displacement 2) vector 3) Scalar 4) Distance
2. Displacement is a_____quantity.
   1) scalar 2) vector 3) derived 4) only magnitude of a
3. If a person could fly non - stop around the equator of earth and reaches at its initial point, the displacement is
   1) 2π radius of earth 2) 2π (radius of earth)^2
   3) diameter of earth 4) zero
4. If a body moves in a circlar path and reach back to its intial position then
   1) Magnitude of displacement is 0 2) Distance is 0
   3) Both 1 & 2 4) Distance is equal to radius
5. If the distance covered by a particle is 0 what can you say about its displacement
   1) It may or may not 0 2) It can not be 0
   3) it is negateve 4) It must be 0
6. If the displacement of a particle is 0 distance covered by it
   1) It may or may not 0 2) It must be 0
   3) it is negateve 4) All are true
7. S.I. Unit of speed
   1) m/s 2) cm/s 3) km/hr 4) m/s^2
8. Which of the following is examples of non - uniform speed?
   1) An aeroplane during take off from the run way
   2) A train running at a speed of 90 km/hr
   3) A car running at a speed of 60 km/hr
   4) An aero plane flying at a speed of 800 km/h
9. Which of the following is example of bodies moving with uniform speed?
   1) A cyclist driving on a crowded road 2) A car running at a speed of 60km/hr
   3) A car starting from rest, picking up speed
   4) An athlete, before taking a long jump (or) high jump

10. Average speed =

1) $\frac{Total\ displacement}{total\ timetaken}$ 2) $\frac{Total\ distance}{total\ timetaken}$

3) $\frac{Total\ timetaken}{Total\ displacement}$ 4) $\frac{Total\ timetaken}{Total\ distance}$

JEE MAIN & ADVANCED

LEVEL-1 Single Correct Choice Type:

1. If on a round trip one person travel 6km and arive back to his starting point then the distance travelled is _____km

   1) 4 2) 6 3) 8 4) 12

2. A particle moves in a circle of radius R. The distance covered by the particle in half of its revolution

   1) π 2) 2R 3) πR 4) R

3. The numerical ratio displacement to distance is

   1) always =1 2) always<1 3) always>1 4) may be $\leq$1

4. A train runs fast a telegraph pole in 15s with a speed of 10m/s then what is the length of the train?

   1) 150m 2) 120m 3) 70m 4)75m

5. A train is 100m long and is moving with a speed of 72km/h. The time taken by the train to cross a pole in the station

   1) 2s 2) 5s 3) 3s 4) 4s

6. A man walks for 1 minute with a speed of 1m/s and he runs for the next minute with a speed of 3m/s along a straight track. The total distance covered is

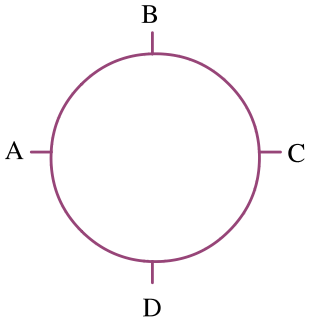
   1) 60m 2) 180m 3) 240m 4) 360m

7. A man travels 3km towords east from his house and then travels 2km towords west.Find the total distance and displacement covered by the man

   1) 2km,1km 2) 3km,4km 3) 5km,4km 4) 1km,2km

Comprehension Type:

A person is moving along a circular path of radius r with uniform speed as shown in the figure. He completes one revolution in four seconds.



8. Average speed along AB is

1) πr 2) $\frac{\pi r}{2}$ 3) $\frac{\pi r}{3}$ 4) $\frac{\pi r}{4}$

9. Average speed along AC is

1) πr 2) $\frac{\pi r}{2}$ 3) $\frac{\pi r}{3}$ 4) $\frac{\pi r}{4}$

10. Average speed for one complete revolution is

1) πr 2) $\frac{\pi r}{2}$ 3) $\frac{\pi r}{3}$ 4) $\frac{\pi r}{4}$

LEVEL-2 & 3 Single Correct Choice Type:

11. A particle moves through a distance 8m due east and then 6m due north then the magnitude of displacement is

1) 2m 2) 14m 3) 6m 4) 10m

12. A body complets one round of circle of radius 'R' in 20s . The displacement of body after 45s is

1) $\frac{R}{\sqrt{2}}$ 2) $\sqrt{2}R$ 3) $2\sqrt{R}$ 4) 2R

13. Rajadhani express moves at a speed of 120kmph how long will it take to cover a distance of 15km

1) 6.4mins 2) 2.3mins 3) 7.5mins 4) 8.3mins

14. A car is moving at a speed of 15m/s . In how much time will it cover a distance of 1.2 km

1) 70sec 2) 80sec 3) 18sec 4) 45sec

15. A bus is moving at a speed of 20m/s howmuch distance in kilometres will the bus cover in 25mins

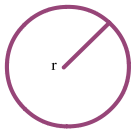
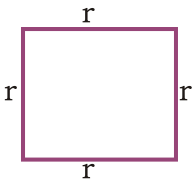
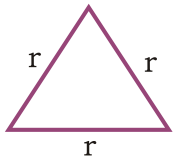
1) 30km 2) 20km 3) 40km 4) 150km

16. A scooterist covers a distance of 3km in 5mins caluculate his speed in km/hr

1) 28 2) 36 3) 42 4) 78

Matrix Match Type:

17. A body is moving along a closed path as shown in the figure and completes one rotation in 't' seconds. Its speed is

	Column - I	Column - II
a)		p) $\frac{2\,r}{2\,t}$
b)		q) $\frac{r}{t}$
c)		r) $\frac{3r}{t}$
d)		s) $\frac{4r}{t}$
		t) $\frac{2\pi r}{t}$

LEVEL-4 & 5 Single Correct Choice Type:

18. A car runs at a constant speed on a circular track of radius 100m and takes 62.8 s for every circular lap. The average speed for each circular lap is

1) 15 m/s 2) –10 m/s 3) 10 m/s 4) 0 m/s

19. A man has to go 50m due narth 40 m due east and 20m due south to reach a field what is his displacement from his house to the field

1) 110m 2) 50m 3) 25m 4) 0m-

20. A person makes one lap around a 400m circular track in 50sec .The average speed of the person is

1) 4m/s 2) 8m/s 3) 16m/s 4) 0m/s

21. If a covers 5km in one hour and stops for 30min again it starts and travels 10km in 30min .what is average speed

1) 10km/hr 2) 3km/hr 3) 4.5km/hr 4) 7.5km/hr

KINEMATICS SYNOPSIS - 2

1) **Velocity :-** Velocity is the rate of change of motion in a specified direction.
Velocity of a body is a vector quantity.
The velocity of a body can be zero, negative or positive.
The numerical value of velocity of a body can be equal to speed only if the body is moving along a straight line in the same direction.
The velocity of a body can never be greater than the speed of that body.

2) **Unit of velocity :-** The C.G.S. unit of velocity is cm/s

3) The S.I. unit of velocity is m/s
Velocity has same units as speed in C.G.S as well as in S.I. system.

Kinds of velocity :-

4) **Uniform velocity :-** When a body covers equal distances in equal intervals of time in a specified direction, (howsoever, short the time intervals may be) the body is said to be moving with a uniform velocity.

5) A body will have a uniform velocity only, if :
i) It covers equal distances in equal intervals of time, i.e., the magnitude does not change. ii) Its direction remains the same.
If any of the two conditions is not fulfilled, then the body will not be moving with a uniform velocity, but with a variable velocity.

6) **Variable Velocity:-** When a body covers unequal distances in equal intervals of time in a specified direction or equal distances in equal intervals of time, but its direction changes, then the body is said to be moving with a variablevelocity.

7) **Average velocity:-** It is the ratio of total displacement to total time taken.

$$\text{Average velocity} = \frac{\text{Total displacement}}{\text{Total time taken}}$$

8) It is possible to have a body with average velocity zero but not with average speed zero

Activity :-

Measure the time it takes you to walk from your house to your bus stop or the school. If you consider that your average walking speed is 4 km h^{-1}, estimate the distance of the bus stop or school from your house

Activity :-

At a time when it is cloudy, there may be frequent thunder and lightning. The sound of thunder takes some time to reach you after you see the lightning.

Can you answer why this happens ?

Measure this time interval using a digital wrist watch or a stop watch.

Calculate the distance of the nearest point of lightning. (Speed of sound in air = 346 m s^{-1})

1. **Acceleration:** Acceleration of an object may also be defined as the rate of the change of velocity of the object.

   i.e., Acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$

   Note: Acceleration is a vector quantity.

2. Acceleration of the body(a)= $\frac{\text{final velocity(v)} - \text{inital velocity(u)}}{\text{time taken(t)}} = \frac{v-u}{t}$

3. **Unit of acceleration :** S.I. unit of acceleration = $m/s^2 = ms^{-2}$

   C.G.S unit of acceleration = $cm/s^2 = cms^{-2}$

4. **Positive acceleration :** If the final velocity of a moving body is greater than the initial velocity, i.e., v > u then acceleration is +ve.

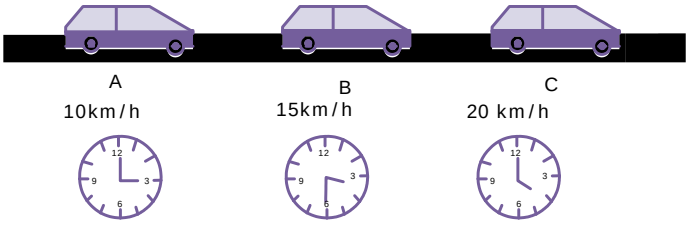
   In other words when the velocity of a body increases with time, its acceleration is positive.

5. **Negative acceleration (Retardation or Deceleration)**

   If the final velocity of a moving body is less than the initial velocity i.e., v < u then the acceleration is –ve.In other words when velocity of a body decreases with time, its acceleration is negative, negative acceleration is also called retardation.Retardation = –(acceleration).

   Example: When a ball is thrown vertically upwards, its velocity decreases with time. So the acceleration of a ball thrown vertically upwards is negative.

6. **Uniform acceleration :**



Observe the above car travelling on a straight road.

At the position A the velocity of the car is 10 km/hr

At the position B the velocity of the car is 15 km/hr

Change in velocity of car from A to B = 15 – 10 = 5 km/hr

The time taken for the velocity to change = 3 : 30 pm – 3 : 00 pm

acceleration of car = $\frac{\text{Change in velocity}}{\text{time}} = \frac{5}{1/2} = 10 \text{ km/hr}^2$

At the position c the velocity of car is 20 km/hr

Change in velocity of car from B to C = (20 – 15) km/hr = 5 km/ hr

The time taken for the change in velocity = 4 : 00 pm – 3 : 30 pm = $\frac{1}{2}$ hr

acceleration = $\frac{\text{Change in velocity}}{\text{time}} = \frac{5}{1/2} = 10 \text{ km/hr}^2$

Thus acceleration of the car is same in both the cases. We say that car is moving with uniform acceleration

7. **Non-uniform acceleration (variable acceleration):**

If the velocity of an object changes by an unequal amount in equal intervals of time, then the acceleration of the object is known as non uniform or variable acceleration.

In other words, an object having variable acceleration is known as non uniformly accelerated motion.

Activity : - • In your everyday life you come across a range of motion in which

(a) acceleration is in the direction of motion.

(b) acceleration is against the direction of motion.

(c) acceleration is uniform. (d) acceleration is non-uniform.

• Can you identify one example each of the above type of motion ?

WORKSHEET-2

CUQ 1. Rate of change of motion in specified direction is

1) Speed 2) Velocity 3) Distance 4) Displacement

2. Velocity =

1) $\frac{distance}{time\ taken}$ 2) distance X time

3) $\frac{displacement}{time\ taken}$ 4) displacement × time

3. SI unit of velocity

1) cm/s 2) cm 3) m 4) m/s

4. Velocity is a

1) Scalar 2) Vector 3) boty 1 & 2 4) None

5. Velocity of a body may be

1) Positive 2) Negative 3) Zero 4) All the above

6. In straight line motion magnitude of velocity =
   1) Distance 2) Displacement 3) Speed 4) Time
7. Acceleration =
   1) $\frac{\text{change in velocity}}{\text{time taken}}$ 2) $\frac{\text{change in speed}}{\text{time taken}}$
   3) Change in velocity × time taken 4) Change in speed × time taken
8. Acceleration is a_____
   1) scalar 2) vector
   3) fundamental quantity 4) All of these
9. The rate of continuous increase in velocity of a body is called
   1) uniform velocity 2) acceleration 3)Constant velocity 4) Retardation
10. C G S units of Acceleration
   1) m/s^2 2) km/s^2 3) cm/s^2 4) All the above

LEVEL-1 Single Correct Choice Type:

1. A body is moving with 108 km/hr then the velocity in m/s
   1) 20 2) 30 3) 40 4) 50
2. The displacement of jogger whose velocity 2 m/s in 50 s
   1) 400 m 2) 300 m 3) 200 m 4) 100 m
3. A body moving with uniform velocity of 50 m/s the velocity after 20 s
   1) 50 m/s 2) 1000 m/s 3) 1000 m/s 4) $\frac{5}{2} m/s$
4. When a car driver travelling at an initial velocity of 10m/s applies brakes and brings the car to rest in 5s, then what is acceleration?
   1) $-2m/s^2$ 2) $2m/s^2$ 3) $3m/s^2$ 4) $4m/s^2$
5. A body has an acceleration of $-3m/s^2$. What is its retardation?
   1) $3m/s^2$ 2) $4m/s^2$ 3) $0.5m/s^2$ 4) $5m/s^2$

Integer Answer Tyre:

6. If a body have initial velocity of 10 m/s and it attains a velocity of 20 m/s in 5 seconds then its accceleration is _____m/s^2

Multiple Correct choice type :

7. Unit of acceleration is
   1) m/s^2 2) cm/s^2 3) m/s 4) cm/s

LEVEL-2 & 3 Single Correct Choice Type:

8. A body is moving with an acceleration $2m/s^2$ then what is the change in velocity in 2s?
   1) 1m/s 2) 2m/s 3) 3m/s 4) 4m/s

9. If a person is travelling in a bus with a velocity 10m/s, after 10s his velocity is 10m/s then his acceleration is _____m/s^2.

   1) 2 2) 1 3) 0 4) –1

10. If a scooter acquires a velocity of 36km/h in 10s just after its start then the acceleration of scooter is

    1) $3m/s^2$ 2) $2m/s^2$ 3) $1m/s^2$ 4) ½ m/s^2

11. A passenger in a moving train tosses a coin. If the coin falls behind him, the train must be moving with

    1) an acceleration 2) a retardation

    3) an uniform speed 4) an uniform velocity

12. If the total displacement of a body is 12 m in 4 secs. Then the average velocity is _____.

    1) 3 m/s 2) 10 m/s 3) 24 m/s 4) 48 m/s

13. A car travels from station A to B at 30 kmph and then back to A at 70 kmph. Find the average velocity of the car.

    1) 35 kmph 2) 0 kmph 3) 42 kmph 4) 100 kmph

Multi Correct Choice Type:

14. Acceleration of a body can be due to

    1) change in magnitude of velocity of the body

    2) change in direction of velocity of the body

    3) change in magnitude of velocity but not in direction

    4) change in direction of velocity but not in magnitude

15. **Statement I :** Final velocity of a moving body is greater than initial velocity then acceleration is positive

    Statement II : If final velocity of a moving body is greater than initial velocity than acceleration is negetive

    1) Both statements I & II are correct 2) Both statement I & II are incorrect

    3) Statement I is correct & statement II is incorrect

    4) Statement I is incorrect & statement II is correct

LEVEL-4 & 5 Single Correct Choice Type:

16. A train is moving at a speed of 40 km/h at 10:00(hh:mm) a.m and at 50 km/h at 10:02 a.m.Assuming that the train moves along a straight track and the acceleration is constant, the value of the acceleration in km/h^2 is

    1) 100 2) 200 3)300 4)400

17. A speeding car changes its velocity from 108 km/h to 36 km/h in 4s the decelaration in m/s^2

    1) 6 2) 5 3) 4 4) 3

Matrix Match

18.

Column - I	Column - II
a) u = 5 m/s and v = 3 m/s and t = 2 sec	p) positive acceleration
b) u = 3 m/s and v = 5 m/s and t = 2 sec	q) negative acceleration
c) u = 0 m/s and v = 6 m/s and t = 3 sec	r) acceleration = 1 m/s^2
d) u = 6 m/s and v = 0 m/s and t = 2 sec	s) acceleration = 2 m/s^2
	t) magnitude of accleration = 3 m/s^2

SYNOPSIS - 3

Introduction : There are three equations for the motion of those bodies which travels with a uniform acceleration. These equations give relationship between initial velocity, final velocity, time taken, acceleration and distance travelled by the bodies. We will study these equations one by one.

1. **First Equation of Motion : (Velocity-Time relation)**

The first equation of motion is v = u + at.

It gives the velocity acquired by a body in time t.

Derivation :

Consider a body having initial velocity 'u'. Suppose it is subjected to a uniform acceleration 'a' so that after time 't' its final velocity becomes 'v'. Now, from the definition of acceleration we know that:

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \quad \text{or} \quad \text{Acceleration} = \frac{\text{Final velocity - Initial velocity}}{\text{Time taken}}$$

$$\text{So, } a = \frac{v - u}{t} \Rightarrow at = v - u \Rightarrow v = u + at$$

where v = Final velocity of the body
u = Initial velocity of the body
a = Acceleration and t = Time taken

By paying due attention to the sign of acceleration, this equation can also be applied to the problems of uniform retardation. In this case a will be replaced by –a.

2. **Second Equation of Motion(Displacement - time relation)**

The second equation of motion is: $s = ut + \frac{1}{2}at^2$.

It gives the displacement of the body in time t.

Derivation :

Suppose a body has an initial velocity 'u' and a uniform acceleration 'a' for time 't' so that its final velocity becomes 'v'.

Let the displacement of the body in this time be 's'. The displacement of the moving body in time 't' can be found out by considering its average velocity.

Since the initial velocity of the body is 'u' and its final velocity is 'v', the average velocity is given by:

$$\text{Average velocity} = \frac{\text{Initial velocity + Final velocity}}{2} = \frac{u + v}{2}$$

Also, Displacement = Average velocity × Time

So, $s = \frac{(u+v)}{2} \times t$ ———— (1)

From the first equation of motion we have, v = u + at. Substituting this value of v in equation (1), we get

$s = \frac{(u+u+at)\times t}{2}$ or $s = \frac{(2u+at)\times t}{2}$ or $s = \frac{2ut+at^2}{2}$ or $s = ut + \frac{1}{2}at^2$

where s = displacement of the body in time t u = Initial velocity of the body
a = Acceleration

Third Equation of motion : Velocity - Displacement relation

The third equation of motion is: $v^2 - u^2 = 2as$. It gives the velocity acquired by a body in displacement s.

Derivation :

Suppose a body has an initial velocity 'u' and a uniform acceleration 'a' for time 't' so that its final velocity becomes 'v'.

Let the displacement of the body in this time be 's'. The displacement of the moving body in time 't' can be found out by considering its average velocity.

Since the initial velocity of the body is 'u' and its final velocity is 'v', the average velocity is given by:

$$\text{Average velocity} = \frac{\text{Initial velocity + Final velocity}}{2} = \frac{u+v}{2}$$

Also, Displacement = Average velocity × Time. So, $s = \frac{(u+v)}{2} \times t$ ———— (1)

And from the first equation of motion we have: v = u + at or at = v – u or $t = \frac{v-u}{a}$

Putting this value of t in equation (1), we get:

$s = \frac{u+v}{2} \times \frac{v-u}{a} = \frac{v^2-u^2}{2a} \Rightarrow v^2 - u^2 = 2as$ where v = Final velocity, u = Initial velocity, a = Acceleration,s = displacement

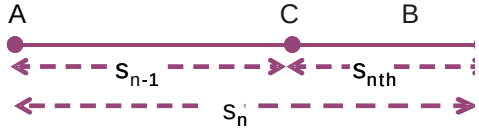
This equation gives us the velocity acquired by a body in displacement s.

Distance travelled in nth second

Consider a body moving with uniformly accelerated motion having acceleration 'a'. The distance of a particle in time 't' is given by

$S = ut + \frac{1}{2}at^2$, where u = initial velocity, at time = 0

If S_n and S_{n-1} are the distance of the particle in n and n – 1 seconds, then distance of the particle in nth second is, $S_{nth} = S_n - S_{n-1}$



$S_n = un + \frac{1}{2}an^2$ $S_{n-1} = u(n-1) + \frac{1}{2}a(n-1)^2$ Now $S_{nth} = S_n - S_{n-1}$

$$= \left(un + \frac{1}{2}an^2\right) - \left(u(n-1) + \frac{1}{2}a(n-1)^2\right) = \left(un + \frac{1}{2}an^2\right) - \left(un - u + \frac{a}{2}(n^2 + 1 - 2n)\right)$$

$$= \left(un + \frac{1}{2}an^2\right) - \left(un - u + \frac{an^2}{2} + \frac{a}{2} - an\right)$$

$$= un + \frac{1}{2}an^2 - un + u - \frac{an^2}{2} - \frac{a}{2} + an = u + an - \frac{a}{2} = u + a\left(n - \frac{1}{2}\right) = u + a\left(\frac{2n-1}{2}\right)$$

$S_{nth} = u + \frac{a}{2}(2n - 1)$ Note : If a body starts from rest, u = 0 $S_{nth} = \frac{a}{2}(2n - 1)$

WORKSHEET-3

CUQ 1. Choose the correct equation.

1) v = u + at 2) u = v + at 3) a = v + ut 4) t = u + va

2. The first equation of motion gives the relation between
   1) Velocity - time 2) displacement - time
   3) velocity - displacement 4) displacement acceleration

3. The second eqation of motion is

   1) $S = ut + \frac{1}{2}at^2$ 2) $S = ut + \frac{1}{2}at$ 3) $S = at + \frac{1}{2}ut^2$ 4) $S = au + \frac{1}{2}at^2$

4. The second equation of motion gives the relation between
   1) Velocity - time 2) displacement - time
   3) velocity - displacement 4) Velocity Acceleration

5. Choose the correct relation.
   1) Diplacement = Average velocity × time
   2) Average velocity = Displacement × time
   3) Displacement = $\frac{\text{Average velocity}}{\text{Time}}$
   4) time = Average Velocity x displacement

6. Choose the correct relation.

   1) $S = (\frac{u+v}{2}) \times t$ 2) $S = (\frac{u+t}{2}) \times v$ 3) $S = (\frac{v+t}{2}) \times u$ 4) $S = (\frac{2}{u+v}) \times t$

7. If a body moves with uniform velocity, then its acceleration is
   1) zero 2) $1 m/s^2$ 3) $2 m/s^2$ 4) $4 m/s^2$

8. Given that $S_{nth} = \frac{a}{2}(2n-1)$ [In SI units], using this equation find the initial velocity
   1) 2m/s 2) 3m/s 3) 1 m/s 4) 0 m/s

9. A body starts from rest and move along a straight line with uniform acceleration a. The distance travelled in the 5^{th} second of its motion is

1) 4a 2) 5a 3) $\frac{9a}{2}$ 4) $\frac{5a}{2}$

10. Given that $u^2 = -2as$ (In SI units), using this equation find final velocity

1) –1m/s 2) 1m/s 3) 0m/s 4) 2m/s

JEE MAIN & ADVANCE

LEVEL-1 Single Correct Choice Type:

1. Given that V = 2 + 4t, (in SI units) using this equation find initial velocity

1) 2m/s 2) 3m/s 3) 4m/s 4) 0m/s

2. Given that v = 2 + 4t (In SI units), using this equation find the acceleration

1) 2 m/s^2 2) 3 m/s^2 3) 4 m/s^2 4) 1 m/s^2

3. Given that S = $2t + \frac{1}{2}3t^2$ (In SI units), using this equation find the initial velocity

1) 2m/s 2) 3m/s 3) 4m/s 4) 0m/s

4. Given that $S = 2t - \frac{1}{2}3t^2$ (In SI units), using this equation find the acceleration

1) $2m/s^2$ 2) $3m/s^2$ 3) $-3m/s^2$ 4) $-2m/s^2$

5. Given that $S = \frac{1}{2}at^2$ (In SI units), using this equation find the initial velocity

1) 1m/s 2) –1m/s 3) 0m/s 4) 2m/s

6. Given that V = 5 + 8t (In SI units) the final velocity after 5 sec is

1) 35 m/s 2) 40 m/s 3) 45 m/s 4) 50 m/s

Multiple Correct choice type :

7. The equation of motion is taken in the form of $v^2 - x^2 = 2bs$. Where 'v', 'x' are final and initial velocities respectively, b is acceleration and 's' is displacement. then $\left(\frac{x}{b}\right)$ represents

1) time 2) acceleration 3) $\frac{s}{v}$ 4) $\frac{v}{s}$

LEVEL-2 & 3 Single Correct Choice Type:

8. Choose the correct statement for the equation $V = V_0 + at$

1) It is a linear equation
2) It is true for uniform motion
3) It is true for any type of motion along a straight line
4) It is true for uniformly accelerated motion

9. A car moving with a speed of 15 m/s can be stopped by applyingbrakes, after travelling a distance of 3m. The retardation of the car is

1) $37.5 m/s^2$ 2) $47.5 m/s^2$ 3) $57.5 m/s^2$ 4) $67.5 m/s^2$

10. A bus travelling with a velocity of 36 kmph is brought to rest by applying brakes. It experiences a uniform retardation of $4 m/s^2$. Before coming to rest, it travels a distance of

1) 0.5 m 2) 12.5 m 3) 7 m 4) 0.6 m

Matrix Match Type:

11. A car running at 72 kmh^{-1} is slowed down to 18 kmh^{-1} by the application of brakes over a distance of 20 m.

Column - I	Column - II
a) Initial velocity of the car in m/s	p) 20
b) Total time in which car stops in s	q) 1.6
c) Total distance covered by it before coming to rest in m	r) 2.13
d) De-acceleration of the car in m/s^2	s) 9.375
	t) 21.34

LEVEL-4 & 5 Single Correct Choice Type:

12. An object undergoes an accelerations of $8 m/s^2$ starting from rest find the distance travel in 1sec .

1) 2 m 2) 4 m 3) 3 m 4) 5 m

13. A particle initially at rest starts moving with a uniform acceleration 'a' the ratio of distances covered by it in the first and in the first three sec is

1) 1 : 3 2) 1 : 5 3) 1 : 7 4) 1 : 9

14. If a body having an initial velocity of 10 m/s, moves with a uniform acceleration of $10 m/s^2$, then the final velocity when it covers a distance of 3m is

1) 12.64 m/s 2) 14.2 m/s 3) 13.25 m/s 4) 15.25 m/s

15. A particle starts from rest with uniform acceleration it travels a distance of 'X' in the first two sec and a distance of 'Y' in the first 4 sec. Then

1) Y = X 2) Y = 2X 3) Y = 3X 4) Y = 4X

Comprehension Type:

Equation of motion in kinematics is $S = ut + \frac{1}{2}at^2$ where S is distance travelled by the body t is time, u is the initial velocity, a is the acceleration of the body. If distance travelled by the body is given by $2S = (10t + 5t^2)m$, then

16. Acceleration of the body is

1) 2.5m/s^2 2) 5m/s^2 3) 1m/s^2 4) 10m/s^2

17. Initial velocity of the body is

1) 10 m/s 2) 5 m/s 3) 5 m/s 4) 10m/s^2

KINEMATICS_KEY

WORKSHEET-1

CUQ:

1.	4	2.	2	3.	4	4.	1	5.	4
6.	1	7.	1	8.	1	9.	2	10.	2

JEE MAINS AND ADVANCED:

1.	4	2.	3	3.	4	4.	1	5.	2
6.	3	7.	1	8.	2	9.	2	10.	2
11.	4	12.	2	13.	3	14.	2		
15.	1	16.	2	17.	a-t; b-s; c-r; d-p,q				
18.	3	19.	2	20.	2	21.	4		

WORKSHEET-2

CUQ:

1.	2	2.	3	3.	4	4.	2	5.	4
6.	3	7.	1	8.	2	9.	2	10.	3

JEE MAINS AND ADVANCED:

1.	2	2.	4	3.	1	4.	1	5.	1
6.	2 m/s^2	7.	1,2	8.	4	9.	3	10.	3
11.	1	12.	1	13.	2	14.	1,2	15.	3
16.	3	17.	2	18.	a-q; b-p,r; c-p,s; d-q,t				

WORKSHEET-3

CUQ:

1.	1	2.	1	3.	1	4.	2	5.	1
6.	1	7.	1	8.	4	9.	3	10.	3

JEE MAINS AND ADVANCED:

1.	1	2.	3	3.	1	4.	3	5.	3
6.	3	7.	1,3	8.	4	9.	1	10.	2
11.	a-p,r; b-q; c-s; d-t			12.	2	13.	4	14.	1
15.	4	16.	2	17.	2				

HEAT
SYNOPSIS-1

THERMOMETRY:

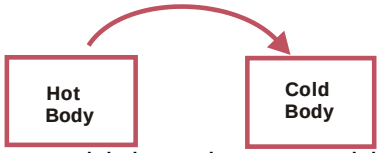
The study of measurement of temperature is called thermometry:

General effects of heat energy :

(a) Heat energy brings about change in temperature
(b) Heat energy brings about change in dimensions
(c) Heat energy brings about change in state
(d) Heat energy affects living beings

Flow of heat energy : Heat flows from a hot body to a cold body. A body which is losing heat is feeling the other body to be cold. a body which is gaining heat is feeling the other body to be hot. Thus heat always flows from a body of higher temperature to the body at lower temperature.

Concept of Heat : Heat is a form of energy which always flows from a hot body to a cold body.



(or) Heat is a form of energy which makes any object hot or cold. Heat energy is also called thermal energy.

Unit of Heat :

S.I. unit of heat is joule(J).

Another commonly used unit of heat is calorie (cal).

One calorie is the quantity of heat energy required to raise the temperature of 1g of water through 1° C.

1 cal = 4.2 J, 1 k.cal = 1000 calories

Note : (i) As heat is a form of energy. So, its unit is same as energy.
(ii) It is a scalar quantity.

Temperature :

The degree of hotness or coldness of the body is called temperature.

Mathematically, Temperature is heat per unit mass.

Unit of temperature :

S.I. unit of temperature is kelvin (K).

Other unit of temperature is degree Celsius (°C) and degree Fahrenheit (°F).

Note :

(i) It is a scalar quantity.

(ii) Thermometry is the branch of heat dealing with the measurement of temperature.

Thermometer :

The device for measuring the temperature of a substance is called a thermometer. ("thermo' is a Latin word which means heat and 'meter' means a measuring device).

The earliest thermometer was developed by Galileo in 1593. Galileo's thermometer was based on the property of expansion of a gas (like air) on heating.

Construction of Thermometer

The construction of thermometer involves two steps

Step I : Calibration of thermometer.

The calibration of thermometer involves fixing of two points on it.

One lower fixed point and other upper fixed point.

Lower fixed point: The melting point of pure ice at normal atmospheric pressure is taken as lower fixed point (L.F.P).

Upper fixed point : The boiling point of pure water at normal atmospheric pressure is taken as upper fixed point (U.F.P).

Freezing and Boiling point :

The lower fixed point of thermometer scale is the temperature of melting ice (ice point). It is given a value of 0°C. The upper fixed point of a thermometer scale is the temperature of boiling water. It is given a value of 100°C (Steam point)

Different scales of temperature :

There are following four scales of temperature in common use :

1. Celsius scale or Centigrade scale
2. Fahrenheit scale
3. Kelvin scale or absolute scale
4. Reaumur scale

1. Celsius scale or Centigrade scale :

This scale was devised by Anders Celsius in the year 1710. On this scale, ice point is taken as 0°C and steam point is taken as 100°C. The fundamental interval is divided into 100 equal parts (divisions). Each division corresponds to a difference of temperature of 1°C (one degree of celsius).

Note : A degree on celsius scale is $\frac{1}{100}$th part of the interval between the ice point and steam point

2. Fahrenheit scale :

This scale was devised by Gabriel Fahrenheit in the year 1717. On this scale, ice point is taken as 32°F and steam point is taken as 212°F. The fundamental interval is divided into 180 equal parts (division). Each division corresponds to a difference of temperature of °F (one degree of Fahrenheit).

Note : The degree on Fahrenheit scale is $\frac{1}{180}$th part of the interval between the ice point and the steam point.

3. Kelvin scale :

This sale of temperature was given by Lord Kelvin (1824 – 1907) and is also known as

Kelvin scale of temperature. On this scale, ice point is taken as 273 K and steam point is taken as 373K. The fundamental interval is divided into 100 equal parts (division). Each division corresponds to one Kelvin.

Note :

1) A degree on Kelvin scale is $\frac{1}{100}$th part of the interval between the ice point and the steam point.

2) The size of 1 degree on the kelvin scale is the same as the size of 1 degree on the celsius scale.

Absolute zero of temperature :

The temperature of –273°C or zero degree on Kelvin scale is called as "Absolute Zero" of temperature. It is the lowest attainable temperature.

0°C = 0 + 273K = 273 K,

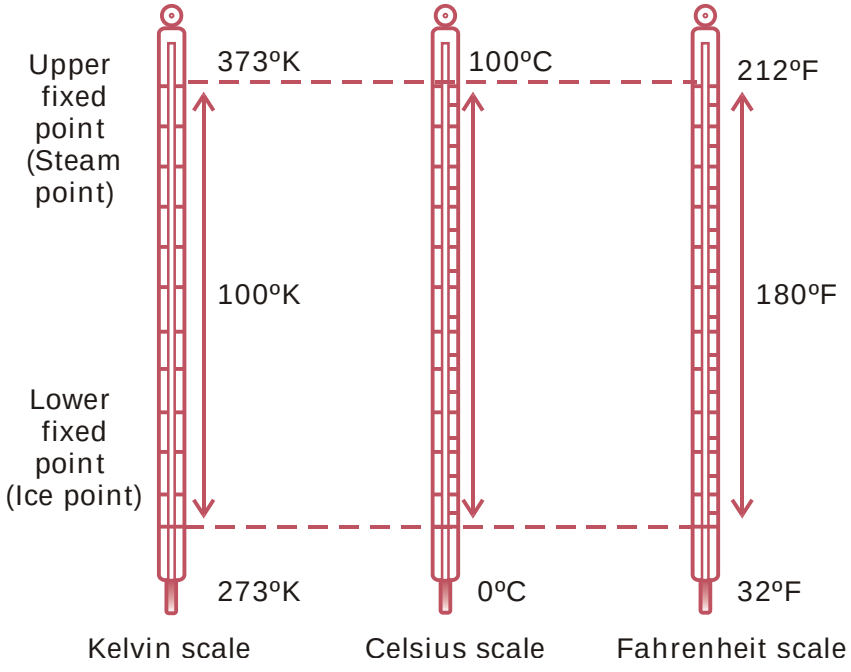
–273 °C = –273 + 273K = 0 K

4. Reaumur scale :

This scale was devised by R.A. Reaumur in the year 1730.

The interval between the lower and the upper fixed points is divided into 80 equal parts.Each division is called one degree Reaumur (1°R). On this scale, the melting point of ice at normal pressure is 0°R. This is lower fixed point. The boiling point of water at normal pressure is 80°R. This is the upper fixed point.

Note : A degree on Reaumur scale is $\frac{1}{80}$th part of the interval between the ice point and the steam point.



Different temperature scales

Parameters of different temperature scales :

Temperature scale	Lower fixed point (Ice point)	Upper fixed point (Steam point)	No. of division on fundamental interval
1. Celsius scale	0°C	100°C	100
2. Fahrenheit scale	32°F	212°F	180
3. Kelvin scale	273K	373K	100
4. Reaumer scale	0°R	80°R	80

Relation between Celsius and Fahrenheit scales of temperature :

From the lower and upper fixed points on the two scales, we can write

Ice point = 0°C = 32°F

Steam point = 100 °C = 212 °F

As the fundamental length between the two standard fixed points is same, we can say.

100°C – 0°C = 212°F – 32°F

100°C = 180 °F

$$1°C = \frac{180}{100}\,°F \qquad \Rightarrow 1°C = \frac{9}{5}\,°F$$

Thus, the size of a degree on the Celsius scale is larger than that on the Fahrenheit scale. Therefore, 1 division on the Celsius scale is equal to 180/100 divisions on the Fahrenheit scale.

Conversion of temperature from one scale to another scale :

Whatever may be the scale of temperature used from experiments it is concluded that,

$$\frac{\text{Thermometre Reading} - \text{Lower fixed point}}{\text{no. of divisions}} = \text{constant}$$

Therefore, in order to convert temperature from one scale to another, following relation is used.

$$= \frac{\text{Temperature on other scale} - \text{Lower fixed point}}{\text{Upper fixed point} - \text{Lower fixed point}}$$

$$= \frac{(\text{Temperature on first scale}) - \text{L.F.P}}{\text{U.F.P} - \text{L.F.P}}$$

$$= \frac{(\text{Temperature on second scale}) - \text{L.F.P}}{\text{U.F.P} - \text{L.F.P}}$$

$$\therefore \frac{C-0}{100-0} = \frac{F-32}{212-32} = \frac{K-273}{373-273} = \frac{R-0}{80-0}$$

$$\text{i.e.,} \frac{C}{100} = \frac{F-32}{180} = \frac{K-273}{100} = \frac{R}{80} \quad \text{i.e.,} \frac{C}{5} = \frac{F-32}{9} = \frac{K-273}{5} = \frac{R}{4}$$

HEAT WORKSHEET-1

CUQ

1. The degree of hotness or coldness of the body is called
   1) heat 2) temperature 3) pressure 4) force
2. Galileo's thermometer was based on the property of expansion
   1) gases 2) liquids 3) solids 4) both (2) and (3)
3. S.I unit of temperature is
   1) Kelvin 2) Celcius 3) Fahrenheit 4) Reaumer
4. Temperature is a _____ quantity
   1) vector 2) scalar
   3) both (1) and (2) 4) Neither a vector nor a scalar
5. The melting point of Ice on celsius scale is _____°C.
   1) 0 2) 32 3) 273 4) 80
6. The melting poine of Ice on Fahrenheit scale is _____ °F.
   1) 0 2) 32 3) 273 4) 80
7. The melting point of ice on kelvin scale is:
   1) 0 K 2) –273 K 3) 373 K 4) 273 K
8. The boiling point of water, on fahrenheit scale is
   1)32°F 2) 98°F 3) 100°F 4) 212°F
9. The no. of divisions between U.F.P and L.F.P on Fahrenheit scale is
   1) 100 2) 180 3) 80 4) 120

JEE MAIN & ADVANCED

LEVEL-1 Single Correct Choice Type:

1. Heat always flows from
   1) higher temperature to lower temperature
   2) lower temperature to higher temperature
   3) sometimes higher to lower and lower to higher temperature
   4) none of these
2. 1 cal = _____
   1) 1.8 J 2) 2.4 J 3) 4.2 J 4) 5.1 J
3. A 1K rise in temperature is
   1) the same as a 1°C rise in temperature
   2) the same as a 1°F rise in temperature
   3) more than a 1°C rise in temperature
   4) less than a 1°F rise in temperature

4. The relation between the Celsius and Fahrenheit temperature scales is

1) $\frac{C-100}{212}=\frac{F-18}{32}$ 2) $\frac{C}{100}=\frac{F-32}{180}$ 3) $\frac{C}{15}=\frac{F-32}{9}$ 4) $\frac{C-32}{100}=\frac{F}{180}$

5. The quantity of heat energy required to raise the temperature of 1g of water through 1° C is _____.

1) 1 kelvin 2) 1 calorie 3) 1 joule 4) all of these

Multi Correct Choice Type:

6. Choose the correct statements:

1) S.I. unit of temperature is kelvin
2) Temperature is a scalar quantity.
3) S.I. unit of heat is joule(J).
4) 1 cal = 4.2 J

Reasoning Type:

7. Statement I : The melting point of pure ice at normal atmospheric pressure is taken as lower fixed point.

Statement-II : one calorie is the quantity of heat energy required to raise the temperature of 1g of water through 1ºC.

1) Both statements I and II are correct.
2) Both statements I and II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

8. Statement I : A degree on Kelvin scale is $\frac{1}{100}$th part of the interval between the ice point and the steam point.

Statement II : A degree on Reaumur scale is $\frac{1}{80}$th part of the interval between the ice point and the steam point.

1) Both statements I and II are correct.
2) Both statements I and II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

Matrix Match Type:

9. Match the following given scales with corresponding division of their fundamental interval.

Column-I	**Column-II**
a) Celsius scale	1) 100 divisions
b) Fahrenheit scale	2) 180 divisions
c) Kelvin scale	3) 212 divisions
d) Reaumer scale	4) 80 divisions
	5) Each division is 1 R

LEVEL-2 & 3 Single Correct Choice Type:

10. Thermometre works on the principle of
    1) substances expands on heating 2) substances contracts on heating
    3) substances have no effect on heating 4) None of these
11. If a body is at a temperature higher than the room temperature the level of mercury in the thermometer's stem
    1) falls 2) remain at the same position
    3) rises 4) may rise or fall
12. 5°F equals to
    1) –50°C 2) –25°C 3) –15°C 4) –10°C
13. Express 100° F in degree celsius.
    1) 37.8°C 2) 40°C 3) 80°C 4) 32°C
14. What is the temperature of Fahrenheit scale corresponding to $-10^{o}C$
    1) 14°F 2) –14°F 3) 22°F 4) 24°F
15. The temperature of a body rises by $40^{o}C$. How much is the increase in Fahrenheit scale.
    1) 8°F 2) 40°F 3) 62°F 4) 72°F
16. At what temperature the scales on celcius and fahrenheit read same
    1) 40 2) 45 3) 0 4) 32

Integer Answer Type:

17. 1 kilo calorie = _____ calories

LEVEL-4 & 5 Single Correct Choice Type:

18. If 1 cal = 4.2 J, then 1 K cal = _____ J.
    1) 420 2) 4200 3) 42000 4) 42
19. The temperature of which Fahrenheit and reaumur scale read the same is
    1) –25.6 2) –20.6 3)25.6 4) 20.6

Multi Correct Choice Type:

20. choose the correct option :
    1) Teperature is a scalar quantity
    2) Heat energy is also called thermal energy
    3) The device for measuring the temperature of a substance is called a thermometer
    4) Temperature of a body decides the direction of heat flow from thebody

HEAT WORKSHEET-1_KEY

CUQ: 1) 2 2) 1 3) 1 4) 2 5) 1 6) 2 7) 4 8) 4 9) 2

JEE MAIN AND ADVANCED:

1) 1 2) 3 3) 1 4) 2 5) 2 6) 1,2,3,4 7) 1
8) 1 9) a-1;b-2;c-3;d-4,5 10) 1 11) 3 12) 3
13) 1 14) 1
15) 4 16) 1 17) 1000 18) 2 19) 1 20) 1,2,3,4

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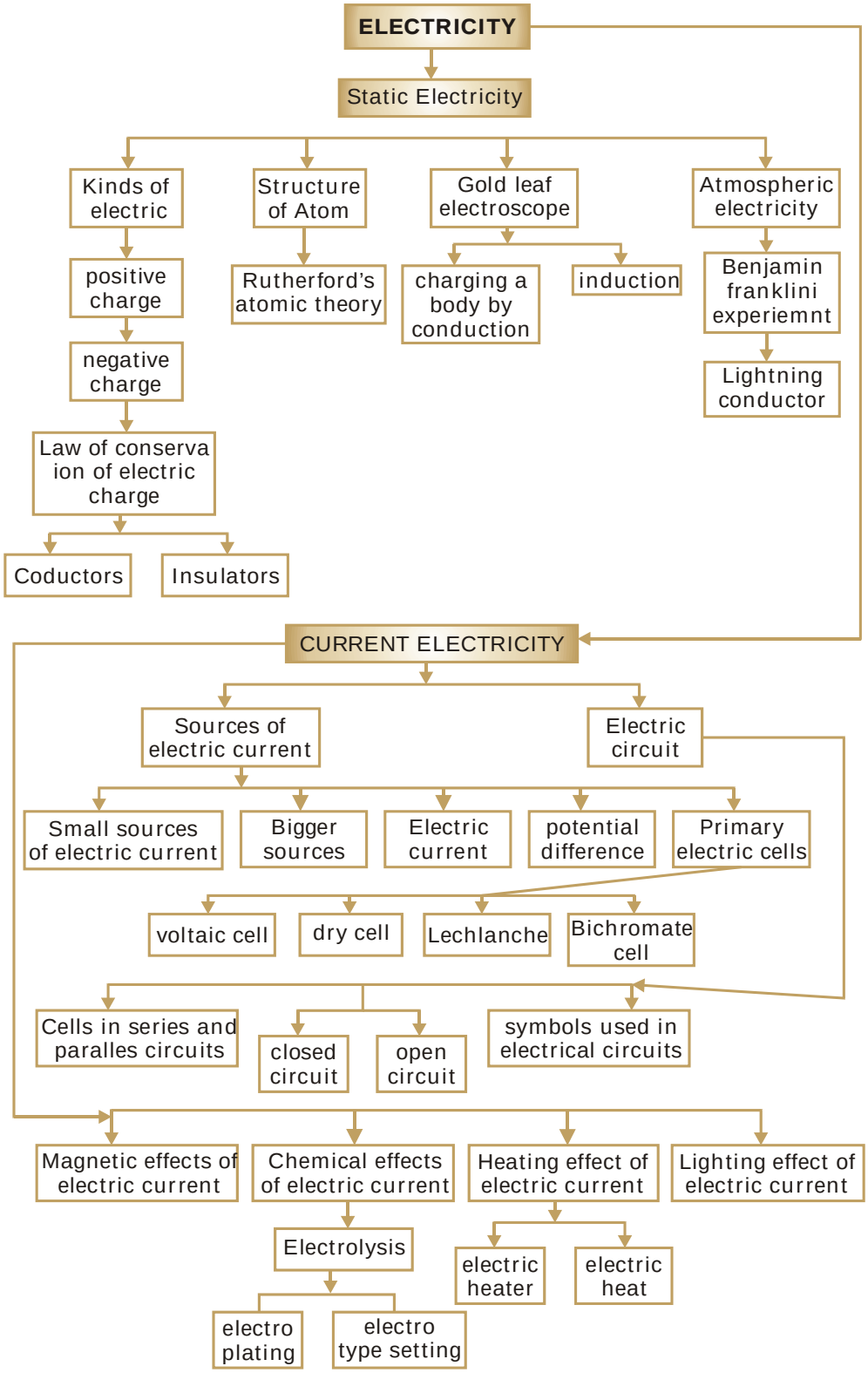
CONTENTS

MEMO GRAPH


ELECTRICITY
Static Electricity
Kinds of electric
positive charge
negative charge
Law of conserva ion of electric charge
Coductors
Insulators
Structure of Atom
Rutherford's atomic theory
Gold leaf electroscope
charging a body by conduction
induction
Atmospheric electricity
Benjamin franklini experiemnt
Lightning conductor
CURRENT ELECTRICITY
Sources of electric current
Small sources of electric current
Bigger sources
Electric current
potential difference
Primary electric cells
voltaic cell
dry cell
Lechlanche
Bichromate cell
Electric circuit
Cells in series and paralles circuits
closed circuit
open circuit
symbols used in electrical circuits
Magnetic effects of electric current
Chemical effects of electric current
Electrolysis
electro plating
electro type setting
Heating effect of electric current
electric heater
electric heat
Lighting effect of electric current

ELECTRICITY

KNOW YOUR SCIENTIST

Charles Augustine Coulomb (1736 - 1806)

Charles Augustine Coulomb (1736 - 1806)

(born June 14, 1736, Angoulême, France — died Aug. 23, 1806, Paris) French physicist. After serving as a military engineer in the West Indies, he returned to France in the 1780s to pursue scientific research. To investigate Joseph Priestley's law of electrical repulsions, he invented a sensitive instrument to measure the electrical forces involved. A light rod made of an insulator, with a small conducting sphere at each end, was suspended horizontally by a fine wire so that it was free to twist when another charged sphere was brought close to it. By measuring the angle through which the rod twisted, Coulomb could measure the repulsive forces. He is best known for formulating Coulomb's law. He also did research on friction of machinery, on windmills, and on the elasticity of metal and silk fibres. The coulomb, a unit of electric charge, was named in his honour.

ELECTRICITY — SYNOPSIS-1

Amber, known as Electron in Greek language, is a kind of fossilled gum having a straw yellow colour. Ancient Greek philosopher Thales found out that when amber is rubbed with wool, it develops a strange property of attracting tiny bits of dry paper, dry straw, dry pieces of leaves, etc., towards itself.

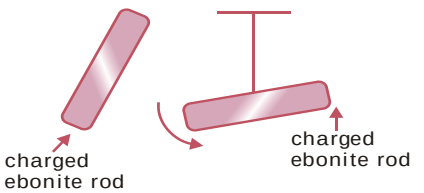
Later some time in seventeenth century, Dr. Gilbert reconstructed the experiment of Thales. He showed that not only amber and wool combination, but many other combinations like ebonite rod and cat's skin, glass rod and silk, sealing wax and wool, etc., also develop similar properties when rubbed with each other.

The substances which acquire this strange property of attraction were said to be charged with electricity or electrified (from the Greek word Elektron).

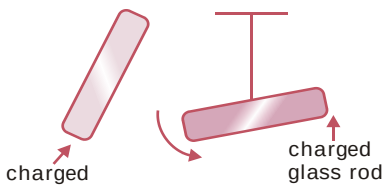
The phenomenon due to which a suitable combination of bodies, on rubbing, gets electrified is called electricity.

TWO KINDS OF ELECTRIC CHARGES

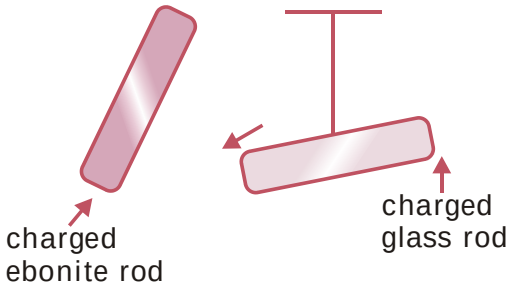
Having found that a number of bodies can be charged by] rubbing with suitable material, Dr. Gilbert set out to find the] nature of electric charge on the bodies. He took glass rod and silk as one combination and cat's skin and ebonite rod as another combination.



The suspended and charged ebonite rod shows repulsion
Experiment - 1, Figure -1



The suspended and charged glass rod shows repulsion
Experiment - 2, Figure - 2



The suspended and charged glass rod shows attraction
Experiment - 3, figure - 3

Experiment 1

Take an ebonite rod and rub it with cat's skin. Suspend it freely by a silk thread- from some support. Bring near this suspended rod, another ebonite rod, which is rubbed with cat's skin. It is observed that "the suspended ebonite rod gets repelled as shown in Figure-1.

Experiment 2

Take a glass rod and rub it with silk and suspend it freely by a silk thread. Near this suspended rod, bring another glass rod which is rubbed with silk. It is observed that suspended glass rod gets repelled as shown in Figure-2.

Experiment 3

Take a glass rod and rub it with silk and suspend it freely by a silk thread. Bring near it an ebonite rod which is rubbed with cat's skin. It is observed that glass rod is attracted by ebonite rod as shown in Figure-3.

From experiments 1 and 2, it is clear that when two bodies have similar charges they repel each other as similar charges on glass rod or ebonite rod repelled each other. From experiment 3, it is clear that charges on the glass rod are not similar to charges on ebonite rod because, instead of repulsion, attraction takes place.

By doing a series of experiments Gilbert was able to establish that whenever a body got electrically charged due to friction then its charge resembled either to the charge produced on the ebonite rod or to the charge produced on the glass rod.

Charged glass rod

Now it is quite inconvenient to say that a body has a charge similar to ebonite rod or charge similar to glass rod. Thus, it was decided to give symbols the charges on ebonite rod and glass rod. These days the charge produced on he glass rod is called positive charge (+), whereas the charge produced on ebonite rod is called negative charge (—).

STRUCTURE OF ATOM

Where do these electric charges come from? Why do the bodies get electrified on rubbing? The answers to these questions were found in the beginning of the twentieth century with the discovery of structure of atom. We now study about the atom and its structure.

Before the beginning of the twentieth century, it was believed that atom is he smallest unit of matter which cannot be broken. Furthermore, it was believed that atoms of same element are alike in all respects, whereas the atoms different elements are different in all respects.

However, in the beginning of the twentieth century a series of experiments showed that an (atom is made of three kinds of sub-atomic particles. Furthermore, these sub-atomic particles are common to all elements, irrespective of the chemical properties of elements. One kind of sub-atomic particle was found to have a charge similar to the charge produced on ebonite rod. They were named electrons and the charge on them was considered negative.

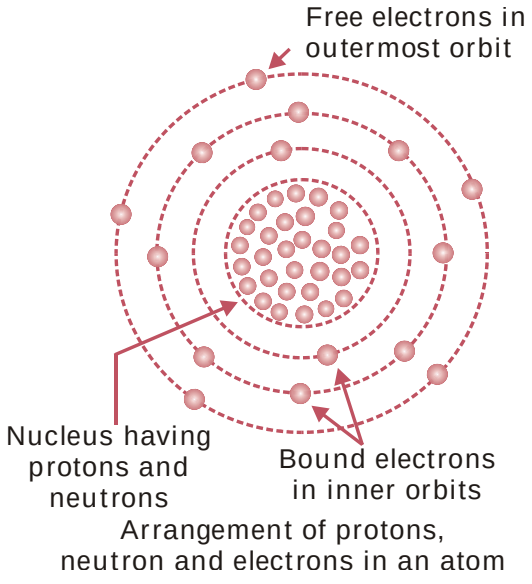
Second kind of sub-atomic particles were found to have a charge similar to the charge produced on glass rod. They were named protons and the charge on them was considered positive. Third kind of sub-atomic particles were found to have no charge, but their mass was equal to the mass of proton. They were named as neutrons.

Furthermore, as the charge on the protons and electrons very small, scientists supposed that charge on each particle is one unit. It means an electron has -1 unit charge and a proton has + 1 unit charge. These charges are equal and opposite.

How these particles are arranged in an atom? It was a big mystery as we know that the positive charge cancels the negative charge. Rutherford proposed the theory for the arrangement of sub-atomic particles which is called Rutherford's atomic theory.

Following are the important points of Rutherford's atomic [theory:

1. An atom consists of three sub-atomic particles, i.e., neutrons, protons and electrons.
2. i) Neutron has no electric charge on it. It has a mass almost equal to mass of one atom of hydrogen.
   ii) Proton has a unit positive charge on it. It has a mass almost equal to mass of one atom of hydrogen.
   iii) Electron has a unit negative charge on it. Its mass $\frac{1}{1837}$ times the mass of one atom of hydrogen.



Arrangement of protons, neutron and electrons in an atom

3. Protons and neutrons form the central core of atom which is commonly called nucleus. The protons and neutrons held together by strong attractive forces called nuclear forces.
4. The electrons revolve around the nucleus in fixed orbit much the same way as planets revolve around the Sun. The electrons close to the nucleus are held strongly by electric pull of protons. These electrons are called bound electrons.

   However, the electrons away from the nucleus experience very little attractive force. Thus, the electrons revolving around the nucleus in the outermost orbit are held by weak force. Such electrons are called free electrons.
5. As the atom of a normal element is electrically neutral therefore it is believed that the number of protons in an atom is equal to the number of electrons.

HOW DO SUBSTANCES GET ELECTRICALLY CHARGED ON RUBBING?

The free electrons (the electrons which are present in the outermost of an atom) are responsible for the electrification of a body.

When two bodies (say body A and body B) are rubbed against each other,] the free electrons of one body (say body A), get transferred to the other body (say body B).

The body A (on losing electrons) has less number of electrons than the number of protons in its nucleus. Thus, on the whole, the body positively charged.

Thus, we can say that positive electrification of the body is due to the deficiency of electrons as compared to normal number of electrons in a neutral atom.

Similarly, the body B, (on gaining electrons) has more negative charges as compared to positive charges in the nucleus. Thus, on the whole, the body gets negatively charged.

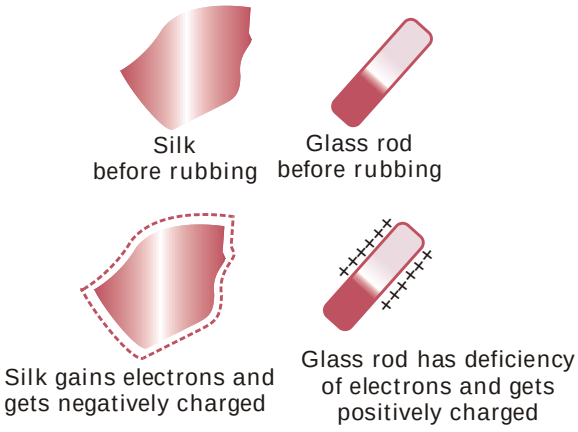
Thus, we can say that negative electrification of a body is due to the excess of electrons as compared to normal number of electrons in neutral atom.

It must be remembered that during positive or negative electrification, it is the electrons and not the protons which get transferred.

Furthermore, if one body gets charged positively due to rubbing, then the body which is used for rubbing gets charged negatively at the same time. In other words, equal and opposite charges are produced at the same time.

LAW OF CONSERVATION OF ELECTRIC CHARGES

It states that the sum total of electrons in a system, is a constant quantity. However, when two bodies in a system are rubbed against other then electrons from one body may get transferred to the other body.



For example, when a glass rod is rubbed with silk, then some electrons from glass rod are transferred to silk. As glass rod develops a deficiency of electrons it gets positively charged. Silk after rubbing has excess of electrons, and hence, gets negatively charged.

Similarly, when an ebonite rod is rubbed with cat's skin, then some of the electrons from cat's skin are transferred to ebonite rod. As the cat's skin has a deficiency of electrons it gets positively charged. The ebonite rod has an excess of electrons, and hence, gets negatively charged.

However, the sum total of electrons in the system of silk and glass rod, or ebonite rod and cat's skin remains same, and hence, electric charges are conserved.

Conductor

A substance, which has a large number of free electrons, such that they start drifting from one end of a substance to the other end, when it is connected to some source of electricity is called conductor.

Ebonite rod gains electrons and gets negatively charged. All metals solutions of acids in water solutions of alkalis in water solutions of soluble salts in water are conductors.

Insulator

A substance, which has few free electrons, such that they do not easily drift from one end of substance to the other end, when connected to some source of electricity, is called insulator.

Substances like alcohol, ether, benzene, chloroform, mica, sugar, starch, wool, fur, ebonite, glass, diamond, rubber, plastics, silk, sulphur, sealing wax; wood are insulators.

ELECTRICITY — WORKSHEET-1

CUQ

1. A pair of substances that on rubbing with one another developed electric charge was discovered by Greek philosopher Thales. The pair was of :
   1) Amber and wool 2) Amber and silk
   3) Amber and ebonite 4) Wool and glass
2. The phenomenon due to which two suitable bodies on rubbing with each other develop the property of attracting small objects around it, is called
   1) electricity 2) atomic theory
   3) both (1) and (2) 4) neither (1) nor (2)
3. The subatomic particles of an atom are :
   1) electrons 2) protons 3) neutrons 4) all of these
4. The protons and neutrons are held firmly in the nucleus by strong :
   1) nuclear forces 2) gravitational forces
   3) magnetic forces 4) both (2) and (3)
5. The electrons revolving close to the nucleus of an atom are called :
   1) free electrons 2) bound electrons
   3) both 1 & 2 4) neither (1) nor (2)
6. The electrons revolving around the nucleus in the outer most orbit are called :
   1) Free electrons 2) bound electrons
   3) both 1 & 2 4) neither (1) nor (2)

JEE MAINS

LEVEL-1 Single Correct Choice Type:

1. Static electricity can be produced by

   1) friction 2) chemical reaction

   3) Both (1) and (2) 4) Neither(1) nor (2)

2. When a comb rubberd on hair it brought near the bits of paper , it attracts them,the reason is

   1) The comb and the paper bits gets oppositely charge

   2) The comb and the paper bits gets similerly charged

   3) The paper bits are very light 4) None of these

3. When a negatively charged body is brought near a suspended positively charged ball , the ball gets

   1) attracted 2) repelled 3) stay at same place 4) none of these

4. Electric charge can flow through

   1) Insulators 2) Conductors

   3) both conductors and insulators

   4)Neither conductors and insulators

5. When a body gains electrons due to friction, it is said to be

   1) Negatively charged 2) positively charged

   3) Both (1) and (2) 4) Neither (1) nor (2)

JEE ADVANCED

Multi Correct Choice Type:

6. Which of following are conductors of electricity

   1) Silver 2) Copper 3)Wood 4) Pure water

Reasoning Type:

7. Statement I : insulators do not allow flow of current through themselves
   Statement II : They have no free charge carriers

   1) Both Statements I and II are correct.

   2) Both Statements I and II are incorrect.

   3) Statement - I is correct, Statement - II is incorrect.

   4) Statement - I is incorrect, Statement - II is correct.

Comprehension Type:

When two bodies are charged by rubbing against each other, they acquire equal and opposite charge.

8. If a glass rod is rubbed with silk, then the charge acquired by the silk is
   1) Positively 2) Negatively
   3) Uncharged 4) Partly positive and partly negative
9. If a glass rod is rubbed with silk, then the charge acquired by the glass rod is
   1) Negatively 2) Positively
   3) Uncharged 4) Partly positive and partly negative
10. Ebonite rod is rubbed with cat's skin, then the change acqired by the cat's skin is
   1) Positively 2) Negatively
   3) Uncharged 4) Partly positive and partly negative

Matrix Match Type:

11.

Column-I	Column-II
a) Good conductor of electricity	1) Wool
b) Excess of electrons	2) Positively charged
c) Deficiency of electrons	3) Copper
d) Insulator	4) Negatively charged
	5) wood

Integer Answer Type:

12. The mass of electron is equal to the x/1837 times the mass of one atom of hydrogen. then the value of x is_____

Multi Correct Choice Type:

13. Which of the following is insulator?
   1) Sulphur 2) Benzene
   3) Alcohol 4) solution alkalis in water
14. Nucleas consists of
   1) protons 2) neutrons 3) electrons 4) free electrons

SCIENTIFIC FACT

What is superconductivity

At low temperatures, metals have high conductivity of electricity, showing low resistance to the passage of current. The electrical resistance of metals decreases with decrease in temperature. Superconductivity reveals that it is not confined to a few metals or alloys, but may be present in all metals and alloys provided they can be cooled to temperatures nearer absolute zero K. Onnes noticed that at 4.2K the electrical resistance of pure mercury (Hg) became nil and the metal acquired that property to superconductivity. The temperature at which the metal acquires high conductivity or superconductivity is known as transition temperature (TE). It has been illustrated that a current of about 1000 ampere passing through a tin wire at about 3K shows no heating at all.

ELECTRICITY SYNOPSIS - 2

Primary Electric cells:

Voltaic cell, Lechlanche cell, Dry cell and Bichromate cell are few examples of Primary electric cells.

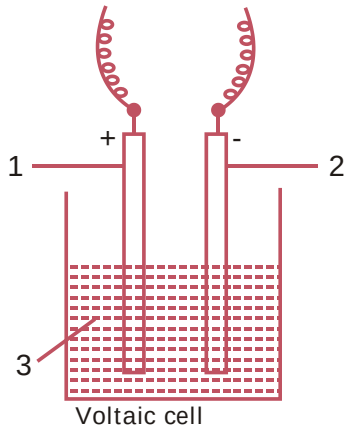
1. Voltaic cell : In 1786 an Italian scientist Voltair, invented the first electric cell. It is known as Voltaic cell.

Construction of a voltaic cell:

1) Take a glass jar and pour dilute sulphuric acid up to 3/4 of the jar.

2) Take a copper plate and a zinc rod and put them in the jar such that half of each of them is immersed in the acid.

3) Take two copper wires and connect each of them to the copper plate and the zinc rod.



Voltaic cell
1. copper sheet(+)
2. zinc sheet(-)
3. dilute sulphuric acid

4) Electricity flows through these wires and if you connect these wires to a electric bell, it rings continuously.

5) In the cell, the copper plate is the positive pole and the zinc rod is the negative pole. The dilute sulphuric acid is called the exciting fluid or electrolyte.

Defects :

Local action : Local action due to impure zinc can be prevented by amalgamating the zinc rod with mercury.

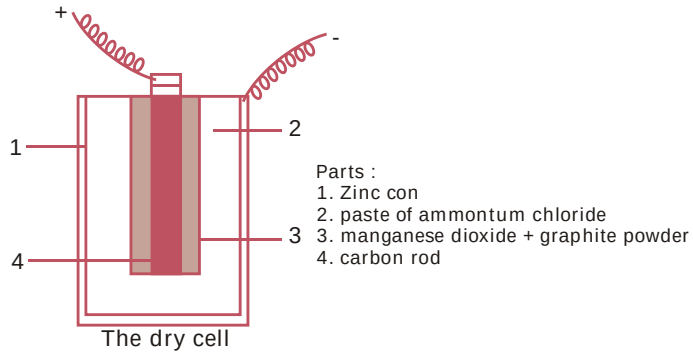
Polarisation : Polarisation is the liberation of hydrogen and it can be removed by using oxidising agents or depolarisers like potassium dichromate, copper sulphate or manganese dioxide.

2. Construction of a dry cell:

1) A dry cell consists of a cylindrical zinc can.

2) In the middle of this zinc can, there is a carbon rod with a brass cap.

3) The zinc can acts as the negative pole and the carbon rod acts as the positive pole.



The dry cell

4) A thick paste of manganese dioxide and graphite powder is packed round the carbon rod. In the next layer, another thick paste of ammonium chloride is packed in the zinc can.

5) To prevent ammonium chloride and manganese dioxide from mixing up with each other, one or two layers of cloth or paper is placed.

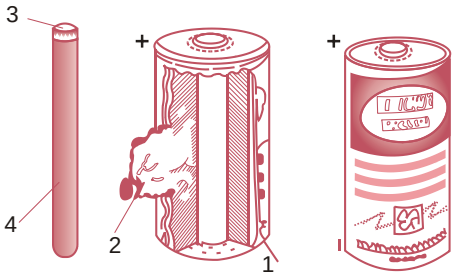
6) Again adjust the length of the carbon rod such that it does not touch the bottom of the zinc can.

7) A piece of cardboard is also put under the carbon rod for this purpose.

8) All the chemicals and carbon rod are sealed with saw dust and pitch. The cell is a modified form of a Lechlanche cell with no liquid in it.


ACTIVITY

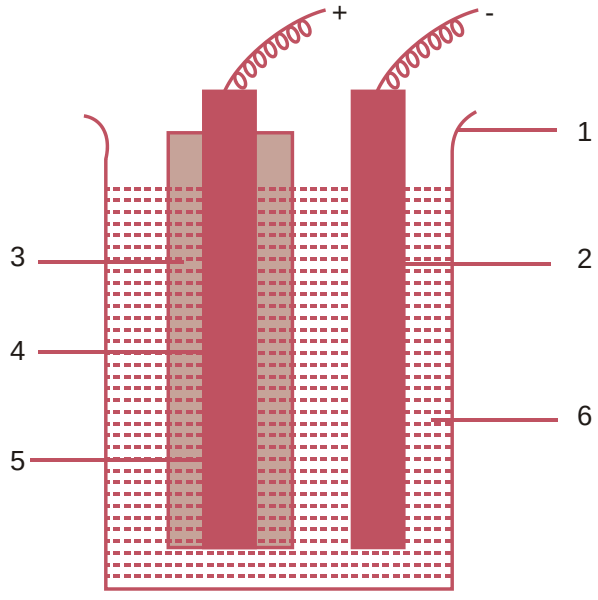
Study the parts of a dry cell. Take an old dry-cell which has been used and thrown away. Remove the outer convering on the cell. You can see the zinc can. Make a hole in the zinc can and tear up a piece of zinc (use a nose-plier or a metal cutter). You will find some black paste first and inside it you can see some white paste.



Opening of a dry cell to see its inner part
1. Cell covering with two layers of paper or cloth
2. Ammonium Chloride paste
3. Carbon rod
4. Manganese dioxide

Find out the names of chemicals present in the two kinds of paste. Hold the brass top of the cell with a pliers and twist it and pull it out of the cell. with a pliers and twist it and pull it out of the cell. You can see the cylindrical carbon rod placed in the middle of the cell as shown in the figure will make your activity clear and easy.

3. Lechlanche cell :



Parts :
1. Glass jar
2. Zinc rod
3. Porous Pot
4. MNixture of managanese dioxide + carbon powder
5. Carbon rod
6. Ammonium chloride solution

Lechlanche cell

In the Lechlanche cell : (1) Positive pole is the Carbon rod. (2) Negative pole is the Zinc rod. (3) Depolariser is the Manganese dioxide.

Bichromate Cell : It consists of a glass vessel containing a mixture of solutions Potassium dichromate ($K_2Cr_2O_7$) and Sulphuric acid (H_2SO_4).A screw cap (S) is fitted to the vessel.To this screw cap, a Zine plate (Zn) is fitted at the middle of two Carbon plates.

Zinc plate acts as negative electrode and the two Carbon plates together act as positive electrode. The solution $K_2Cr_2O_7$ with H_2SO_4 acts as an electrolyte.

ELECTRICITY WORKSHEET - 2

CUQ 1. A device in which potential difference is maintained between the two terminals by converting chemical energy into electric energy is called :

1) electric fan 2) dynamo
3) electric cell 4) electric heater

2. The liquid used in a simple voltaic cell is

1) dilute sodium hydroxide 2) dilute nitric acid
3) dilute hydrochloric acid 4) dilute sulphuric acid

3. The negative terminal and the electrolyte in case of dry cell are :

1) carbon rod and manganese dioxide
2) zinc cylinder and manganese dioxide
3) zinc cylinder and ammonium chloride
4) carbon rod ammonium chloride

4. Dry cells are used in

1) Telegraph 2) Flash equipments of cameras
3) Telephones 4) electric bulb

5. How many defects are their in the voltaic cell

1) 2 2) 3 3) 4 4) 5

6. Which is used to prevent polarization

1) Potasium dichromate 2) Hydrogen sulphite
3) Carbon dioxide 4) Ammonium chloride

JEE MAINS

LEVEL-1 Single Correct Choice Type:

1. The primary cell which is used in daily life is

1) Lechlanche 2) Dry cell 3) Bichrometre cell 4) Simple voltaic cell

2. The depolarization used in leclanche cell is

1) Solution of ammonium chloride 2) Porous pot
3) Powered carbon 4) manganese dioxide

3. In a Lechlanche cell the anode is made of

1) Potassium rod 2) Zinc rod 3) carbon rod 4) Iron rod

4. The electrolyte used in a dry cell is
   1) H_2SO_4(Dilute) 2) $NH_4Cl + H_2SO_4$
   3) NH_4Cl(Paste) 4) None of these
5. In an Bichromate cell the glass vessel containing a mixture of solutions are
   1) $K_2Cr_2o_7 + H_2SO_4$ 2) $NH_4Cl + H_2SO_4$
   3) $K_2Cr_2o_7 + HNO_3$ 4) None of these

JEE ADVANCED

Multi Correct Choice Type:

6. The defects in voltaic cell are
   1) Local action 2) Polarisation 3) Radiation 4) Reflection

Reasoning Type:

7. Statement I : A primary cell converts chemical energy into electrical energy
   Statement II : A primary cell converts electrical energy into chemical energy
   1) Both Statements I and II are correct.
   2) Both Statements I and II are incorrect.
   3) Statement - I is correct, Statement - II is incorrect.
   4) Statement - I is incorrect, Statement - II is correct.

Comprehension Type:

Voltaic cell , lechlanche cell, Dry cell and Bichromate cell are few examples of primary electric cells

8. In an voltaic cell the negative pole is
   1) zine rod 2) carbon rod 3) copper rod 4) None of these
9. In an Dry cell the positive pole is
   1) zine rod 2) carbon rod 3) potassium rod 4) None of these
10. In an lechlanche cell the positive pole is
    1) zine rod 2) carbon rod 3) potassium rod 4) None of these

Matrix Match Type:

11.

Column-I	Column-II
a) Electrolyte in voltaic cell	1) Dilute H_2SO_4 + Potassium Bi - chromate
b) Electrolyte in lechlanche cell	2) NH_4Cl (paste)
c) Electrolyte in Bichromate cell	3) Ammonium chloride solution
d) Electrolyte in a dry cell	4) Dilute H_2SO_4
	5) Dilute HNO_3

Multi Correct Choice Type:

12. A dry cell consists of
    1) Zinc rod 2) NH_4Cl (paste)
    3) Manganese dioxide + Graphite poweder 4) Carbon rod

ELECTRICITY SYNOPSIS - 3

1. **Conductors and insulators:** The materials which allow the electric current to pass through them are the conductors of electricity and the materials through which electric current does not pass are the non-conductors or the bad conductors of electricity. Metals are the conductors of electricity. Non metals like glass, plastic, wood, paper, cloth and rubber are the non-conductors of electricity.

   Non-conductors of electricity are also called insulators. All leads (wires) being used in an electric circuit are metallic wires coated with plastic or rubber. Coating of a conductor with a non-conductor is called insulation.

   If we happen to touch a metallic end of a lead through which current is passing, it gives an electric 'SHOCK'. The shock may be fatal too or otherwise it shakes the body and harms the person who has suffered the electric shock. Insulation saves a person from electric shock.

2. **ELECTRIC CIRCUIT**

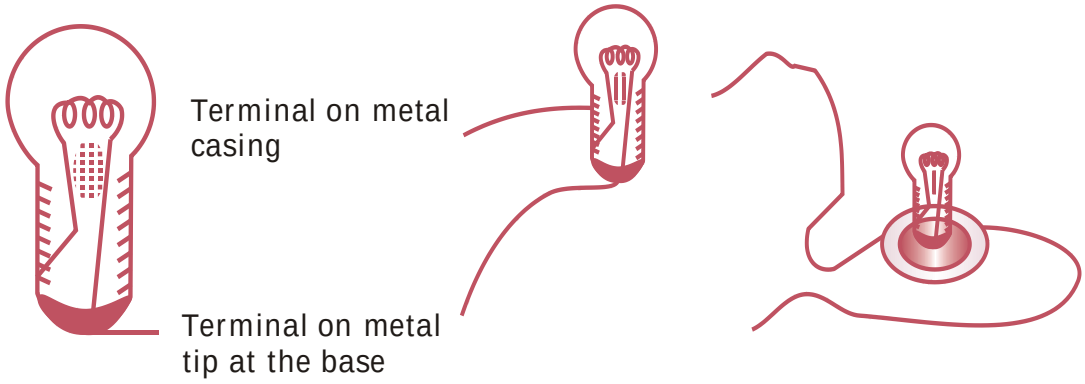
   An electric cell or dry cell is the source of energy for the bulb to glow and warm up. Let us now learn the way in which this electric energy is made available to the bulb in the torch.

   Make a simple electric circuit

   Step 1: Take out the bulb from bulb from a torch. Examine the bulb carefully.

   The bulb is a small globe of thin glass enclosing a coiled filament supported on two thick wires. One of these thick wires is connected to the metal casing around the base of the bulb. The other wire is connected to the metal tip at the base. The metal casing and the metal tip at the base are the two terminals of the bulb.

   Step 2: Take two pieces of insulated wire. Insulated wires have metal wire inside with a plastic covering on the outside. Remove the plastic covering from both the ends of each piece of wire. Fix these wires on the bulb as shown in the picture with the help of Insulating adhesive tape. Or fix the bulb on a bulb holder. The two screws on the bulb holder are the two terminals which are connected to the two terminals on the bulb. The two pieces of wire be connected to the two terminals on the holder, as shown in the picture.



Inside a torch bulb

Bulb connected with wires

Step 3: Connect the two free ends of the wires from the bulb or the bulb holder to an electric cell in such a way that one piece of wire is connected to the positive terminals of the cell and the other to the negative terminal of the cell. This may be done with the help of a rubber band or an adhesive tape.
When you have finished with connections, the bulb lights up.
With your finger trace the path of the electricity from the positive (+ ive) terminal on the cell to the negative (-ive) terminal of the cell. It is a round about path travelled by electricity.

3. Closed and Open Circuit

The dry cell has two terminals. The central terminal of the dry cell is called positive terminal. The base of the dry cell (which is made of a metal) is called negative terminal.

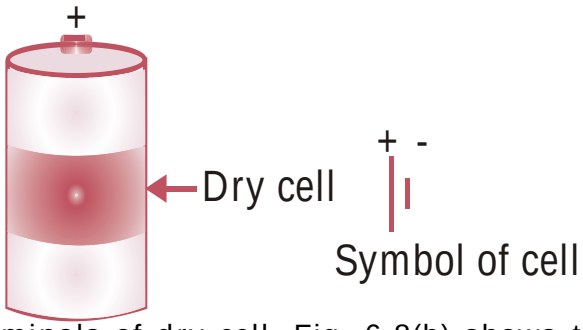
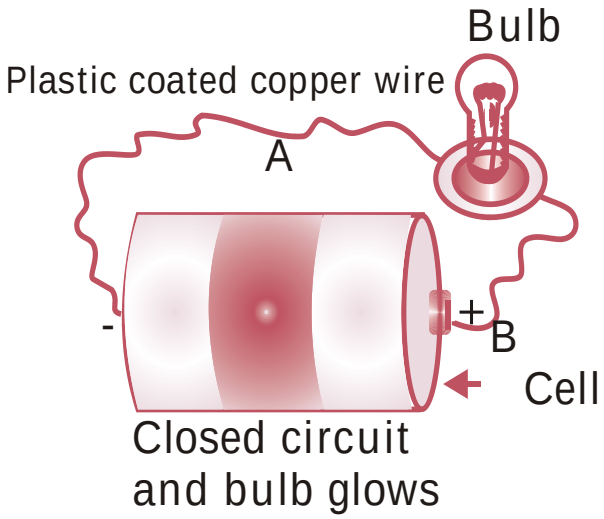
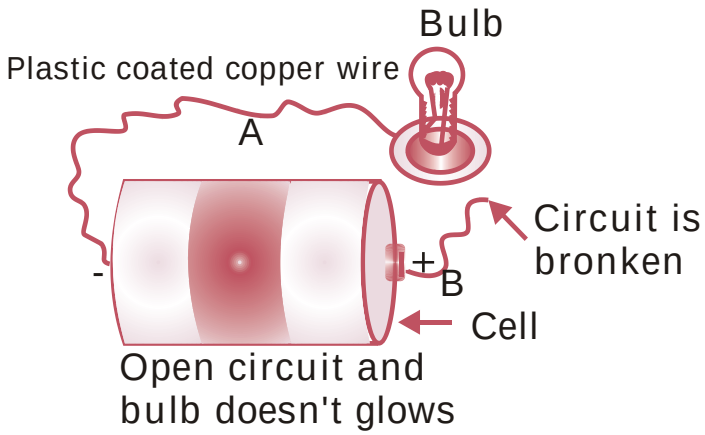


Fig. shows the terminals of dry cell. Fig. 6.8(b) shows the symbol for dry cell. The long line represents positive terminal of the cell and the small and thick line represents negative terminal of the cell.
For this experiment you need a torch cell; a torch bulb marked 1.5 V, cellotape, a plastic coated 1 metre long copper wire and an old used blade.
Cut the plastic coated copper wire into two halves A and B. Remove plastic coating from each end of the wire such that 1 cm of plastic is removed. Now fix one bare end of each wire A and B to the terminals of 1.5 V bulb with the cellotape. Fix the other end of wire A to the base of cell with the help of cellotape. Now touch the bare end of wire B to the central terminal of cell as shown in Fig. 6.9(a). What do you observe?



The bulb lights up. This shows that electric current is flowing in wire A and B through the bulb.

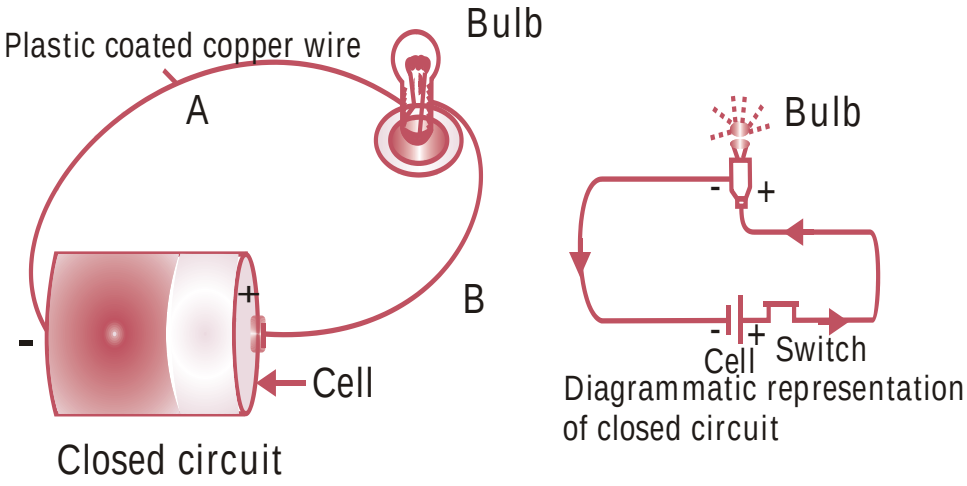
The path along which electric current flows is called electric circuit.



Now remove the wire B from the central terminal as shown in Fig. . What do you observe? The bulb does not glow. It is because electric current does not flow, if the path is broken or path is incomplete.

CLOSED CIRCUIT OR COMPLETE CIRCUIT

When the path which starts from one terminal of the cell, ends at the other terminal of the cell, without any break, then such a circuit is called complete circuit or closed circuit. When the circuit is closed, then any electric appliance in that circuit starts working. In the present case the bulb starts glowing.



OPEN CIRCUIT OR INCOMPLETE CIRCUIT

When the path of current, starting from one terminal of the cell to another terminal of the cell is broken or incomplete, then such a circuit is called open circuit or incomplete circuit.

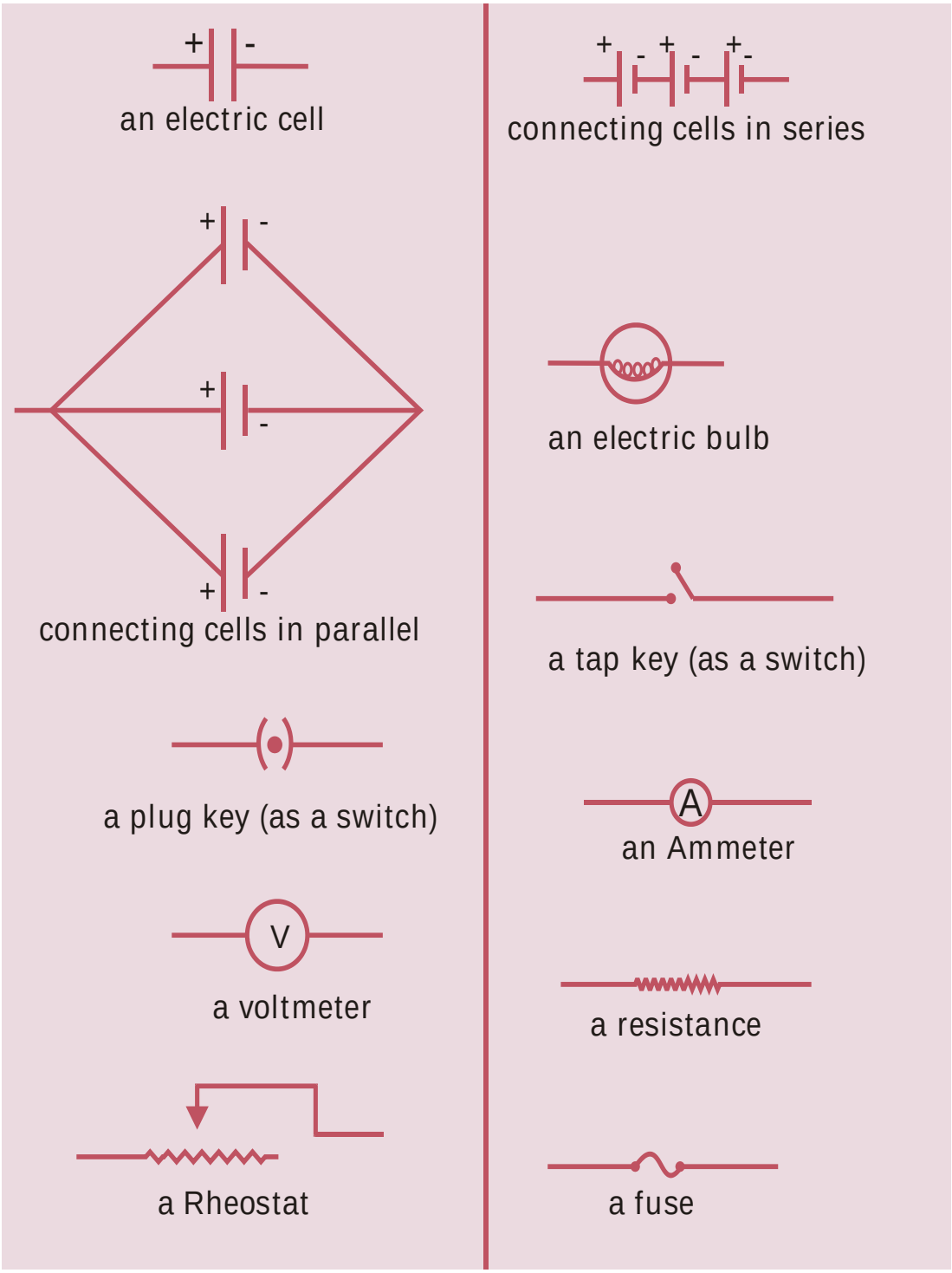
For example, when we remove wire B from central terminal of cell, then the circuit is open circuit or incomplete circuit.

Switches are used in the household wiring^ to open or close the electric circuit.

When we switch on a particular electric appliance, we close the electric circuit. Conversely, when we switch off an electric appliance, we open the electric circuit.

Symbols used in Electrical circuits:

You find hereunder some symbols used in electrical circuits.



A switch, a simple device to 'close' or 'open' a circuit: An electric circuit passes through a switch. Switch is a simple device which helps us to close or open the circuit. It helps in saving electricity when not in use. You are always advised to switch 'off the lights or other gadgets in your home to save electricity.

Connecting Electric Cells in Series

Activity:

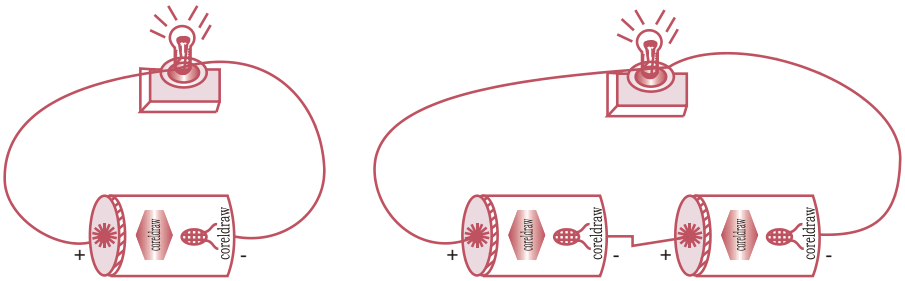


Fig. Using a dry cell to make a bulb glow Fig. Connecting the dry cell in series

Take a dry cell and a torch bulb. Connect the bulb to the cell using copper wires as shown in Fig. . Observe the intensity- of light. The bulb does not glow brightly.

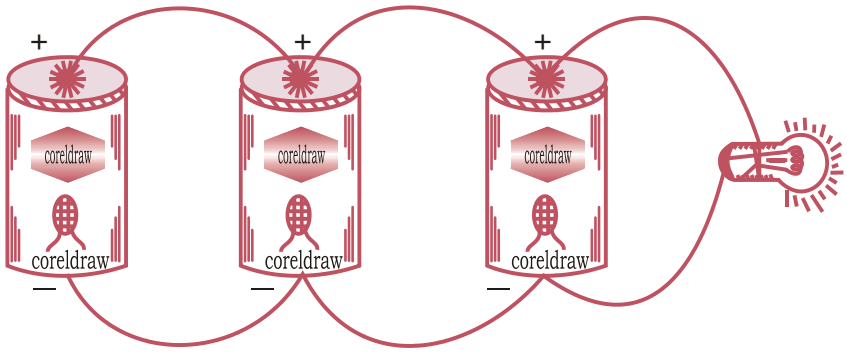
Now take one more dry-cell and connect two cells as shown in fig. 6.40 (b). In this method the positive of the first cell js connected to the negative of the second. The negative of the first and the positive of the second are connected to the bulb. The bulb now glows brighter.

In the battery torch or battery light two or three dry cells are put into a metal container in series. The positive of one cell is connected to the negative pole of another cell in the series connection, When the, switch is turned on, the circuit is closed and the bulb glows and gives light.

Connecting Electric Cells in Parallel:

Connect one torch bulb to one cell as you did in fig.. You, will observe that, the bulb toes not glow brightly.

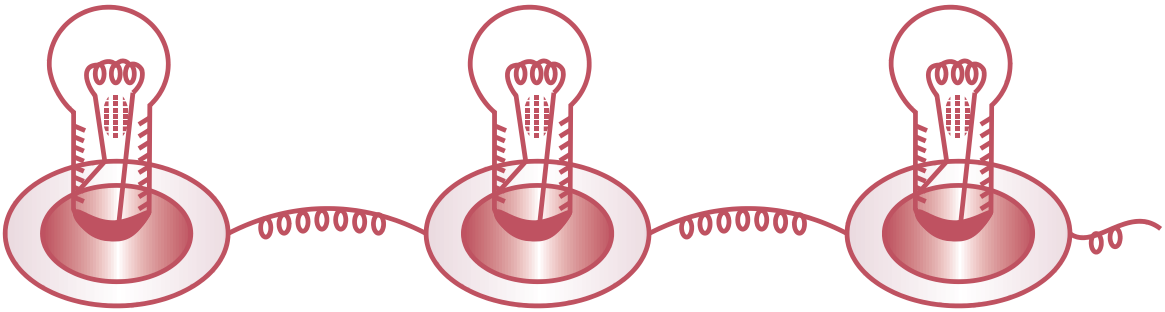
Take three dry cells and connect them as shown in fig.. That is all the positive poles of the three cells are connected together, and all the three negative poles are connected together. These three positives and three negatives are connected to the bulb- You will observe that there is no change in the brightness of the bulb!



When cells are connected in parallel, their total electromotive force is the same as that if any one of them.

When cells are connected in series, their electromotive force is equal to the sum of the EMF of all the cells used.

Connect three torch bulbs in series as shown in figure. Connect this to a dry cell and observe that brightness of each of the three bulbs. Now connect one more dry cell in series with he first cell. Observe the brightness of each of the bulb. Then connect one more dry cell in series with the first two cells. Again observe the bulbs.



Disconnect one of the three bulbs in the circuit. The circuit becomes open and all the three bulbs stop glowing. In series connection of bulbs,' if one bulb gets fused, all the other bulbs in the series will stop working. Three bulbs connected in Series

Connecting Bulbs in Parallel:

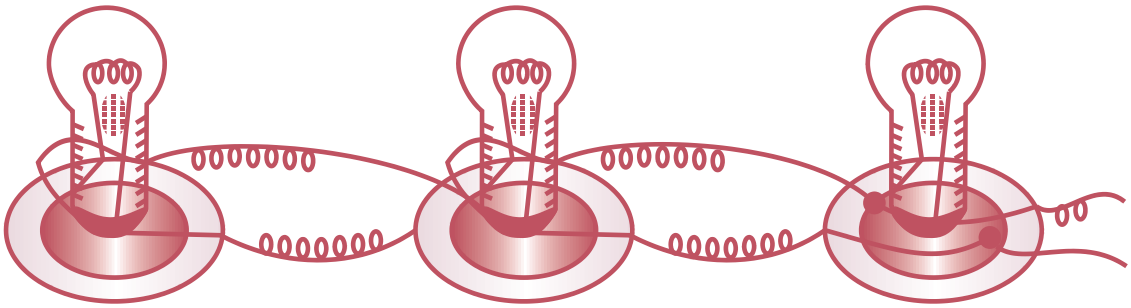
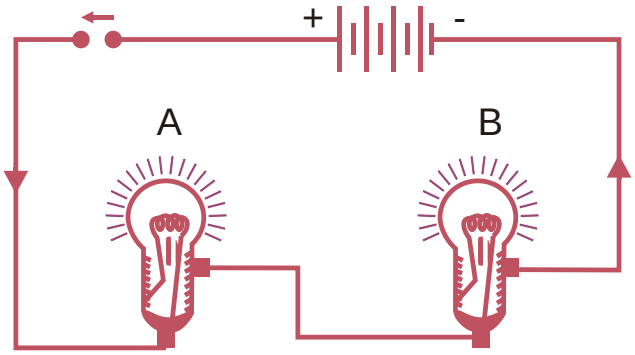


Fig: Three bulbs connected in Parallel

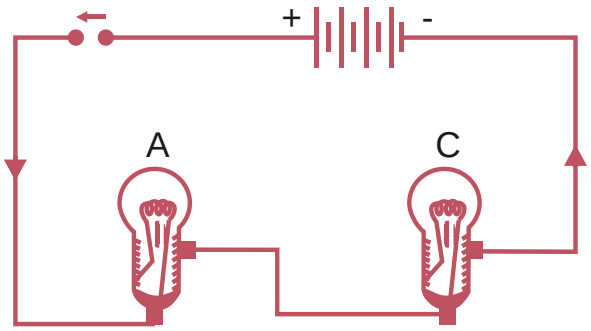
Connect three bulbs in parallel. That is, one end of each of the three bulbs are connected one wire, the other ends of the three bulbs are connected to another wire These two wires are connected to a dry cell. All the three bulbs glow dimly. Now disconnect one of the bulbs. The other bulbs continue to glow as before.

To study the properties of (i) Series circuit, (ii) Parallel circuit

Materials required : a battery of four cells two bulbs of 1 watt each one fused bulb a switch few lengths of connecting wires cellotape.

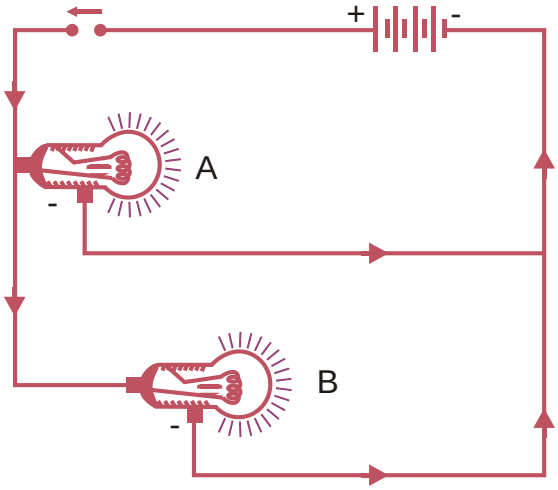


Method: Connect the bulbs A and B in series by connecting them to connecting wires with the help of cellotape as shown in Fig. 6.13(a). Connect the free ends of connecting wires to a battery through a switch. Close the switch. What do you observe? Both the bulbs will glow. However, they will not glow very brightly. Open the switch. What do you observe?



Both the bulbs will stop glowing.

Now remove the bulb B and instead fix a fused bulb C [Fig.]. What is your observation? Bulb A does not glow.



Following are the conclusions from the above investigation.

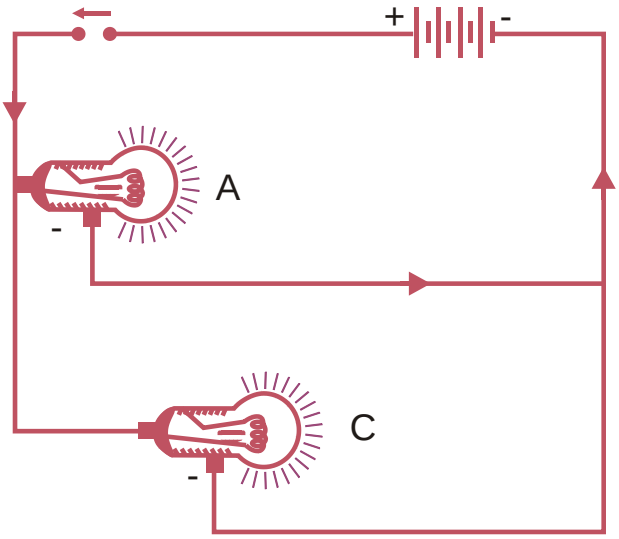
1. In series circuit all the appliances work simultaneously when switch is closed. Conversely, all appliances stop working when switch is open.

2. In series circuit, if any, of the appliances goes out of order, the other appliances stop working.

3. As the bulbs were not glowing very brightly, it can be concluded that in series the appliances do not work to their full capacity.

Now connect the bulbs A and B in parallel, such that they have common positive and common negative terminals as illustrated by Fig. , through a switch and a battery.

Close the switch. What do you observe? Both the bulbs A and B glow very brightly. Now remove the bulb B and instead fix a fused bulb C Fig. . What is your observation?



The bulb A continues glowing brightly, whereas bulb C does not glow. Following conclusions can be drawn from above investigation.

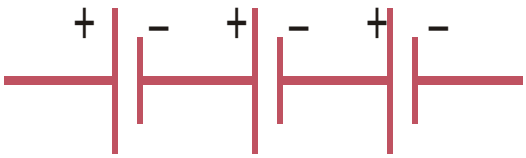
1. In parallel circuit all the appliances work independently

2. In parallel circuit if one appliance goes out of order, the other continues working. It means that each appliance in parallel circuit can be operated independently by a switch.

3. As the bulbs glow brightly, it means each appliance gets enough electric energy, and hence, works to its full capacity.

ELECTRICITY WORKSHEET - 3

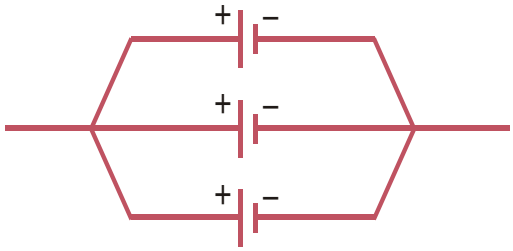
CUQ 1.



in the above figure the three cells are connected in

1) parallel 2) series 3) both 1 & 2 4) neither 1 nor 2

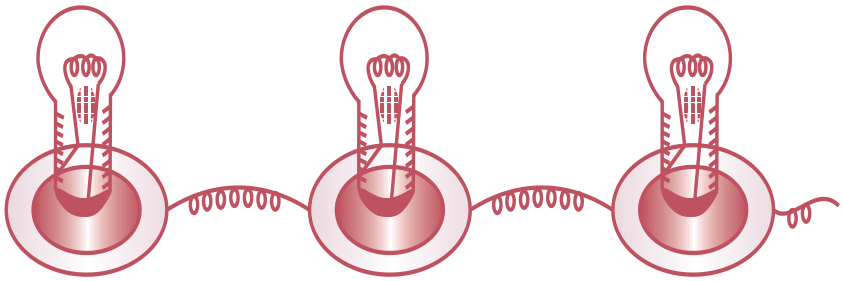
2.



in the above figure the three cells are connected in

1) parallel 2) series 3) both 1 & 2 4) neither 1 nor 2

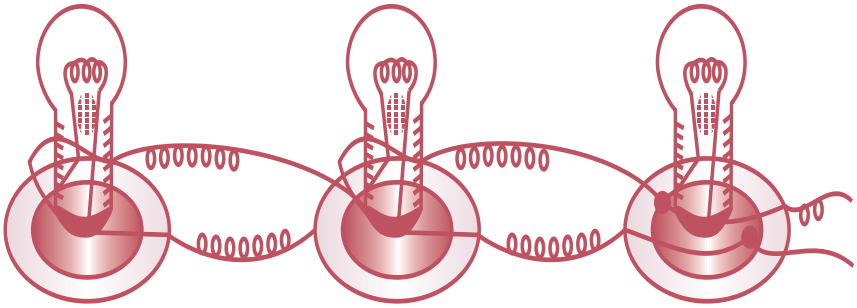
3.



In the above figure, the three bulbs are connected in

1) parallel 2) series 3) both 1 & 2 4) neither 1 nor 2

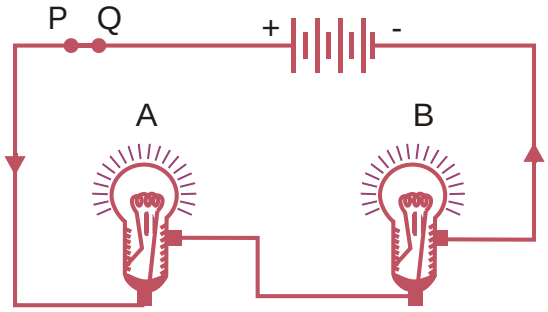
4.



In the above figure, the three bulbs are connected in

1) parallel 2) series 3) both 1 & 2 4) neither 1 nor 2

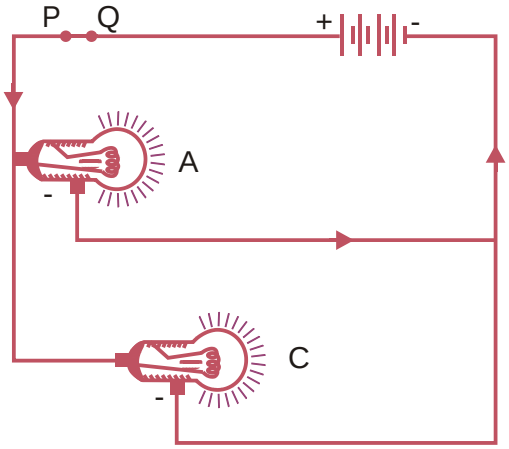
5.



Study the above figure and choose the correct statement from the following.

1) Only bulb 'A' glow dimly
2) Only bulb 'B' glow dimly
3) both bulbs 'A' and 'B' will not glow
4) both bulbs 'A' and 'B' will glow dimly

6.



Study the above figure and choose the correct statement from the following.

1) Only bulb 'A' glow brightly
2) Only bulb 'B' glow brightly
3) both bulbs 'A' and 'B' will not glow
4)both bulbs 'A' and 'B' will glow brightly

JEE MAINS

Single Correct Choice Type:

1. When negative terminal of a cell is connected to the positive terminal of the next cell are said to be in

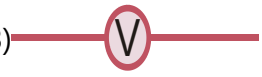
1) Series
2) Parallel
3) Both(1) and (2)
4) Neither (1) nor (2)

2. When electric cells are connected in series the electromotive force

1) Increase 2) Decreases

3)Remain same 4) become zero

3. The symbol for electric cell is

1)  2)  3) 

4) 

4. Greater potential difference (or emf) is obtained in the circuit when cells are connected in

1) series 2) parallel

3) both (1) and (2) 4) neither (1) nor (2)

5. The total e.m.f of the series combination of three cells of equal e.m.f is 4.5V .What is the emf of each cell

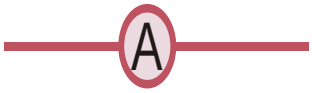
1) 1.5V 2)3.5V 3)6.5V 4) 12.5V

JEE ADVANCED

Multi Correct Choice Type:

6. The symbol for switch

1)  2) 

3)  4) 

Reasoning Type:

7. Statement I : If a voltage V is applied across the bulbs connected in series ,then the voltage across each bulb remains the same

Statement II : If a voltage V is applied across the bulbs connected in parallel ,then the voltage across each bulb remains the same

1) Both Statements I and II are correct.

2) Both Statements I and II are incorrect.

3) Statement - I is correct, Statement - II is incorrect.

4) Statement - I is incorrect, Statement - II is correct.

Comprehension Type:

If the second terminal of a bulb is connected to the first terminal of the next bulb and so on, then the bulbs are said to be connected in series

If the terminal of all the bulbs are connected together and the second terminals of all the bulbs are connected together, then the bulbs are said to be connected in parallel.

8. In a parallel circut of bulbs

   1) Same current exists in all the bulbs 2) Same voltage exists in all the bulbs

   3) Failure of any bulb leads to a break down in the circuit

   4) All of above

9. What is the total emf , when three cells of emf's are 2V,2.5V, 4V are connected in series

   1) 4V 2)2.5V 3)2V 4)8.5V

10. What is the total emf, when three cells of emfs are 2V,2V,2V are connected in parallel

    1) 4V 2) 1V 3)2V 4) 5V

Matrix Match Type:

11.

Column-I	Column-II
a) Bulbs in series	1) $E=E_1 + E_2 + E_3$
b) Bulbs in parallel	2) Brightness of each bulb remains the same, even when one bulb is removed
c) Unit of emf	3) Volt
d) Unit of potential difference	4) Failure of any bulb leads to a break in the circuit

Integer Answer Type:

12. Four electronic cells each of emf 1V connected in parallel , then the combined emf is_____ V

Multi Correct Choice Type:

13. Choose the correct option

    1) The path along which electric current flows is called electric circuit

    2) Coating of a conductor with a non-conductor is called insulator

    3) The materials which allow the electric current to pass through them are called conductors

    4) The materials which allow the electric current to pass through them are called non-conductors

14. If a voltage V is appled across the bulbs in series ,then

    1) The voltage applied is divided among the bulbs

    2) The same current exists in all the bulbs

    3) The same voltage exists in all the bulbs

    4) The current is divided among the bulbs

ELECTRICITY WORKSHEET-1_KEY

CUQ: 1) 1 2) 1 3) 4 4) 1 5) 2 6) 1

JEE MAINS AND ADVANCED:

1) 1 2) 1 3) 1 4) 2 5) 1 6) 1,2

7) 1 8) 2 9) 2 10) 1 11) a-3;b-4;c-2; d-1,5 12) 1

13) 1,2,3 14) 1,2

ELECTRICITY WORKSHEET-2_KEY

CUQ: 1) 3 2) 4 3) 3 4) 2 5) 1 6) 1

JEE MAINS AND ADVANCED:

1) 2 2) 4 3) 3 4) 3 5) 1 6) 1,2 7) 1

8) 2 9) 2 10) a-4;b-3;c-1;d-2 11) 1,2,3,4 12) 1,2,3,4

ELECTRICITY WORKSHEET-3_KEY

CUQ: 1) 2 2) 1 3) 1 4) 2 5) 4 6) 4

JEE MAINS AND ADVANCED:

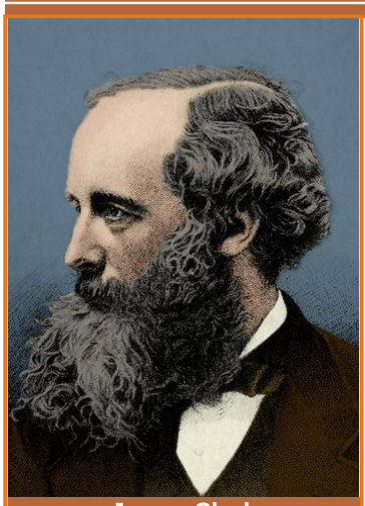
1) 1 2) 1 3) 1 4) 1 5) 1 6) 2,3

7) 4 8) 2 9) 4 10) 3 11) a-1,4; b-2; c-3; d-3 12) 1

13) 3 14) 2,3,4

LIGHT

KNOW YOUR SCIENTIST



James Clerk Maxwell (1831 - 1879)

James Clerk Maxwell (1831 - 1879)

James Clerk Maxwell (13 June 1831 – 5 November 1879) was a Scottish physicist and mathematician. His most prominent achievement was formulating classical electromagnetic theory. This united all previously unrelated observations, experiments and equations of electricity, magnetism and even optics into a consistent theory. Maxwell's equations demonstrated that electricity, magnetism and even light are all manifestations of the same phenomenon, namely the electromagnetic field. Subsequently, all other classic laws or equations of these disciplines became simplified cases of Maxwell's equations. Maxwell's achievements concerning electromagnetism have been called the "second great unification in physics", after the first one realised by Isaac Newton. He was the first cousin of notable 19th century artist Jemima Blackburn.

LIGHT SYNOPSIS -1

Introduction to Light:

We see so many objects around us, colourful and different. On the way to school, we see things like buses, cars, cycles, trees, animals etc.,

Think of the same places at the night time in complete darkness, what will we see? We cannot see anything.

Suppose you go inside a completely dark room. Will you be able to see any objects in the room? You cannot see anything.

But, when you light a candle or a torch you can see the objects present in the room, Can't you?. So, we can say that we need **'light'** to see any object.

But even if you light a candle or a torch and ask a blind man to see the objects in the room, will he be able to see? He will not be able to see.

So we can say that we need **'eyes'** to see objects around us.

Thus, both the light and the eyes are necessary to see the objects around us.

The meaning of "we see the objects" is that we get the sensation of sight in our eyes.

So, it is the light which produces the sensation of sight in our eyes.

How do you think, we see all the objects?

When the light falls on an object, the object allows some light to bounce back (i.e., the object reflects some light). We see the object when these reflected light enters our eyes.

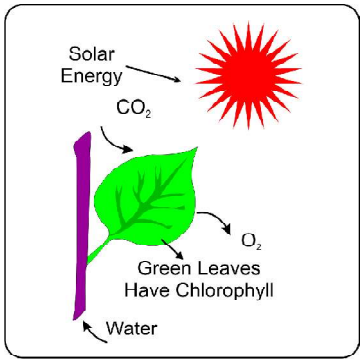
In a room objects are seen only when there is light. We see the object on which the light falls. Is the light between the lamp and the object visible?

We cannot see the light. You may argue that we can see sunlight streaming in through a window. Actually we are not seeing the light. There are some dust particles in the air. When the light falls on the dust particles they reflect the light falling on them into our eyes. So, what we see actually are dust particles reflecting the sunlight.

If there are no dust particles in the air, we cannot see anything. i.e., If there was nothing to reflect light you would not see anything.

So we can conclude that, **"LIGHT ITSELF IS NOT VISIBLE, THOUGH IT MAKES OTHER OBJECTS VISIBLE".** Light - A form of Energy, it consists of tiny packets of energy called photons.

The Sunlight is the main source of energy. The plants get energy from the sunlight and store energy. This stored energy is taken by animals, birds and human beings in the form of food.

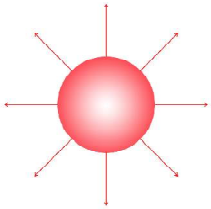


Food gives muscular energy to the animals and human beings. Since the animals and human beings get energy from the light (given by the sun) we can say that light is a form of energy.

From all the above observations, we can conclude that

"Light is a form of invisible energy which produces the sensation of sight in our eyes"

Sources of light:Consider a body emitting light as shown :



We observe that the body emits light in all directions. Such a body which emits light in all directions is said to be the **source of light.**

Types of Sources of Light: Observe sources of light such as Sun, bulb, candle etc.,

We observe that they emit their own light. Such sources of light which emit their own light are called **Self luminous sources or simply luminous sources.**

(ii) Non luminous source:

Observe objects such as book, pen, chair etc.,

We observe that they cannot emit light of their own.Such objects which cannot emit light of their own are called **non-luminous objects.**

Note We are able to see the book, pen, chair etc., when the light from them reaches our eye but these objects cannot emit light of their own. What they do is, they just reflect the light falling on them from the luminous sources like electric bulb, tube light, sunlight.

Speed of light : Light travels at very fast speed i.e., 3×10^8 m/s. It means the speed of light is 300000000 m/s or 300000 km/s.

Terms related to light:

I) Optical medium: Any material (or) non-material through which light energy passes wholly (or) partially is called optical medium

Ex:- vaccum,air,water, glass etc.

II) Homogeneous medium: An optical medium which has a uniform composition throughout is called homogeneous medium.

Ex:- vaccum,diamond, distilled water, pure alcohol etc.

III) Heterogeneous medium:- An optical medium, which has different composition at different points is called heterogeneous medium.

Ex :- Air ,muddy water, fog, mist, clouds, smoke etc .

IV) Transparent medium:- A medium which allows most of the light energy to pass through it is called transparent medium.

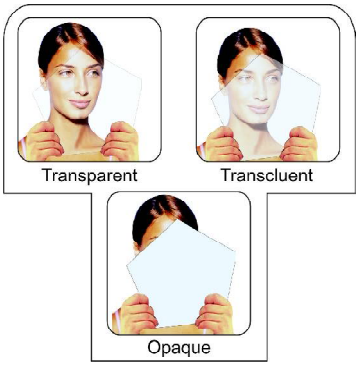
Ex:- vaccum,glass,clear air, alcohol, benzene etc.

V) Translucent medium:- A medium which partially allows the light energy to pass through it is called translucent medium.

Ex:- oiled paper,tissue paper ,ground glass, butter paper etc.

VI) Opaque bodies:- The bodies which do not allow the light energy to pass through them are called **opaque bodies.**

Ex:-Bricks,wood,metals etc.



VII) Point source of light :-A source of light which is of the size of pinhead is called point source of light. Ex:- The pinhole act as a point source of light.

VIII) Extended source of light :- Any source of light which is bigger than point source of light is called extended source of light

Ex:- Bulb, Tube light, burning candle etc.

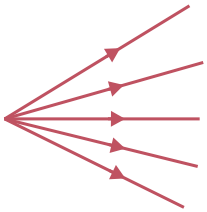
IX) Ray of light :- The path along which light energy travels in a given direction is called ray of light .

Ray of light

X) Beam of light:- A collection of number of rays of light is called beam of light.

XI) Parallel beam:- When the rays of light travels parallel to each other,then the collection of such rays is called parallel beam.

XII) Divergent beam:- When the rays of light originating from a point ,travel in various directions,then the collection of such rays is called divergent beam.



Ex:- The rays coming out from a bulb or a burning candle or a car headlight constitute a divergent beam.

Note:- A point source produces a divergent beam of light.

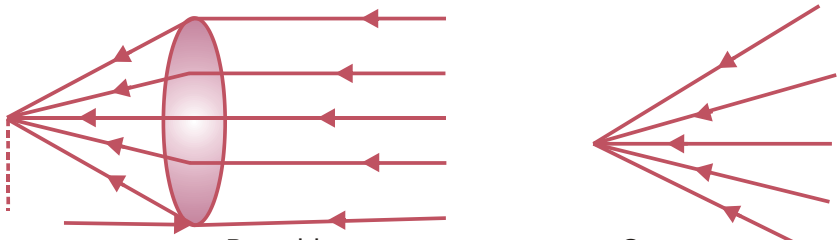
SCIENTIFIC FACT

Why do we experience a blinding feeling when we enter a dark room after standing in sunlight?

The mechanism of seeing in the dark involves two types of cells - rods and cones, in the eye. These cells are present in the light - sensitive innermost layer of the eye called the retina. They lie in front of a pigmented tissue layer. Cones are present in the area of greatest visual activity - fovea centralis, which lies at the centre of small yellow pigments spot behind the pupil. Rods and cones are present around the fovea.

Cones are active under intense illumination, whereas rods are active in dim light. In the dark rods are sensitised by a pigment called rhodopsin or the visual purple that is formed within the rods. Rhodopsin is bleached by light and is reformed by the rods in darkness. Hence a person who steps from sunlight into a dark room experiences a blinding feeling till the pigments begin to form. This process takes around 30 minutes to reach maximum sensitivity.

XIII) Convergent beam:- When the rays of light coming from different directions, meet at a point then the collection of such rays is called convergent beam.



Ex:- If a parallel beam is made to pass through a convex lens, then it meets at a point. This kind of collection of rays is called convergent beam of light.

Rectilinear propagation of light:

Light travels in a straight line as long as it is travelling in the same medium. We can observe that light travels in a straight line when we observe the beam of a car headlight on a misty night or a beam of a torchlight entering a smoky room. We can also perform an experiment to demonstrate that light travels in a straight line.

Experiment – 1

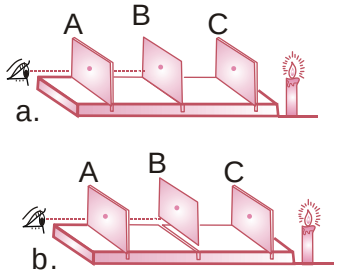
Aim: to demonstrate that light travels in a straight line

Aids: three square cardboard sheets of equal size, plasticine of suitable stands, candle, knitting needle, iron nail.

Method:

1. Take three cardboard squares of equal size. Locate the centre of each piece of cardboard by drawing the diagonals.
2. With the help of a nail, make a hole at the centre of each cardboard.
3. Now fix the three cardboards on plasticine or on stands so that they remain upright.
4. Arrange the three cardboards A, B and C, one behind the other such that their centres are in the same horizontal line. You may pass a knitting needle through the holes to conform if they are in a straight line.
5. Now place a burning candle in front of the board C and look through the pinhole in board A. The flame will be clearly visible. This shows that light travels in a straight line. Now, move board B slightly and again look through the pinhole in board A. You will not be able to see the flame. This shows that light does not travel in a zig–zag way.

Conclusion: light travels in a straight line. This property of light is called rectilinear propagation of light.



Rectilinear propagation of light

LIGHT WORKSHEET -1

CUQ 1. Light causes the _____

1) sensation of small 2) sensation of sound
3) sensation of sight 4) sensation of touch

2. Light is a form of _____ and it travels in a straight line path
1) Mass 2) Force 3) Energy 4) time

3. The path which light energy travels in a given direction is called
1) beam of light 2) source of light
3)ray of light 4) can't say

4. Stars are the example of
1) Luminous bodies 2) Non-Luminous bodies
3) Both(1) and (2) 4) Neither(1) nor (2)

5. Clear water is example of
1)Heterogeneous medium 2) Translucent medium
3) Transparent medium 4) Opaque medium

6. Which of the following is the example of optical medium?
1) wood 2) furniture 3) brick 4) glass

7. Smoke is the example of
1) homogeneous medium 2) Heterogeneous medium
3) both (1) and (2) 4) neither (1) nor (2)

8. Tube light is the example of
1) point source of light 2) extended source of light
3) both (1) and (2) 4) neither (1) nor (2)

JEE MAINS

Single Correct Choice Type:

1. Light is
1) visible and also makes objects visible on which it falls
2) invisible but makes objects visible on which it falls
3) invisible but becomes visible when it falls on an object
4) sometimes visible and sometimes invisible but it always makes objects visible on which it falls

2. A single straight line drawn from a point source, is called a
1) ray 2)bunch 3) both (1) and (2) 4) Neither (1) nor (2)

3. By definition, A material through which light energy passes wholly (or) partially is called
1) Luminous body 2) Transparent medium
3) Non luminous body 4) Optical medium

4. A ray of Light travels in
1) Straight lines 2) Curved lines
3) Sometimes in straight lines sometimes in curved lines 4) Can't say

5. By definition,A collection of number of rays of light is called

1) beam 2)Ray 3) Light 4) None

6. Light energy consist of tiny packets of energy are called

1) Electrons 2) Photons 3) Protons 4) Neutrons

7. By definition,An optical medium, which has different composition throughout is called

1) Homogeneous medium 2) Heterogeneous medium

3) both (1) and (2) 4) neither (1) nor (2)

8. A medium which allows most of the light energy pass through it is called

1) Transparent medium 2) Translucent medium

3) Opaque medium 4) all of these

9. A medium which allows partially the light energy to pass through it is called

1) Transparent medium 2) Translucent medium

3) Opaque medium 4) None of these

10. A point source of light will always produce a

1) parallel beam 2) convergent beam

3) divergent beam 4) all of these

11. When the rays of light originating from a point, travel in various directions, then the collection of such rays is called

1) Parallel beam 2) ray of light

3) Divergent beam 4) Convergent beam

12. When the rays of light coming from differnt directions, meet at a point then the collection of such rays is called

1) Parallel beam 2) ray of light

3) Divergent beam 4) Convergent beam

13. Choose the odd one out:

1) muddy water 2) fog 3) smoke 4) distilled water

14. Bodies which do not allow the light energy to pass through them are called

1) Transparent bodies 2) Translucent bodies

3) Opaque bodies 4) all of these

15. Choose the odd one out

1) stars 2) sun 3)glow warm 4) chair

JEE ADVANCED

Multi Correct Choice Type:

16. Which of the following is homogeneous medium

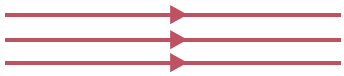
1) Vaccum 2) Clear air 3) Distilled water 4)Pure alcohol

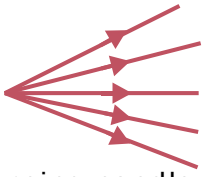
Comprehension Type:

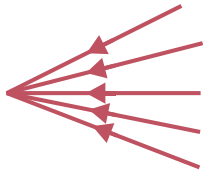
Light produced by source travels in all directions

17. Which of the following figure represents ray of light

1) 

2) 

3) 

4) 

18. Burning candle is an example of

1) point source of light 2) Extended source of light

3) Some times point source, some times extended source

4) Neither point source nor extended source.

19. The example for point source of light

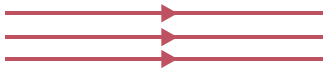
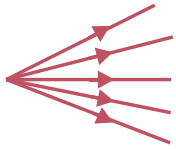
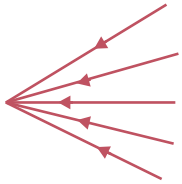
1) Candle 2) bulb 3) pin hole 4) tube light

Integer Answer Type:

20. The speed of light in air is_____$\times 10^8$m/s

Matrix Match Type:

21.

Column-I	Column-II
a) Ray of light	1) 
b) Parallel beam of light	2) 
c) Divergent beam of light	3) 
d) Convergent beam of light	4)

Statement Type:

22. *Statement I :* Moon and wood are non-luminous bodies

Statement II : Non-luminous bodies don't emit energy by themselves,but reflect the light energy falling on them

1) Both Statements I and II are correct.
2) Both Statements I and II are incorrect.
3) Statement - I is correct, Statement - II is incorrect.
4) Statement - I is incorrect, Statement - II is correct.

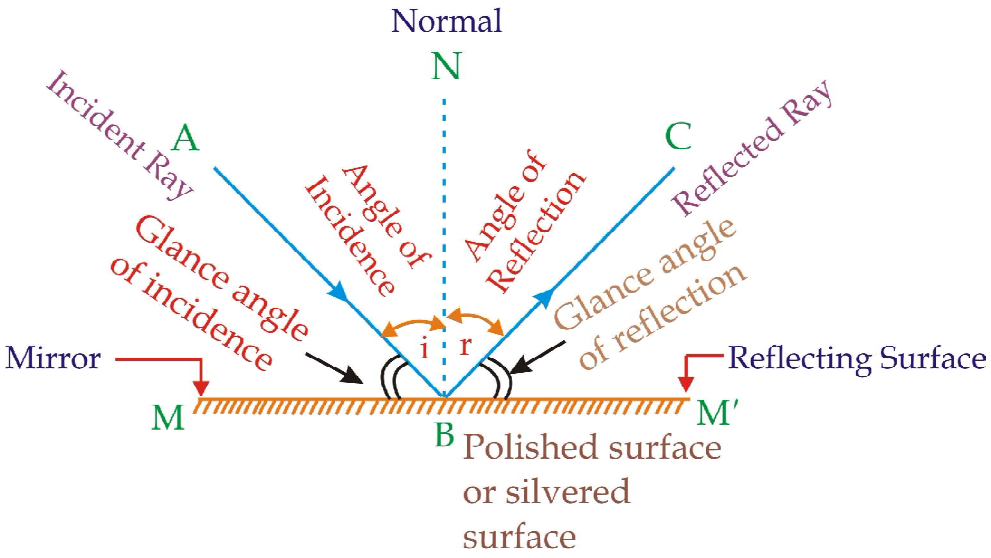
LIGHT — SYNOPSIS-2

Reflection of light: When a beam of light is incident on a surface, a part of it is returned back into the same medium. The part of light which is returned back into the same medium is called the reflected light.

The remaining part of light is absorbed if the surface on which the incident light strikes is opaque or it is partly transmitted and partly absorbed if the surface is transparent.

Reflection: The return of light into the same medium after striking a surface is called reflection.

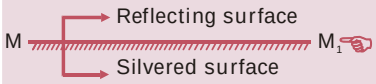
Reflection of light is the process which enables us to see different objects around us. Luminous bodies are directly seen, but non luminous objects are seen only because they reflect the light incident on them which on entering into our eyes, make them visible.

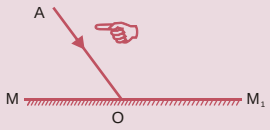
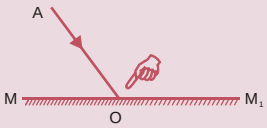
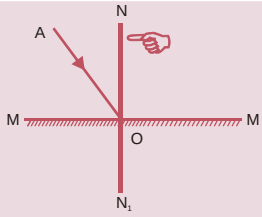
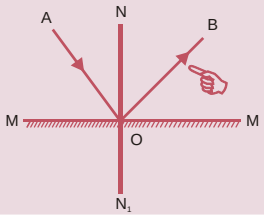
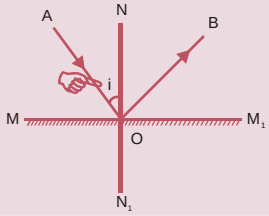
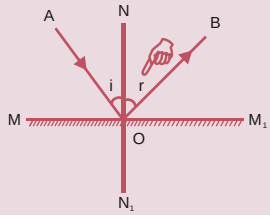


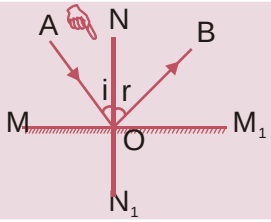
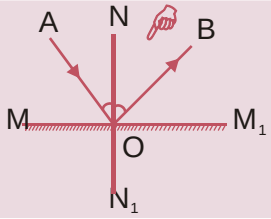
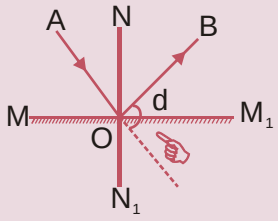
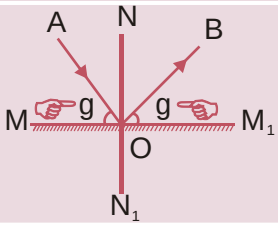
Note: Reflection is possible in case of plane mirror.

A plane mirror is a plane glass plate which is silvered at its one surface. The other surface is then reflecting surface of the plane mirror.

Terms related to Reflection of Light :

Term	Figure	Representation	Definition
Mirror		MM_1	A highly polished surface which reflects almost whole of the light incident upon it is called a mirror. It has two surface - a reflecting surface and a silver surface

Term	Figure	Representation	Definition
Incident ray		AO	The light ray striking the reflecting surface is called the incident ray
Point of incident		O	The point at which the incident ray strikes the reflecting surface is called the point of incidence
Normal		NN_1	The perpendicular draw to the surface at the point of incidence is called the normal
Reflected ray		OB	The light ray coming back to the same medium after reflection is called reflected ray
Angle of incidence		i	The angle, which the incident ray makes with the normal at the point of incidence, is called the angle of incidence.
Angle of reflection		r	The angle, which the reflected ray makes with the normal at the point of incidence, is called the angle of reflection.

Term	Figure	Representation	Definition
Plane of incidence		Plane ACNO	The plane containing the incident ray and the normal is called the plane of incidence
Plane of reflection		Plane BDNO	The plane containing reflected ray and the normal is called the plane of reflection.
Angle of deviation		d	In the absence of the mirror, the ray AO would have gone along the straight line path AOE. But, the presence of mirror makes the ray to deviate through an angle ∠EOB. This angle is called angle of deviation. Thus, the angle through which a ray deviates from its normal path is known as angle of deviation.
Glancing angle		g	The angle made by the incident ray or the reflected ray with the mirror is known as glancing angle g) g_i-Glancing angle of incidence g_r-Glancing angle of reflection $g_i = 90 - I$ and $g_r = 90 - r$

Regular and irregular reflection:

Regular Reflection: Reflection of light is of two kinds depending on the nature of the reflecting surface–regular reflection and diffused or irregular reflection. When the reflecting surface is very well polished and smooth, the light that falls on it is regularly reflected. This phenomenon is known as regular reflection.

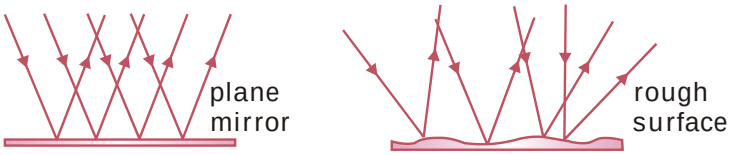
Note: Regular reflection takes place on highly polished on smooth surfaces

Ex: Plane mirror

Irregular Reflection: If the reflecting surface is irregular, the rays of light that fall on it are scattered in all directions. This is called irregular or diffused reflection.

Note: Irregular reflection takes place on rough surfaces

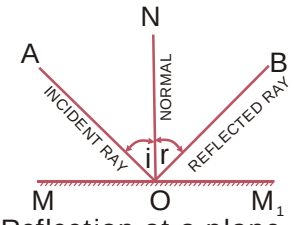
Ex: Wall, wood, paper, cinema screen, ground glass etc.



a. Regular reflection b. Irregular reflection

Two types of reflection

Laws of Reflection: The reflection at a surface obeys the following two laws, which are called the laws of reflection.



Reflection at a plane surface

1. The angle of incidence 'i' is equal to the angle of reflection r (i.e. $\angle i = \angle r$). In figure $\angle AON = \angle BON$.

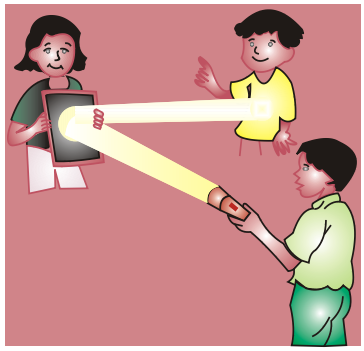
   For a ray incident normally on a surface, $\angle i = 0^0$, therefore $\angle r = 0^0$. Thus, a ray of light incident normally on a surface is reflected back along the same path.

2. The incident ray, the reflected ray and the normal at the point of incidence, lie on the same plane.

ACTIVITY

Request one of your friends to hold a mirror in his/her hand at one corner of a dark room. You stand at another corner with a torch in your hand. Switch on the torch and direct its light beam onto the mirror which your friend is holding.

Your can see a patch of light on the other side. Adjust the direction of the torch so that one patch of light falls on another friend standing in the room. What do you conclude from this activity? Do you agree that a mirror changes the direction of light that falls on it ? This activity also suggests that light travelling along straight lines are reflected from a mirror.



LIGHT WORKSHEET- 2

CUQ 1. The point at which the incident ray strikes the reflecting surface is called
1) Point of incident 2) reflected ray
3) angle of reflection 4) plane of incidence

2. If angle of incidence = 45° the angle of reflection is_____
1) 90^0 2) 0^0 3) 45^0 4) 135^0

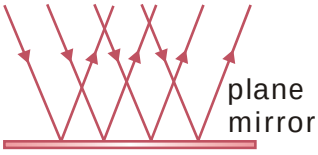
3. The plane containing the incident ray and the normal is called
1) Point of incident 2) reflected ray
3) angle of reflection 4) plane of incidence

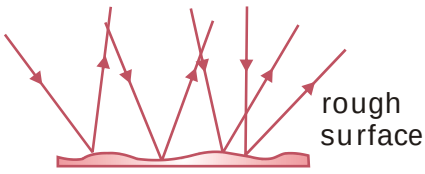
4. When a light ray incidence on a refleting surface along the normal , then the angle of reflection is
1) 90^0 2) 0^0 3) 60^0 4) 180^0

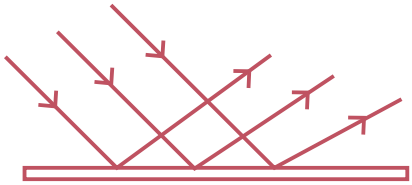
5. The plane containing the reflected ray and the normal is called
1) Plane of reflection 2) reflected ray
3) angle of reflection 4) plane of incidence

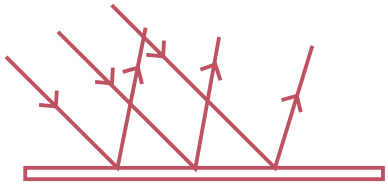
6. When a light ray incidence on a refleting surface along the normal , then the sum of angles of incidence and reflection is
1) 0^0 2) 90^0 3) 120^0 4) 360^0

7. Which of the following best represents regular reflection?

1) 

2) 

3) 

4) 

8. A smooth polished surface from which regular reflection can take place.
1) Mirror 2) Lens 3) Wall 4) Wood

9. The light ray striking the reflecting surface is called
1) Incident ray 2) Reflected ray 3) Normal 4) All the above

10. The perpendicular drawn to the surface at the point of incident.
1) Incident ray 2) Reflected ray 3) Normal 4) All the above

11. The light ray coming back to the same medium after reflection is called
1) Incident ray 2) Reflected ray 3) Normal 4) All of these

12. The angle, which the incident ray makes with the normal at the point of inci dence is called
1) Angle of incidence 2) Angle of Reflection
3) Angle of deviation 4) Glancing angle

13. The angle, which the reflected ray makes with the normal at the point of inci dence, is called
    1) Angle of incidence 2) Glancing angle
    3) Angle of deviation 4) Angle of reflection
14. The angle made by the incident ray with the mirror is known as
    1) Angle of incidence 2) Glancing angle
    3) Angle of deviation 4) Angle of reflection
15. The angle made by the reflected ray with the mirror is known as
    1) Angle of incidence 2) Angle of Reflection
    3) Glancing angle 4) None of these

JEE MAINS

Single Correct Choice Type:

1. The phenomenon in which light that strikes a surface and is thrown back into the same medium is called
   1) reflection of light 2) Polarisation 3) Refraction 4) None
2. If the angle between the mirror and the incident ray is 40^0, the angle of reflection (r) is
   1) 40^0 2) 80^0 3) 50^0 4) 100^0
3. If the angle between the incident ray and the reflected ray is 100^0, the angle of reflection is
   1) 100^0 2) 50^0 3) 80^0 4) 40^0
4. If angle of incidence is 20^0 then angle of reflection is
   1) 10^0 2) 20^0 3) 30^0 4) 40^0
5. If angle of incidence is 20^0 then glancing angle is
   1) 60^0 2) 70^0 3) 80^0 4) 90^0
6. If angle between mirror and incidence ray is 30^0 then the angle between reflected ray and mirror is
   1) 30^0 2) 40^0 3) 50^0 4) 60^0
7. The angle between mirror and reflected ray 60^0 then angle between incidence ray and reflected ray is
   1) 40^0 2) 30^0 3) 20^0 4) 60^0
8. The angle of incidence is 40^0 the angle of reflection is
   1) 40^0 2) 30^0 3) 20^0 4) 10^0
9. The angle made by the mirror with reflected ray is 40^0 then what is the angle of incidence
   1) 50^0 2) 100^0 3) 40^0 4) 30^0

10. Angle of incidence = 0 then glancing angle is

1) 90^0 2) 100^0 3) 45^0 4) 30^0

11. Choose the correct statement

1) Angle of incident is always equal to glancing angle
2) Angle of incidence is always equal to angle of reflection
3) Incident ray, reflected ray and normal all lie in different planes
4) All the above

12. In which the following regualr reflection takes place

1) Wall 2) Wood 3) paper 4) Plane mirror

13. The angle of incidence is 15^0 and the angle of reflection is

1) 10 2) 15^0 3) 25^0 4) 75^0

14. In the following, irregular reflection takes place

1)Wall 2)Wood 3)Paper 4)All of these

15. The ratio of incident angle to the reflected angle is

1)3:2 2)1:2 3)2:3 4)1:1

JEE ADVANCED

Multi Correct Choice Type:

16. Choose the correct statement(s) related to law reflection of light

1) The angle of incidence is equal to the angle of reflection
2) The incident ray,the reflected ray and the normal at the point of incidence,lie on the same plane
3) The angle of incidence is not equal to the angle of reflection
4) The incident ray,the reflected ray and the normal at the point of incidence,does not lie on the same plane

17. The angle of incidence at which angle of incidence and angle of reflection are equal

1) 0^0 2) 30^0 3) 40^0 4) 15^0

18. If angle of incidence is 40^0 then

1) Angle of reflection is 50^0 2) Angle if reflection 40^0

3) glancing angle 50^0 4) glancing angle 40^0

Reasoning Type:

19. Statement I : Regular reflection occurs when a beam of light falls on a smooth and polished surface

Statement II : Irregular reflection occurs when a beam of light falls on a rough surface.

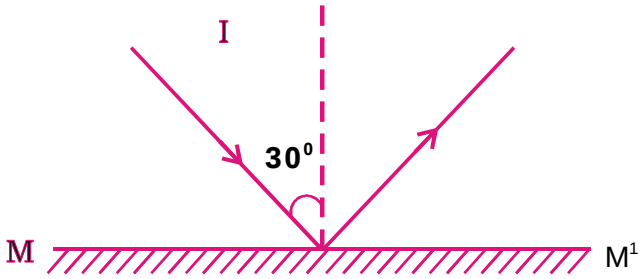
1) Both Statements I and II are correct.
2) Both Statements I and II are incorrect.
3) Statement - I is correct, Statement - II is incorrect.
4) Statement - I is incorrect, Statement - II is correct.

20. Statement I : Angle of incidence = Angle of reflection

Statement II : Incident ray, reflected ray and normal at the point of incidence lie in the same palne.

1) Both Statements I and II are correct.
2) Both Statements I and II are incorrect.
3) Statement - I is correct, Statement - II is incorrect.
4) Statement - I is incorrect, Statement - II is correct.

Comprehension Type:



Angle of incidence is equal to angle of reflection

21. Angle of reflection =

1) 30 2) 60^0 3) 120 4) 90^0

22. Angle of incidence + Angle of reflection =

1) 60^0 2) 30^0 3) 120^0 4) 90^0

23. Glancing angle =

1) 60^0 2) 30^0 3) 120^0 4) 90^0

Matrix Match Type:

24.

Column-I	Column-II
a) Regular reflection	1) Angle between normal and incident ray
b) Irregular reflection	2) polished smooth surfaces
c) Angle of incidence	3) Angle through which a ray deviates from its normal path
d) Angle of reflection	4) rough surfaces
	5) angle between normal and reflected ray

Integer Answer Type:

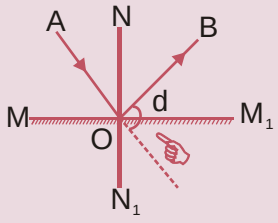
25. If the angle of incidence is 20^0, then the angle of reflection is _____

26. In which of the following regular reflection takes place

1) Still water 2) Oil 3)Highly polised metals 4)Furniture

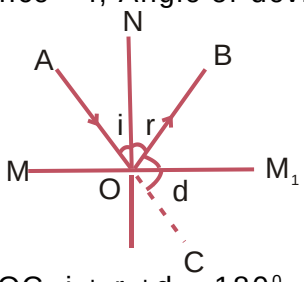
LIGHT SYNOPSIS-3

Angle of deviation

Angle of deviation		d	In the absence of the mirror, the ray AO would have gone along the straight line path AOE. But, the presence of mirror makes the ray to deviate through an angle ∠EOB. This angle is called angle of deviation. Thus, the angle through which a ray deviates from its normal path is known as angle of deviation.

Formula for the angle of deviation due to reflection:

In the figure angle of incidence = i; Angle of deviation = d =?



Consider the straight line AOC, $i + r + d = 180^0$

i.e the sum of angle of incidence, angle of reflection and angle of deviation is 180^0

$\Rightarrow d = 180 - (i + r) = 180 - (i + i)$ $(\because i=r) = 180 - 2i$

Therefore, for an angle of incidence i, the angle of deviation is equal to

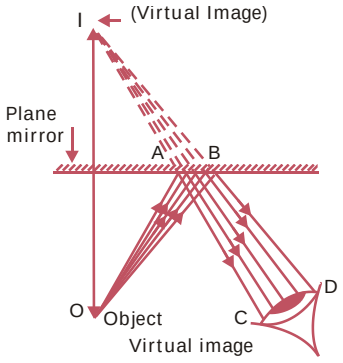
$180 - 2i = \pi - 2i$, $d = 2g$

Note: The deviation produced by n reflections from two plane mirrors inclined at an angle θ is given by $D = n(180 - \theta) = 360 - 2\theta$, where n is even.

Image: When the rays of light, diverging from a point, after reflection or refraction, either actually meet at some other point, or appear to meet at some other point, then that point is called image of the object.

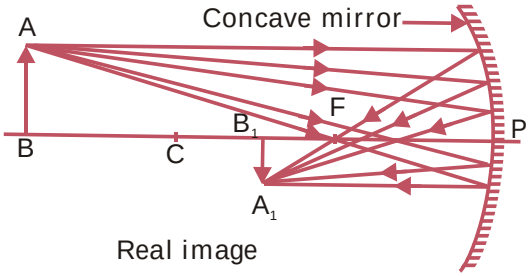
Types of images:

a) Virtual Image: When the rays of light, diverging from a point, after reflection or refraction, appear to diverge from another point, then the image so formed is called virtual image.



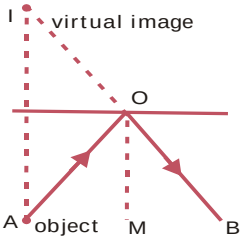
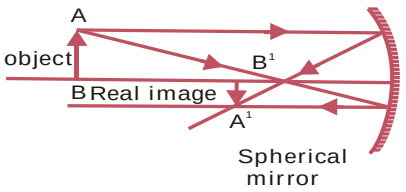
virtual images are always erect upright. The path of the rays forming a virtual image is shown by dotted lines.

b) Real Image: When the rays of light, diverging from a point, after reflection or refraction actually converge at some other point then that point is real image of the object.



Real images are always inverted (upside down). Real images and the path of the rays which form them are shown by continuous lines.

Distinction between real image and virtual image:

S. No.	Virtual Image	Real Image
1.	The rays of light after reflection or refraction appear to meet at some other point.	The rays of light after reflection or refraction actually meet at some other point.
2.	It cannot be taken on screen	It can be taken on screen
3.	It is always erect	It is always inverted
4.	Image of our face in a plane mirror	Image formed on a cinema screen
5.		

COOL PHYSICS FACT

One way mirrors are used a lot in spy movies, but are thy really one - way? Try to devise a glass or a glass coating so that room scenes will pass in only one direction. If this is impossible then how do the so - called one - way mirrors work?

Most one-way mirrors depend on one side (say the room in a which a criminal is being questioned) being more brightly it than the other side (where a viewer is). Some of the light incident on the glass from the criminal's side is reflected by the front and back surfaces of the glass. If the other side is relatively dark, then the criminal sees only the reflected mirror. The viewer, on the other hand, receives ample light transmitted through the glass and can clearly see the criminal. The mirror effect is enhanced if the viewer's side of the glass is coated with a very thin layer of metal that would increase the amount of reflected light to the criminal but still allow enough light for the viewer.

Characteristics of an image formed by a plane mirror:

1. The image is formed behind the mirror and has the same size as the object
2. The image is laterally inverted.
3. The image is as far behind the mirror as the object is in front of it.
4. The image is virtual. It cannot be received on a screen.
5. The image is erect.

Effect of Rotation of Mirror on Reflected Ray:

If a plane mirror is rotated through an angle θ, the reflected ray is rotated through an angle 2θ.

LIGHT_WORKSHEET-3

CUQ 1. The angle through which a ray deviates from its normal path is known as

1. Angle of incidence
2. Angle of reflection
3. Glancing angle
4. Angle of deviation

2. Formula for the angle of deviation due to reflection is equal to _____

1) $180^0–2i$ 2) 180^0+2i 3) $180^0–i$ 4) $90^0–2i$

3. When the rays of light diverging from a point, after reflection or refraction, either actually meet at some other point, or appear to meet at someother point, then that point is called

1. object 2. image 3. Both 1 and 2 4. Neither 1 or 2

4. When the rays of light, diverging from a point, after reflection or refraction appear to diverge from another point, then the image so formed is called____

1. object 2. real image 3. virtual image 4. None of these

5. Image of our face in a plane mirror is

1. Virtual image 2. real image 3. object 4. All of these

6. Virtual images_____

1. Cannot be taken on screen
2. can be taken on screen
3. Impossible
4. All inverted always

7. Virtual images_____

1. All inverted always
2. can be taken on screen
3. Are Impossible
4. Are always erect upright

8. When the rays of light, diverging from a point, after reflection or refraction actually converge at some other point then that point is

1. Virtual image 2. Real image 3. Object 4. None of these

9. Real images_____

1. Can not be taken on screen
2. can be taken on screen
3 Are always virtual
4. Are impossible

10. Real images_____

1. Can not be taken on screen
2. Are always virtual
3. Are always inverted
4. None of these

11. Which of the following is the characteristic of an image formed by plane mirror
    1. The image is laterally inverted 2. The image is real
    3. The image is inverted 4. magnified size
12. Which of the following is not a characteristic of image formed by plane mirror
    1. Same size as the object 2. The image is virtual
    3. The image is inverted 4. The image can not be taken on a screen
13. If a plane mirror is rotated through an angle Q, the reflected ray is rotated through an angle
    1. Q 2. Q/2 3. 2Q 4. 3Q
14. The angle at which glancing angle of incidence and angle of reflection are same
    1. 90^0 2. 45^0 3. 20^0 4. 15^0

JEE MAINS

Single Correct Choice Type:

1. Reflected ray rotated through 40^0 if the mirror rotate through (for a given incident ray)
   1) 20^0 2) 50^0 3) 0^0 4) 15^0
2. If the mirror is rotated through 5^0, then the reflected ray will rotate through for a given incident ray is
   1) 10^0 2) 50^0 3) 0^0 4) 15^0
3. Reflected ray rotated through 20^0 if the mirror rotate through (for a given incident ray)
   1) 20^0 2) 50^0 3) 10^0 4) 15^0
4. If the mirror is rotated through 30^0, then the reflected ray will rotate through for a given incident ray is
   1) 10^0 2) 60^0 3) 0^0 4) 15^0
5. A ray of light is incident on a plane mirror at angle of 60°, then the angle of deviation is_____.
   1) 60° 2) 30° 3) 50° 4) 90°
6. A ray of light is incident on a plane mirror at angle of 30°, then the angle of deviation is_____.
   1) 60° 2) 120° 3) 90° 4) 180°
7. A ray of light is incident on a plane at angle of 40^0, then angle of deviation is_____.
   1. 50^0 2. 100^0 3. 90^0 4. 20^0
8. If the angle of reflection is 30^0 then angle of deviation of incident ray is_____.
   1. 50 2. 30^0 3. 60^0 4. 120^0
9. If the angle of incident is 19^0 then angle of deviation is
   1. 132^0 2. 122^0 3. 142^0 4. 152^0

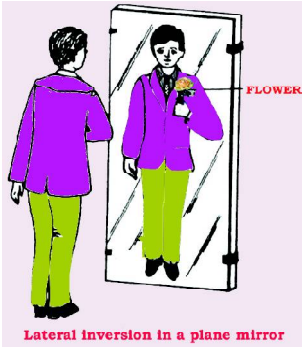
10. If the angle of deviation is 10^0 for than angle of incidence.
    1. 80 2. 85 3. 90 4. 95
11. If the plane mirror is rotated by an angle 15 the reflected ray is rotated through
    1. 20^0 2. 30^0 3. 40^0 4. 50^0
12. Reflected ray is rotated through 12^0 if the mirror rotated through_____.
    1. 10^0 2. 8^0 3. 6^0 4. 3^0
13. The angle of reflection for an incident ray is 30^0 then angle of deviation is
    1. 30^0 2. 40^0 3. 60^0 4. 70^0
14. If the glancing angle for incident ray is 12^0 then angle of deviation is
    1. 24 2. 36 3. 12^0 4. 20^0
15. If the object is placed at a distance 10cm then Image distance is
    1. 12 cm 2. 20cm 3. 40 cm 4. 10 cm

LIGHT SYNOPSIS-4

Lateral inversion:

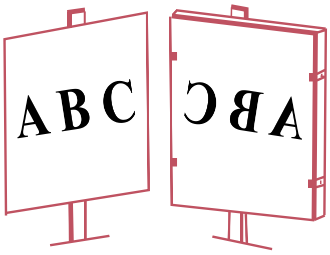
When we place any object in front of a plane mirror, its image is such that its left hand side is seen on the right hand side and the right side is seen on the left.

Figure shows a boy as you will see him when he stands before you. Now, make him stand in front of a mirror and see his image figure.



Lateral inversion in a plane mirror

Note that the flower on the coat now appears to be on the right side, and when you see him directly the flower on the coat is on the left side. Similarly, if you write with your right hand, the image in the mirror seems to write with left hand.

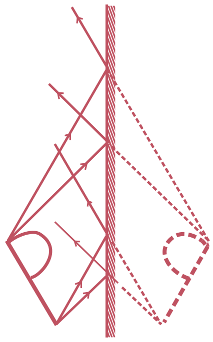


Lateral inversion a plane mirror

Above figure illustrates another example of a lateral inversion. If you write letters 'ABC' on a piece of paper, they will look like 'ƆBA' when seen in the mirror. You can see that the letter A has gone from the left side to the right side in the mirror. Not only this, but each letter has gone through a lateral inversion. Letter 'B' becomes 'ᗺ' and 'C' has become 'Ɔ'. Can you now tell why 'A' remains as 'A', when seen in the mirror?

This phenomenon of left appearing right and right appearing left on reflection in a plane mirror is called the lateral inversion.

This type of inversion also occurs on the blotting paper used to dry ink while writing. The individual letter on the blotting paper can be read by seeing its image in a plane mirror. The letter **P** when seen in a plane mirror appears **q** as shown in figure.


Lateral inversion

Note that the lateral inversion of letters such as A, H, I, M, O, T, U,V, W, X and Y is not noticeable.

It is due to lateral inversion of the image formed in a plane mirror that it becomes difficult to read text on a page which is reflected by a plane mirror.

The letters on the front of an ambulance are written laterally inverted like ƎƆИA⅃UᗺMA. The reason is that the driver of the vehicle moving on road ahead of the ambulance reads these words laterally inverted as AMBULANCE in his rear view mirror and so he will give side to pass the ambulance first.

Displacement of image:

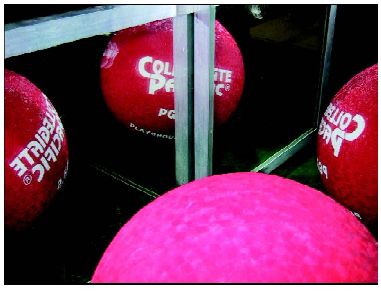
(a) If the object is displaced by a distance x towards or away from the mirror, the image also suffers the same displacement in opposite direction.

(b) If the mirror is displaced by a distance x , towards or away from the object, the image is displaced by 2x

Multiple Reflections :

What happens if the object is placed between two mirrors that are at an angle to each other? Let us find out...

a) Mirrors kept at angle of 90° and the object is placed symmetrically (i.e., object is placed on the bisector of the two mirrors) : Here, 3 images are formed.



b) Mirrors kept at angle of 45°. Here, 7 images are formed.

Note : The seventh image is formed on the bisector of the mirrors.

Formula for number of images formed in two plane mirrors:

The formula for number of images (n) formed if object is placed symmetrically (if the object is placed on the bisector of the mirrors) is $n = \left(\frac{360°}{\theta}\right) - 1$ where θ in degrees is the angle between the mirrors.

S.No.	θ in degrees	Number of images if the object is placed symmetrically
1	0°	∞
2	20°	17
3	30°	11
4	45°	7
5	60°	5
6	90°	3

Now we shall consider two special cases to study multiple reflections.

1. When a pair of mirrors are parallel to each other.
2. When a pair of mirrors are kept perpendicular to each other.

ASTONISHING FACT

Why do we have sodium vapour lamp in the streets and not mercury vapour lamp?

The efficiency of sodium vapour lamps is good - between 40 and 50 lumens per watt. Hence they are used for street lighting.

LIGHT WORKSHEET - 4

CUQ 1. Which of the following show lateral inversion?

1)A 2)B 3)O 4) None

2. If the object is displaced by a distance 2cm towards the mirror, then the image also suffers the _____displacement in opposite direction.

1)1cm 2)2cm 3)4cm 4)5cm

3. If the object is displaced by a distance 6cm away from the mirror, then the image also suffers the _____displacement in opposite direction.

1)2cm 2)4cm 3)6cm 4)8cm

4. If the mirror is displaced by a distance 4cm, towards the object, the image is displaced by

1)2cm 2)4cm 3)6cm 4)8cm

5. If the mirror is displaced by a distance 7cm away from the object, the image is displaced by

1)8cm 2)14cm 3)24cm 4)10cm

6. The two mirrors are arranged in parrallel to each other then the number of images are

1)2 2)4 3)6 4)infinite

7. The two mirrors are arranged in perpendicular to each other then the number of images are

1)2 2)4 3)3 4)10

8. Which of the following does not shows lateral inversion?

1) A 2) B 3) C 4) None

9. If the mirror is displaced by a distance 2cm, towards the object, the image is displaced by

1)8cm 2)4cm 3)24cm 4)16cm

JEE MAINS

Single Correct Choice Type:

1. The phenomenon of left appearing right and right appearing left on reflection in a plane mirror is

1) Lateral invertion 2) lateral plane

3) Both (1) and (2) 4) neither (1) nor (2)

2. If the mirror is displaced by a distance x , towards or away from the object, the image is displaced by

1)x 2)2x 3)3x 4)4x

3. Formula for number of images form in two plane mirrors is ('θ' let be the angle between two mirrors)

1) $\frac{360}{\theta}-1$ 2) $\frac{360}{2\theta}-1$ 3) $\frac{360}{3\theta}-1$ 4) $\frac{360}{4\theta}-1$

4. Which of the following capital English letter does not show lateral inversion

1) U 2) V 3) W 4) All of these

5. Choose the correct statement :

1) In a mirror our left hand appears to be right hand.

2) 'AMBULANCE' word on an ambulance van is written in the form of its mirror image

3) The word 'Red' laterally inverted when it is seen in a plane mirror.

4) All of these

6. Which of the following letter does not show lateral inversion

1) B 2) C 3) O 4) Z

7. Which of the following letter show lateral inversion

1) B 2) A 3) X 4) M

8. If the object is displaced by a distance 4cm, then the image also suffers the displacement_____

1) 4 cm 2) 2 cm 3) 8 cm 4) 3 cm

9. If the mirror is displaced 3cm towards the object the image is displaced

1) 3 cm towards object 2) 3 cm away from object

3) Image position doesnot change 4) None of these

10. If the angle between two palne mirror is 2^0 then the no. of images formed is

1) 180 2) 179 3) 17 4) 18

11. The number of images formed by two mirrors at 45^0 to each other is

1) 11 2) 7 3)9 4)3

12. The number of images formed in two plane mirror, when they are held at the angle of 36º.

1) 9 2) 12 3) 4 4) 18

13. Which of the following capital English letter shows lateral inversion

1) A 2) H 3) I 4) B

14. The number of images formed by two mirrors at 0^0 to each other is

1) 11 2) 7 3)9 4)infinite

15. If the no.of images are formed by two plane mirrors are 3 then the angle between them is

1) o^0 2) 45^0 3) 60^0 4) 90^0

16. If two plane mirrors are kept at an angle 30^0 then_____images are formed

1) 7 2) 10 3) 11 4) 9

17. An object is placed infront of the plane mirror.If the mirror is displaced 5cm away from the mirror then the image is displaced by

1) 5 cm 2) 2 cm 3) 10 cm 4) 8 cm

18. Which of the following letter shows lateral inversions

1) I 2) O 3) X 4) G

JEE ADVANCED

Multi Correct Choice Type:

19. Which of the following does not show lateral inversion?

1) A 2) H 3) O 4) I

Reasoning Type:

20. Statement I : Infinite images are not seen when two plane mirrors are facing eachother.

Statement II : After very successive reflection some amount of light energy is absorbed, their by luminosity of images goes on decreasing, till they are no longer visible

1) Both Statements I and II are correct.

2) Both Statements I and II are incorrect.

3) Statement - I is correct, Statement - II is incorrect.

4) Statement - I is incorrect, Statement - II is correct.

Comprehension Type:

The phenomenon of left appearing right and right appearing left on reflection in a plane mirror is called lateral inversion.

21. Which of the following capital English letter does not show lateral inversion

1) N 2) O 3) P 4) Q

22. Which of the following capital English letter shows lateral inversion

1) W 2) X 3) Y 4) Z

23. Which of the following capital English letter shows lateral inversion

1) N 2) P 3) Q 4) All the above

Matrix Match Type:

24. The formula for number of images (n) formed if object is placed symmetrically (if the object is placed on the bisector of the mirrors) is $n=\left(\frac{360^\circ}{\theta}\right)-1$ where θ in degrees is the angle between the mirrors.

Column-I	Column-II
a) $\theta = 60^0$	1) n = 11
b) $\theta = 30^0$	2) n = 3
c) $\theta = 90^0$	3) n = 5
d) $\theta = 20^0$	4) n = 10
	5) n = 17

NOTE : θ is the angle between two mirrors and n is number of images.

Integer Answer Type:

25. The number of images formed by two mirrors at 30^0 to each other is____.

WORKSHEET-1 KEY

CUQ: 1) 3 2) 3 3) 3 4) 1 5) 3 6) 4 7) 2 8) 2

JEE MAINS AND ADVANCED:

1) 2 2) 1 3) 4 4) 1 5) 1 6) 2 7) 2 8) 1
9) 2 10) 1 11) 3 12) 4 13) 4 14) 3 15) 4 16) 1,2,3,4 17) 1 18) 2 19) 3 20) 3 21) a-4;b-1;c-2;d-3 22) 1

WORKSHEET-2 KEY

CUQ: 1) 1 2) 3 3) 4 4) 2 5) 1 6) 1 7) 1 8) 1
9) 1 10) 3 11) 2 12) 1 13) 4 14) 2 15) 3

JEE MAINS AND ADVANCED:

1) 1 2) 3 3) 2 4) 2 5) 2 6) 1 7) 4 8) 1
9) 1 10) 1 11) 2 12) 4 13) 2 14) 4 15) 4 16) 1,2
17) 1,2,3,4 18) 2,3 19) 1 20) 1 21) 1 22) 1 23) 1
24) a-2;b-4;c-1;d-5 25) 20 26) 1,2,3

WORKSHEET-3 KEY

CUQ: 1) 4 2) 1 3) 2 4) 3 5) 1 6) 1 7) 4 8) 2
9) 2 10) 3 11) 1 12) 3 13) 3 14) 2

JEE MAINS AND ADVANCED:

1) 1 2) 1 3) 3 4) 2 5) 1 6) 2 7) 2 8) 4
9) 3 10) 2 11) 2 12) 3 13) 3 14) 1

WORKSHEET-4 KEY

CUQ: 1) 4 2) 2 3) 3 4) 4 5) 2 6) 4 7) 3 8) 1
9) 2

JEE MAINS AND ADVANCED:

1) 1 2) 2 3) 1 4) 4 5) 4 6) 3 7) 1 8) 1
9) 10) 2 11) 2 12) 1 13) 4 14) 4 15) 16) 3
17) 3 18) 4 19) 1,2,3,4 20) 1 21) 2 22) 4 23) 4
24) A-3;B-1C-2;D-5 25) 1

FORCE

SYNOPSIS-1

Introduction of Force:

Defination: Push or pull is called force

Types of Forces:

Contact force:

1. Mechanical force
2. Frictional force
3. Deforming force
4. Tensional force
5. Normal force

Non-contact force:

1. Gravitational force
2. Electrostatic force
3. Magnetic force
4. Nuclear force

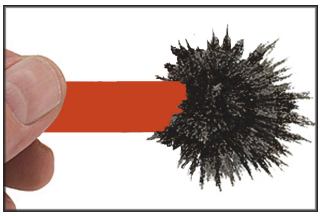
Non-contact forces: The force applied on the body from certain distance is called non-contact forces.

These forces have an ability to crete a sphere of influence around a body, whcih is commonly called force field.

Gravitational force: The pull of the earth on any body towards its centre is called gravitational force.

Magnetic Force : The force exerted by the magnet is called magnetic force

Observe the iron filings kept near a magnet:



Here, iron filings are attracted by the magnet.

This is because of the force exerted by the magnet called Magnetic Force.

ACTIVITY

Place safety pin, alpin, piece of wool, paper, aluminium spoon, porcelein cup, iron nail, plastic comb, etc., on a table. Bring a magnet near to each object and observe what happens.

Electrostatic Force : The force of attraction between any charged particle's is called electrostatic force

Observe the boy keeping a comb near the pieces of paper after combing his hair.

Here, the pieces of paper are attracted by the comb.

This is because of the force called **Electrostatic Force**.

ACTIVITY Comb the dry hair many times and bring the comb near to the pieces of paper. Take a glass slab and rub it with woolen cloth and bring it near to the pieces of paper. Observe what happens. Pieces of paper are attracted by comb and glass slab.

NUCLEAR FORCES

The force that acts between protons and neutrons of an atom is called nuclear force. It acts very small distances such as 10^{-15}m.

Contact force: The forces which act on another body through some connector or physical contact are called contact force.

Eg:- Horse pulling a cart.

Railway Engine pulling stationary train

A foot ball player can set a ball in motion by applying force of pull by hitting it by his own foot.

Mechanical Force: The force applied by a physical contact is called mechanical force.

Eg:- Cutting the piece of cloth using scissors.

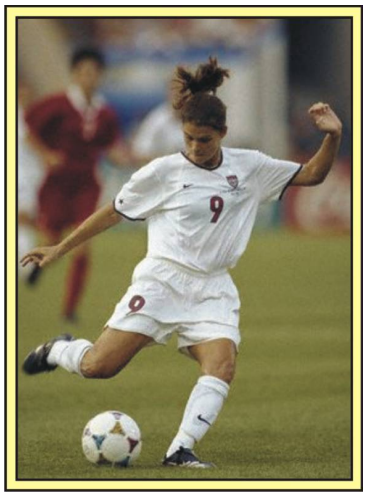
Mechanical force of three types

1. Muscular force
2. Deforming force
3. Frictional force

Muscular Force: the force applied by museles called muscular force.

The mechanical force is of three types:

a) Physical or Muscular Force : Observe the player kicking a foot ball:



Here the force used by the player in kicking the football is called Physical or Muscular force.

b) Deforming Force: The force which change's the shape of the body is called deforming force

Look at the boy stretching the rubber of a catapult:

Here the force used to stretch the rubber of the catapult is called Deforming Force.

c) Frictional Force: Look at the boy moving his toy car on a carpet:

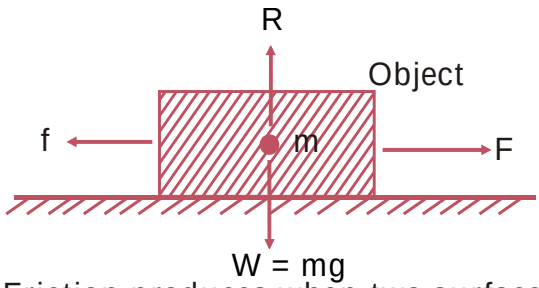
Here, as the car moves, the carpet resists the movement of the car, so it slows down and stops after some time.

This force that resists the movement of the car is called Frictional Force.

Friction:

1. **Friction :** According to Newton's first law of motion, a body continues to be in its state of rest or of uniform motion in a straight line unless an external force acts on it. This means, a ball rolled on the ground must continue to move forever unless stopped by some force. Our common experience is that a ball rolled on the ground gradually slows down and finally stops even when no one has stopped it. Then, why does a rolling ball stop after moving through a certain distance ? The rolling ball stops after covering a certain distance due to the force of friction acting between the ball and the ground.

Thus, the force which opposes the relative motion of a body over another is called force of friction.



Friction produces when two surfaces are in contact

Note : i) The force of friction is always parallel to the two surfaces.

ii) Normal reaction and frictional force always perpendicular to each other.

2. Cause of friction : Friction is due to the irregularities (interlocking) of the two surfaces in contact.

3. Factors on which frictional force depends :

i) The nature of two surfaces in contact with each other.

ii) Normal force with the surfaces are being pressed together.

Note : The force of friction does not depend upon the area of the surfaces in contact.

4. Effects of Friction :

i) Friction opposes motion : If we roll a ball on open ground it moves for a while, slows down and then stops due to frictional force.

ii) Friction produces heat : Rub your palms together for a few seconds. They become warm. The friction between the palms produces heat.

iii) Friction causes wear and tear : If we look at the soles of our old shoes and compare them with our new pair of shoes we will find that the old ones are worn out. When we walk, the soles wear out due to friction between the ground and the shoes. Similarly, the tyres of cycles and automobiles wear out due to friction.

5. Advantages of friction (Why is friction a necessity) **:**

Some advantages of friction are :

i) Nails and screws hold the wooden boards together due to friction.

ii) Power is transmitted from motor to a machine by a friction belt.

iii) The friction between our feet and the ground helps us to walk on the ground without slipping and falling.

iv) The friction between the road and the surface of the tyre permits safe driv ing.

v) We are able to write on paper board because of the friction between the pen / pencil and the paper.

vi) The moving vehicles such as bicycles, cars scooters, etc., are able to move on the road because of friction between the tyres and the road surface.

vii) It is force of friction which saves us from impact of meteors coming from the space. When a meteor enters the earth's atmosphere, the force of friction between the meteor and air generates enough heat such that it burns be fore reaching ground.

6. Disadvantages of friction (Why is friction considered wasteful) **:**

i) Friction between various parts of machines leads to a loss of energy. There fore friction reduces the efficiency of machines.

ii) Friction causes wear and tear of moving machine parts.

iii) Friction between rotating parts of a machine produces heat and causes damage.

vi) Thus friction is an evil. From advantages and disadvantages of friction. It is clear that friction is necessary and at the same time it is an evil.

"Hence friction is a necessary evil."

7. Methods of reducing (minimising) the friction :

The friction between two surfaces can be reduced by the following methods.

i) Friction can be reduced by polishing or smoothing the surface.

ii) Friction is reduced in machines by applying oil or grease on the moving parts.

iii) Friction can be reduced by using the ball bearings.

iv) Aeroplanes and automobiles are streamlined in their shape in order to de crease air or water friction.

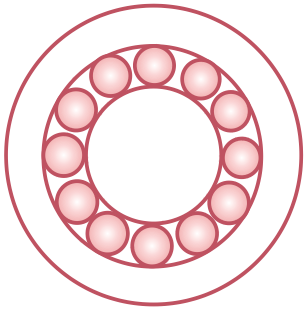
Ex :- Rockets, car, ships, missiles, aeroplanes and automobiles have special shapes. Birds and fish have streamlined bodies.

Note :- Pointed shaped bodies is called streamlined.

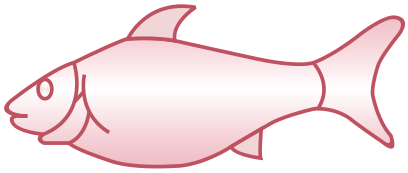
v) Friction can be reduced by applying soap solution to the rough surfaces.

vi) Friction can also be reduced by applying powder to the rough surfaces. Graph-ite powder is used in machines to reduce friction.

Ex :- When a small quantity of powder is applied to the wooden carom board the surface of carom board becomes smooth and hence the friction between carom board and coins gets reduced.



Ball bearing



fish

8. Methods of increasing friction :

In certain situations, we need to increase friction, inspite of fact it consumes more energy. Following examples will illustrate the statement.

i) Tyres of all kinds of vehicles are provided with deep grooves, so as to in crease friction. This prevents the vehicle from skidding on wet roads and sharp turns.

ii) The soles of shoes of athletes and mountaineers are provided with spikes and grooves. The spikes increase friction and prevent slipping.

iii) Industrial belts are provided with rough surfaces so as to increase friction. This prevents the belts from slipping over moving iron pulleys.

iv) Grinding stones of flour mills have rough surface. This increases friction and help in fine grinding of the grain.

v) Soles of our shoes must have grooves.

FORCE_WORKSHEET - 1

CUQ

1. The pull or push on an object is called

1) Force 2) Mass 3) Momentum 4) Velocity

2. The force which acts an another body through some contact or connector is called _____

1) Gravitational force 2) Contact force

3) Non-contact force 4) Magnetic force

3. The force used by scissiors to cut the pieces of cloth is _____ force

1) Mechanical 2) Muscular 3) electrical 4) physical

4. The force used to stretch the rubber of the catapult is called _____force

1) constructional 2) magnetic 3) deforming 4) electrical

5. The force that resists the movement of car on the carpet is _____ force

1) mechanical 2) electostatic 3) nuclear 4) frictional

6. It becomes difficult to walk on highly polished surface or wet ground, as they offer

1) More friction 2) less friction 3) Velocity 4) Mass

7. The tyres of different vehicles are provided with __ to offere large friction.

1) nails 2) Tentacles 3) deep grooves 4) edge

8. It is the _____ force which holds the nails and srews in the wooden furniture.

1) muscular 2) weight 3) gravity 4) frictional

9. The moving vehicles are stopped when we apply breaks, as they offer _____.
   1) velocity 2) friction 3) speed 4) nothing
10. The writing on a paper with pancil or ball pen is possible on account of ____ between its tip and paper .
   1) hardness 2) smoothness 3) friction 4) mass

JEE MAIN AND ADVANCED

LEVEL-1 **Single Correct Choice Type:**

1. The force which does not make direct contact but acts through space is called _____
   1) Frictional force 2) Tension
   3) Non-contact force 4) Contact force
2. Ball released from a certain height reaches the ground, because of
   1) Magnetic force 2) Gravitational force
   3) Electric force 4)Muscular force
3. The force used by the player in kicking the foot ball is called
   1) Muscular force 2) Frictional force
   3) Deforming force 4) Electric force
4. The force which opposes the relative motion of the body is called _____
   1) Friction 2) Gravitational force
   3) Tensional force 4) Electro static force
5. A magnet actracting a piece of iron is called _____ force
   1) Electro static 2) Gravitational
   3) Frictional force 4) Magnetic
6. A negatively charged balls repelling each other is due to _____ force
   1) Gravitational 2) Electro static
   3) tension 4) Magnetic
7. A rolling stops after covering a certain distance due to the ____ acting between the ball and the ground
   1) Mechanical force 2) Gravitational force
   3) Frictional force 4) Electrical force
8. By greasing the moving parts of machinery the friction can be
   1) Increased 2) Reduced 3) Both (1) and (2) 4) Remain same

9. The deep grooves in the tyre of a tractor

1) Decreases friction 2) Increases friction

3) Make it stable 4) Make tyre more attractive

Multi Correct Choice Type

10. Whcih of the following are non-contact forces?

1) Frictional force 2) Electro static force

3) Gravitational force 4) Magnetic force

LEVEL-2 & 3 Single Correct Choice Type:

11. Force of friction increases with the

1) increase in the weight of a body 2) decrease in weight of a body

3) either (1) or (2) 4) none of these

12. Force of friction can

1) oppose the motion of a body 2) produce heat

3) produce wear and tear 4) all the above

13. In order to increase friction between two bodies

1) their surface of contact should be rough

2) the weight of the body should be more

3) both (1) and (2)

4) none of these

14. Force of friction is

1) always a disadvantage 2) always an advantage

3) some times an advantage and some times a disadvantage.

4) neither advantage nor disadvantage.

15. If the weight of the block is 6 kg and 4N force is applied to pull the block. then the frictional force acted upon is _____

1) 6N 2) 4N 3) 8N 4) 16 N

16. A boy shooting an arrow from a bow

1) Gravitation 2) deforming 3) frictional 4) Normal reaction

17. Machine oil is put between moving parts of a machine to

1) reduce the friction 2) increase the friction

3) does not effect 4) none of these

18. Streamling the bodies_____the friction

1) Increase 2) Decrease 3) Does not change 4) None of these

Statement Type

19. Statement I : Iron fillings attract to the magnet because of the magnetic force

Statement II : The force used to cut the piece of cloth by the scissors is called mechanical force.

1) Both Statements I and II are true.

2) Both Statements I and II are false.

3) Statement - I is true, Statement - II is false.

4) Statement - I is false, Statement - II is true.

Matrix Match Type:

20.

Column - I	Column - II
a) Magnetic force	1) Force present between protons
b) Nuclear force	2) Force which changes the shapes of the object.
c) Deforming force	3) Force excerted by magnets
d) Mechanical force	4) Force excerted by scissors

LEVEL-4 & 5 Single Correct Choice Type:

21. A cricket ball rolling down the ground stops after travelling some distance. The force acting on the ball is

1) Gravitational 2) Frictional force of ground

3) Tension 4) Mechanical force

SYNOPSIS-2

Weight : The gravitational force of attraction of the earth acting on a body is known as its weight. Near the surface of the earth it is the product of mass of the body M and gravitational acceleration g, thus weight W = Mg and acts vertically downward.

i.Weight of the body messured by spring balance.

ii.Weight is not constant it changes according to 'g' value. where $g = 9.8 m/s^2 \left(or\right) 980 cm/s^2$

Eg:- Moon gravity is $\frac{1}{6}^{th}$ of earth gravity. So, if a man weight 60 kgs on earth. His weight on moon is _____

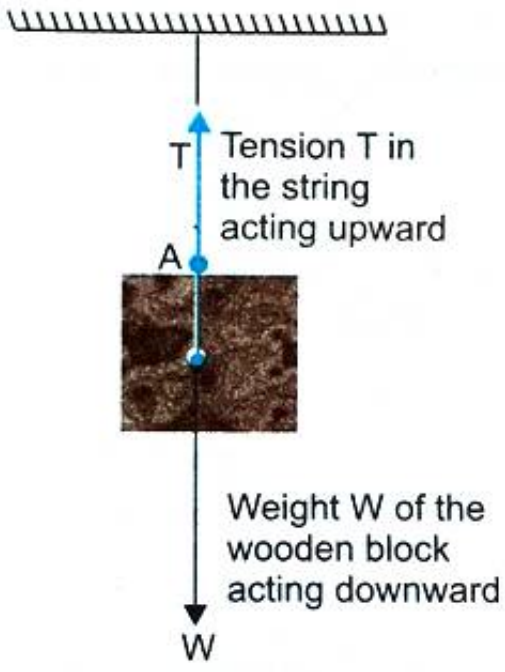
$\frac{60}{6} = 10\ kg$ on moon

The force pull or push is either directly employed on another body. This force of pull (or) push is called action force. Due to this action force another force comes into play which is commonly called reaction force or consequential force. This force is equal in magnitude to the action of force, but act's in the in opposite direction. It has no existence of it's own, but it comes into play when an action force act's on the same body.

1. Force of tension
2. Force of normal force (or) normal reaction
3. Force of friction
4. Force of compression (or) spring force

Tension : Suspend a block by a string such that it's weight (W) acts vertically downwards and string gets stretched. The force exerted by the string (T) in upward direction which is equal to weight of the block This is called force of tension

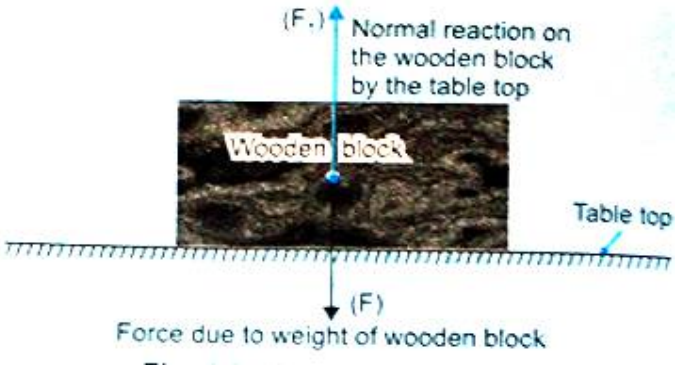
1. This force develop in the string
2. Tension in the string (T) =Weight of the block (W)



3. If we cut the string near the point A, it is seen that the string jerk's upwards this proves that tension in the string acts in the opposite direction of the weight.

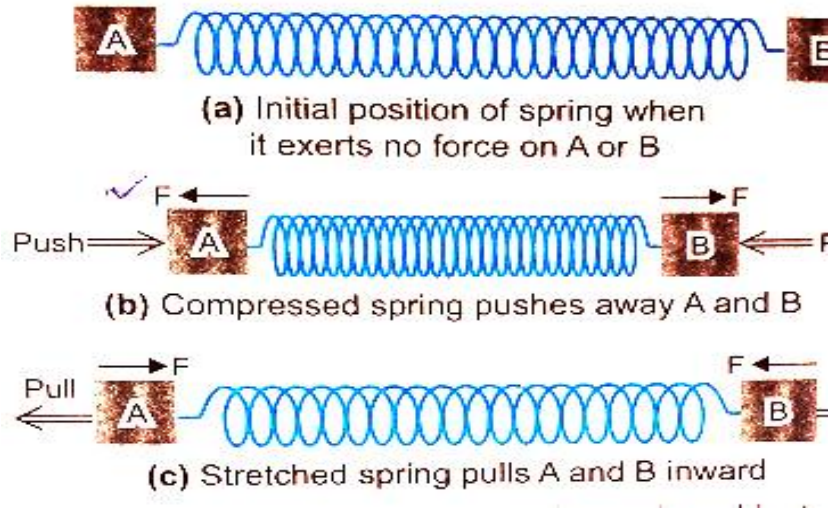
Normal reaction : The force which acts normally to the surface by the force applied by the surface of the table is called normal reaction force.

Normal reaction force (N)=Weight of the block (W)



4. Normal force is always a pushing force
5. The same body may experience more than one normal force.

Spring Force : The force exercted by a compressed spring is called spring force.



The force of push applied on the wooden block A and B, such that spring get's compressed. The compressed spring applies a force F on either of the blocks A and B in the outward direction i.e opposite to the direction of the push

The force of pull applied on the wooden block A and B, such that spring get's stretched. The stretched spring applies a force F on either of the blocks A and B in the inward direction i.e opposite to the direction of the pull

diagram

Buoyant force : When a body is partcially or fully dipped into the fluid, the fluid excert force on the body. The force by the fluid is perpendicular to the surface and equal to the pressure. The resultant of all these contact forces is called the force of buoyancy or buoyant force

Buoyant force (B) = Weight of the body in the fluid

1. The weight mg of the part of the fluid
2. The resultant (B) of the contact force by the remaining fluid

WORKSHEET - 2

CUQ

1. The force with which earth pull's the body towards its centre is called_____

   1) weight 2) friction 3) Tension 4) Magnetic force

2. The force exerted by the surface of table on to the block is _____force

   1) Tension 2) Normal reaction

   3) gravitational force 4) Frictional force

3. Force due to weight of the wooden block is

   1) mass of the block 2) Height of the block

   3) volume of the block 4) Weight of the block

4. Normal reaction of the wooden block makes an angle of _____ on the surface

   1) 30^0 2) 60^0 3) 90^0 4) 0^0

5. What is the formula for weight of the body

   1) W=mg 2) W=2mg 3) W=g 4)W=0

6. What is the value of 'g' of the earth near the surface

   1) $98\frac{m}{s^2}$ 2) $980\frac{m}{s^2}$ 3) $9.8\frac{m}{s^2}$ 4) $900\frac{m}{s^2}$

7. If the mass of man is 100kg. What is his weight

   1) 9.8 kg 2) 98 kg 3) 980 kg 4) 98 g

8. The tension in the string equal to_____

   1) mass 2) gravitational force

   3) weight of the body 4) mass of the string

9. When we push the spring which is attached to the wall come back's to it's initial positon due to _____

   1) frictional force 2) restoring force 3) gravational force 4) Tension

10. The force exerted by the fluid on the body when it is immersed in the fluid is_____

    1) force of friction 2) Buoyant force 3) gravational force 4) Tensional force

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LEVEL-1 Single Correct Choice Type:

1. The acceleration due to gravity is independent of
   1) friction 2) mass 3) weight 4) normal reaction
2. Teasional force act's _____
   1) along block 2) along string 3) downwards 4) center of block
3. The mass of the body is 10kg. Then weight of the body is_____ $\left[g = 9.8m/s^2\right]$
   1) 980 kg 2) 98 kg 3) 9.8 kg 4) 98 g
4. The weight of the body is 3kg. Then tension of the body is_____ $\left[g = 9.8m/s^2\right]$
   1) 3N 2) 4N 3) 2N 4) 1N
5. Instrument used to measure weight of the body is _____
   1) common balance 2) table balance 3) spring balance 4) by hand
6. How many normal reaction forces can be experienced by the body
   1) Only one 2) No normal reaction 3) Only two 4) More than one
7. The force of pull applied on the wooden block which are attached by the spring act's_____
   1) opposite to the direction of pull 2) same direction of pull
   3) perpendicular to the direction of pull 4) downwards
8. A block of 4kg is placed on a table. The force due to weight of the block is 4N Then what is the normal reaction
   1) 10N 2) 8N 3) 4N 4) 2N

Multi Correct Choice Type:

9. Which of the following are the contact forces
   1) Tensional force 2) Normal reaction
   3) spring force 4) gravational force

Statement Type:

10. Statement I : Weight of the body is constant
    Statement II : Weight of the body is measured by spring balance
    1) Both Statements I and II are true.
    2) Both Statements I and II are false.
    3) Statement - I is true, Statement - II is false.
    4) Statement - I is false, Statement - II is true.

LEVEL-2 & 3

11. Acceleration due to gravity of the moon is _____ (g is gravity of earth)

1) g/6 2) g/2 3) g/4 4) equal to g

12. When we place a wooden block on the surface of table. Block does not sink in to table because

1) pull of earth gravity 2) reaction force of table top

3) weight of block 4) reaction force of block

13. The force acting perpendicular to the surface of the body in outward direction is caleld_____

1) mechanical force 2) Gravitional force

3) Both (1) & (2) 4) Normal reaction

14. Relation between weight and normal reaction

1) R=mg 2) R > mg 3) R < mg 4) R =0

15. The mass of the body is 2kg. Then weight of body is _____

1) 19.6kg 2) 98kg 3) 9.8kg 4) 196kg

16. weight of a body in the fluid is 3kg 'what is buoyancy force

1) 6N 2) 3N 3) 1N 4) 1.5N

Comprehension Type

The weight of the body is W=mg

17. mass of the body is 1.0kg it's weight is_____ $\left[g = 10m/s^2\right]$

1) 10kg 2) 98kg 3) 9.8kg 4) 99kg

18. mass of the body is 4kg it's weight is_____ $\left[g = 9.8m/s^2\right]$

1) 39.2kg 2) 392kg 3) 3.92kg 4) 3920kg

19. weight of the body is 9.8kg it's mass _____ $\left[g = 9.8m/s^2\right]$

1) 1kg 2) 10kg 3) 9.8kg 4) 98kg

Matrix Match Type:

20.

Column - I	Column - II
a) Normal reaction	p) $g = 9.8m/s^2$
b) gravity of earth	q) N=mg
c) Tensional force	r) Fluid force
d) Buoyant force	s) T=mg

FORCE_SYNOPSIS-3

Force :

Push or pull of a body is called force

Units of Force : S.I unit of force = newton

C.G.S unit of force = dyne.

Relation between C.G.S unit of force and S.I unit of force is

1 newton $=10^5$ *dyne*

Effects of Force :

1. Force can bring change in state of motion (or) rest
2. Force can change direction
3. Force can change speed
4. Force can change shape

What else can a force do, besides moving a body?

Observe the boy catching a ball:

Here the boy applies some force to stop the ball.

i.e., Force can stop the moving bodies. Observe a player hitting a ball with his bat:

We observe that the player applies some force to change the direction of the ball.

i.e., Force can change the direction of the moving bodies.

Observe the girl sitting on a bean bag:

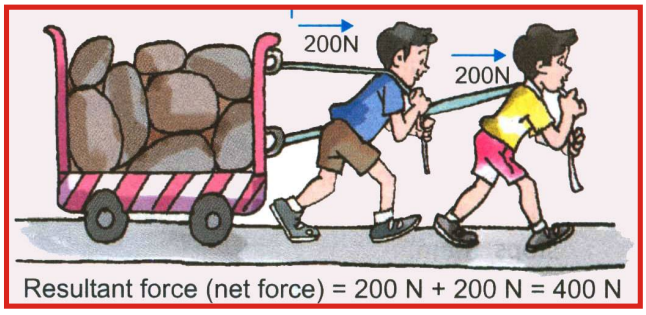
We observe that when the girl applies some force, the shape of the bag is changed.

i.e., Force can change the shape of the bodies.

Magnitude and direction of force :- A force can be large or small. The magnitude tells us how large or how small is a force.

The amount or the strength of force is called its magnitude. The magnitude of force is generally shown by a straight line. It means the greater the length of line, the more is its magnitude. The direction of force is shown by placing an arrow head over the line pointing the direction in which force is acting.

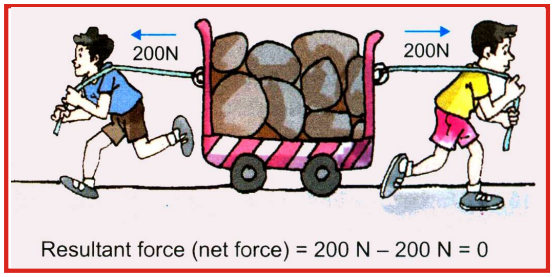
Addition of forces :- Suppose a boy trying to pull a heavy cart by applying a force of 200 N is unable to move it. Now let another boy apply a force of 200 N along with the first boy in the same direction.



It will be seen that cart will (i) start moving (ii) cart will move fist. The reason is that the two force applied in the same direction, get added and produce a large resultant force (net force). This force will be from the above figure.

200 N + 200 N = 400 N.

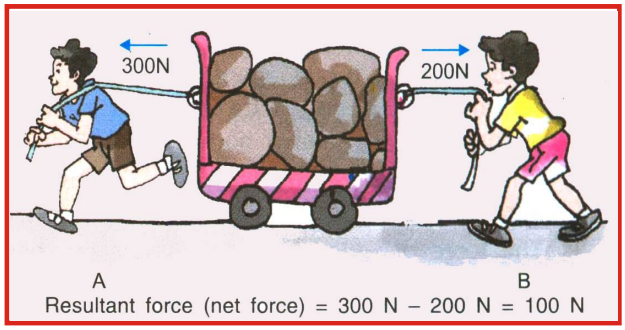
Cancellation and subtraction of forces :- If two boys pull the above cart in opposite directions with a force of 200 N each as shown in the figure it is observed that cart will not move at all.



It is because the resultant force (net force) becomes zero as the forces, being equal and opposite, cancel each other.

Resultant force = 200 N – 200 N = zero

Imagine a cart being pulled by two boys A and B, such that A can apply a force of 300 N and B can apply a force of 200 N shown in the figure.



The net force or the resultant force will be the difference of the forces and will act in the direction of the bigger force.

Thus, resultant force = (300 N – 200 N) = 100 N

and will act in the direction in which A is pulling. From the above examples following conclusions can be drawn :

i) When two forces are applied on the same body and at the same point and in the **same direction,** then the resultant force (total force or net force) is equal to the sum of the force acting separately. The direction of the resultant force will be the same as each of the force.

ii) When two forces are applied at the same point but in the **opposite directions,** then the resultant force (total force or net force) is equal to the difference of the forces acting separately. The direction of resultant force will be the direction in which the larger force acts.

FORCE WORKSHEET - 3

CUQ 1.Force can change the _____of the bodies.

1) direction 2) shape 3) speed 4) all of these

2. Which of the following is a vector quantity ?

1) Mass 2) Force 3) speed 4) Distance

3. S.I unit of force is_____

1) newton 2) dyne 3) kg 4) joule

4. Force can bring change in_____

1) weight 2) mass 3) speed 4) friction

5. C.G.S unit of force is_____

1) newton 2) kg 3) dyne 4) joule

6. If two boys are applying force on a bag of 50kg to pull each with a force of 50N then net force =_____

1) 50N 2) 100N 3) 5N 4) 500N

7. 1 Newton=_____dyne's

1) 10^3 2) 10^5 3) 10^7 4) 10^2

8. If two equal forces are acting on the same body in the opposite direction then the body is

1) moves fast 2) slow down

3) remains same 4) 1st move fast and slow down

9. If force is applied in the direction of motion of the body, then

1) speed decrease 2) comes to rest

3) increases the speed 4) moves with half of the speed

10. If the force applied in opposite direction to the direction of motion of the body then

1) speed decrease 2) comes to rest

3) speed increases 4) remain same

JEE MAIN AND ADVANCED

LEVEL-1 Single Correct Choice Type:

1. If two forces acting on a body at a point in the same direction, are 200 N and 100 N respectvely, then the resultant force is _____ N

1) 200 2) 300 3) 100 4) 0

2. If two forces acting on a body at a point in the opposite direction are 200 N and 300 N respectvely, then the resultant force is _____.

1) 100 N 2) 200 N 3) 300 N 4) 400N

3. If two forces acting on a body at a point in the opposite direction, are 200 N and 200 N respectvely, then the resultant force is _____ N

1) 200 2) 300 3) 100 4) 0

4. If no force acts on a body it will

1) Get displaced

2) Move with increasing speed

3) Move with decreasing speed

4) Either remain at rest or move in a straight line.

5. If two forces are applied on the same body and at the same point and in the same direction, then the resultant force is equal to

   1) The sum of the forces acting separately

   2) The difference of the force acting separately

   3) The product of the forces.

   4) The sum of the squares of the forces

6. What is the formula for net force

   1) sum of the forces acting

   2) difference of the forces acting

   3) force of first body 4) force of second body

7. The amount of strength of force is called

   1) weight 2) mass 3) direction 4) magnitude

Comprehension Type

Net force is the sum of the individual forces acting on the body

8. If $F_1 = 100N$ $F_2 = 500N$ acting in the same direction on the same body then

   $F_{net} =$

   1) 400N 2) 600N 3) 200N 4) 300N

9. If $F_1 = 300N$ $F_2 = 500N$ acting in the opposite direction on the same body then

   $F_{net} =$

   1) 200N 2) 800N 3) 700N 4) 100N

10. If $F_1 = 5N$ $F_2 = 5N$ acting in the same direction on the same body then

    $F_{net} =$

    1) 5N 2) 0N 3) 25N 4) 10N

LEVEL-2 & 3 Single Correct Choice Type:

11. A force 100N acts on an object towards east direction and another force of 50N acts on the object towards west direction. The net force actiong on the object is

    1) 100N 2) 50N 3) 150N 4) 25N

12. 1 dyne =_____Newtons

    1) 10^{-2} 2) 10^{-5} 3) 10^{-7} 4) 10^{5}

13. A force can change _____of the body

    1) shape 2) mass 3) weight 4) volume

14. If $F_1 = 2N, F_2 = 3N$ act in the same direction, then net force is _____

1) 5N 2) 1N 3) 0N 4) 6N

15. The net force acting on the body is 10N. If two equal forces acting simuntaneously on the body, the F is _____

1) 10N 2) 5N 3) 1N 4) 0N

16. Two dogs are applying equal forces on a piece of a cloth in opposite direction what do you observe

1) move's forward 2) move's backward

3) remains same 4) move's upward's

Comprehension Type

17. If $F_1 \, and \, F_2$ are acting on the same body in the same direction is

1) $F_{net} = F_1 + F_2$ 2) $F_{net} = F_1 - F_2$ 3) $F_{net} = F_1 \times F_2$ 4) $F_{net} = 2F$

18. If $F_1 \, and \, F_2$ are acting on the same body in the opposite direction is

1) $F_{net} = F_1 + F_2$ 2) $F_{net} = F_1 - F_2$ 3) $F_{net} = F_1 \times F_2$ 4) $F_{net} = 0$

19. If $F_1 = F\,N, F_2 = F\,N$ acting on two different bodies at the same time then the force is _____

1) F N 2) 2F N 3) 0 N 4) F/2 N

Multi Correct Choice type

20. Unit of force is _____

1) newton 2) dyne 3) kg-m 4) g-cm

SYNOPSIS-4

Linear momentum :- Quantity of motion possessed by a moving body is known as momentum of the body. (or) The total quantity of motion contained in a body is called momentum.

Mathematical expression : Momentum of a body is equal to the product of the mass (m) of the body and the velocity (V) of the body. It is denoted by **P = m×v** .

Units of momentum : S.I. unit of momentum = S.I unit of mass × S.I unit of velocity = kg × m/s = kg m/s. Similarly C. G. S. unit of momentum is **g cms^{-1}.**

The direction of momentum of a body is same as that of the direction of the velocity of the body.

Change in momentum : conssider a body of mass 'm' initialy moving with a velocity 'v_1' after moving with a velocity of 'v_2'

initially momentum of a body $(p_1) = mv_1$

final momentum of a body $(p_2) = mv_2$

change in momentum of a body = final momentum of a body -initial momentum

$$p_2 - p_1 = mv_2 - mv_1 = M(v_2 - v_1) = M\Delta V$$

Change in momentum of two bodies having different masses m_1 and m_2 is $m_2v_2 - m_1v_1$.

Weight : The gravitational force of attraction of the earth acting on a body is known as its weight. Near the surface of the earth it is the product of mass of the body M and gravitational acceleration g, thus weight W = Mg and acts vertically downward.

i. Weight of the body messured by spring balance.

ii. Weight is not constant it changes according to 'g' value where $g = 9.8\,m/s^2$

Mass : The amount of matter cotained in a body is called its mass.

Units of Mass : In CGS system unit of mass is gram (g).

In SI system unit of mass is kilogram (kg)

DIFFERENCE BETWEEN MASS AND WEIGHT

MASS	WEIGHT
1) It is the measure of metter contained in a body. 2) It is a constant quantity. 3) It is found by means of physical balance 4) It is a scalar quantity.	1) It is the force with a body is attracted towards the centre of earth. 2) It is a variable quantity. 3) It is found by means of spring balance. 4) It is a vector quantity.

ACTIVITY

Ask two students to pull the object on the table from opposite sides and from one side. What is observed ?

WORKSHEET - 4

CUQ 1.Mathematical expression of linear momentum is

1) $p = \frac{m}{v}$ 2) $p = m \times v$ 3) $p = \frac{v}{m}$ 4) $p = m + v$

2. C.G.S unit of linear momentum is

1) $g\,cm\,s^{-1}$ 2) $kg\ m\,s^{-1}$ 3) $g\,cms$ 4) $kg\,ms$

3. Which of the following is a vector quantity ?
   1) Mass 2) Weight 3) speed 4) Distance
4. Which of the quantity is differece from place to place ?
   1) mass of body 2) weight of the body 3) both(1) & (2) 4) neither(1) nor (2)
5. linear momentum is a _____quantity
   1) scalar 2) vector
   3) fundemental quantity 4) Both (1) and (2)
6. change in momentum= _____
   1) Final momentum + initial momentum
   2) Final momentum - initial momentum
   3) Final momentum $\times$ initial momentum
   4) initial momentum - final momentum
7. The measure of matter contain in the body is
   1) mass 2) weight 3) volume 4) Both (1) and (2)
8. mass is _____quantity
   1) scalar 2) vector 3) derived quantity 4) Both (1) and (2)
9. physical balance is used to measure _____of the body
   1) volume 2) weight 3) mass 4) area
10. S.I unit of linear momentum is
   1) kg m/s 2) $g\ cms^{-1}$ 3) kg 4) g-cm

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LEVEL-1 Single Correct Choice Type:

1. spring balance is used to measure _____
   1) mass 2) weight 3) linear momentum 4) volume
2. C.G.S. unit of mass is
   1) kilogram 2) milligram 3) gram 4) meters
3. A car is moving with a velocity 50 m/s it's mass is 5kg find linear momentum of the car
   1) 10 kg m/s 2) 25 kg m/s 3) 250 kg m/s 4) 250 g cm/s
4. A person of mass 60kg is running with a velocity of 10 m/s find is linear momentum
   1) 60 kg m/s 2) 600 kg m/s 3) 6 kg m/s 4) 60 g cm/s
5. if m=300 g and velocity v=10 cm/s then p is
   1) 3000 g cm/s 2) 300 g cm/s 3) 30 g cm/s 4) 30 kg m/s
6. A body of mass m_1 is moving with a velocity v_1 and collides another body of mass m_2 which is moving with a velocity v_2 then the change in momentum is
   1) $m_2v_2 - m_1v_1$. 2) $m_2v_2 + m_1v_1$. 3) $m_2v_2 \times m_1v_1$. 4) $m_1v_2 - m_2v_1$.

.Comprehension Type:

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

7. Momentum of a body depends on
   1) Mass 2) Velocity 3) Both (1) and (2) 4) Neither (1) nor (2)
8. The total quantity of motion contained in a body is
   1) Mass 2) Velocity 3) Momentum 4) None of these
9. C.G.S unit of momentum is
   1) g cm s^{-2} 2) g cm 3) g cm s^{-1} 4) g m/s^2

Statement Type

10. Statement I : Matter contained in a body is called mass
Statement II : Mass is measured by spring balance.
1) Both Statements I and II are true
2) Both Statements I and II are false
3) Statement - I is true, Statement - II is false.
4) Statement - I is false, Statement - II is true.

LEVEL-2 & 3 Single Correct Choice Type

11. A man having mass of 50 kg moving with a velocity 18 km/hr what is his momentum
1) 50 kg m/s 2) 250 kg m/s 3) 250 g cm/s 4) 2500 kg m/s

12. If a car of mass 600 kg has a linear momentum 3600 kg m/s what is it's velocity
1) 60 m/s 2) 60 cm/s 3) 6 m/s 4) 0.6 m/s

13. A person of weights 50 kg what is his weight on the moon
1) 8.33 kg 2) 40 kg 3) 10 kg 4) 8 kg

14. A car of mass 2000 kg moving with a velocity 10 m/s. A lorry of mass 4000 kg is moving with a velocity 5 m/s find the momentum
1) both have equal 2) lorry > car 3) car > lorry 4) 0

15. mass of the golf ball is 0.1 kg the velocity of the ball is 90 kmph .Find the momentum of the golf ball
1) 10 m/s 2) 25 m/s 3) 2.5 m/s 4) 1 m/s

16. If a body has p=480 kg m/s v=2 m/s find velocity of the body
1) 24 kg m/s 2) 240 kg m/s 3) 2.4 kg m/s 4) 240 kg m/s

17. A antheletic runing with a velocity of 60 m/s having a momentum 720 kg m/s
1) 120 kg m/s 2) 12 kg m/s 3) 0.12 g cm/s 4) 1.2 kg m/s

Matrix Match Type:

18.

Column - I	Column - II
a) Weight	1) m/s
b) Momentum	2) kg
c) Mass	3) mg
d) Velocity	4) m×v
	5) g cm/s

Integer Answer Type:

19. The weight acting on a mass of 10.5 kg being pulled by the earth is___N. ($g=10ms^{-2}$)

Multi Correct Choice Type

20. units of linear momentum is
1) kg m/s 2) g cm/s 3) $kg\,ms^{-1}$ 4) $g\,cms^{-1}$

FORCE KEY

WORKSHEET - 1

CUQ'S: 1) 1 2) 2 3) 1 4) 3 5) 4 6) 2 7) 3 8) 4
9) 2 10) 3

LEVEL-1: 1) 3 2) 2 3) 1 4) 1 5) 4 6) 2 7) 3 8) 2
9) 2 10) 2,3,4 11) 1 12) 4 13) 3 14) 3 15) 2 16) 2
17) 1 18) 2 19) 1 20) a-3, b-1, c-2, d-4 21) 2

WORKSHEET - 2

CUQ'S: 1) 1 2) 2 3) 4 4) 3 5) 1
6) 3 7) 3 8) 3 9) 2 10) 2

LEVEL-1: 1) 2 2) 2 3) 2 4) 1 5) 3
6) 4 7) 1 8) 3 9) 1,2,3 10) 4
11) 1 12) 2 13) 4 14) 1 15) 1
16) 2 17) 3 18) 1 19) 1 20) a-2, b-1, c-4, d-3

WORKSHEET - 3

CUQ'S: 1) 4 2) 2 3) 1 4) 3 5) 3
6) 2 7) 2 8) 3 9) 3 10) 1

LEVEL-1: 1) 2 2) 1 3) 4 4) 4 5) 1
6) 1 7) 4 8) 2 9) 1 10) 4
11) 2 12) 2 13) 1 14) 1 15) 2
16) 3 17) 1 18) 2 19) 1 20) 1,2

WORKSHEET - 4

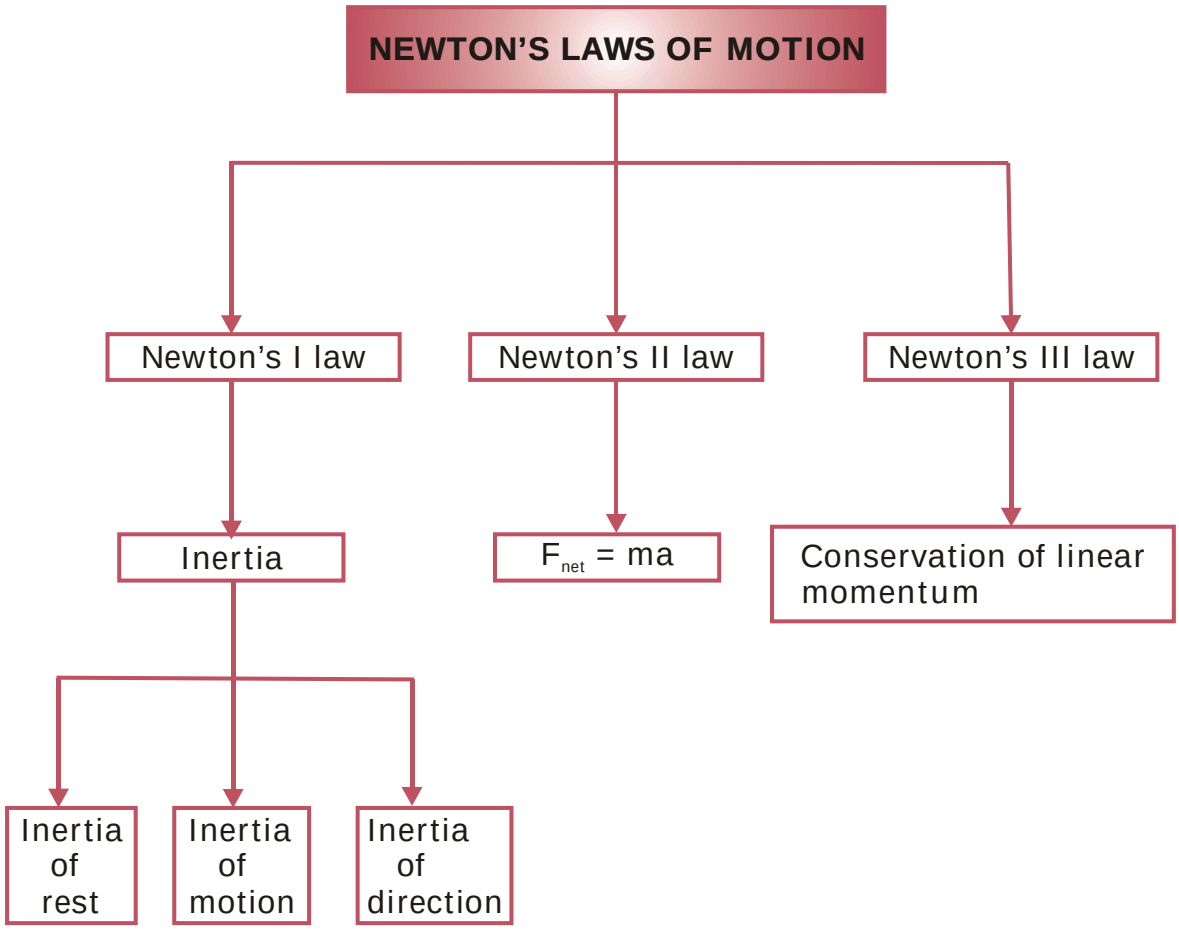
CUQ'S: 1) 2 2) 1 3) 2 4) 2 5) 2
6) 2 7) 1 8) 1 9) 3 10) 1

LEVEL-1: 1) 2 2) 3 3) 3 4) 2 5) 1
6) 1 7) 3 8) 3 9) 3 10) 3
11) 2 12) 3 13) 1 14) 1 15) 3
16) 2 17) 2 18) a-3, b-4,5, c-2, d-1 19) 105
20) 1,2,3,4

NEWTON LAW'S OF MOTION

CONTENTS

MEMO GRAPH


NEWTON'S LAWS OF MOTION
Newton's I law
Newton's II law
Newton's III law
Inertia
F_{net} = ma
Conservation of linear momentum
Inertia of rest
Inertia of motion
Inertia of direction

NEWTON LAW'S OF MOTION

NEWTON'S LAWS OF MOTION SYNOPSIS-1

(Newton's I law of motion, Inertia, Types of Inertia : Inertia at rest, Inertia of motion and Inertia of Direction).

Newton has given three laws to describe the motion of bodies. These laws are known as Newton's laws of motion.

Newton's First law: If no external force acts, a body continues to be in its state of rest or of uniform motion along a straight line. (or)

If no external force acts, we can also say that "bodies" go on doing what they are doing.

Inertia: In the above law it is clear that a body at rest and a body in uniform motion continue to do what they are doing. Thus, a body cannot change its state of rest or of uniform motion by itself.

The inability of a body to change by itself its state of rest or of uniform motion is called inertia of the body or inertia can also be defined as the tendency of a body to remain in the state of rest or uniform motion.

Measure of inertia: Mass is the measure of inertia. It is more difficult to move a heavier body than a lighter body from the state of rest. Similarly, it is more difficult to stop a heavier moving body than a lighter body. Thus, the more the mass, the more the inability of the bodies to change their state and hence the more their inertia. Hence we can conclude that mass is the measure of inertia.

Force and inertia: We have seen that inertia is defined as the inability of a body to change by itself its state of rest of uniform motion. Then, how can the body overcome this inability (inertia)? The body does it with the help of force. Thus force is an agent which overcomes inertia.

Definition: Force may be defined as that physical cause which changes or tends to change the state of rest or the state of motion of a body.

Types of Inertia: There are three different types of inertia. They are:

(i) Inertia of rest (ii) Inertia of motion (iii) Inertia of direction

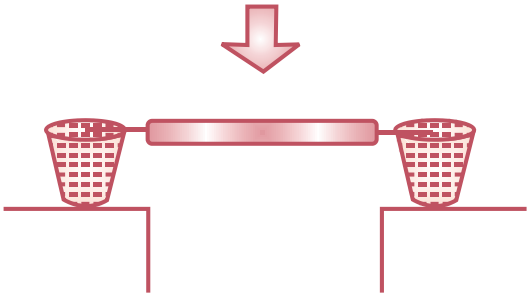
(i) Inertia of rest: The tendency of a body to continue in its state of rest is called inertia of rest.

Example:

a) The passengers standing in a bus fall backwards, when the bus suddenly starts because the feet of the passengers start moving along with the bus as it is in contact with the floor of the bus. Whereas, the upper part of the body, due to inertia of rest, tries to remain stationary. Thus the lower portion of the body (foot) moves forward and the upper portion remains at rest due to inertia of rest, and thus the standing passengers fall back.

b) When a paper on which a pile of books are placed is suddenly pulled with a jerk, we expect the books also to move, but this does not happen. This is because the books, stay where they were due to inertia of rest when the paper is pulled out.

ACTIVITY



A wooden scale is placed horizontally with its two ends resting on two glass tumblers containing water as shown in figure. Strike suddenly the centre of the ruler with a long rod. Observe that neither the glass tumblers break nor the water spill out. But the scale gets broken into two pieces. Why does this happen?

(ii) Inertia of motion: The tendency of a body to continue in its state of motion is called inertia of motion.

Example:

a) When a fan is switched off, it continues to move due to inertia of motion.

b) A running boy falls in the forward direction if he is tripped by a stone because the stone stops his foot, whereas the rest of the body continues moving forward due to inertia of motion and hence the boy falls in the forward direction.

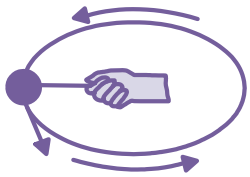
c) A rider falls forward when a galloping horse stops suddenly because when a horse stops, the rider due to inertia of motion, continues moving and hence falls in forward direction.

d) Before taking a long jump, an athlete runs a certain distance. In doing so, he picks up inertia of motion which helps in taking a longer leap.

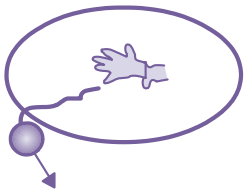
(iii) Inertia of direction: The tendency of a body to maintain its direction of motion is known as inertia of direction.

Example 1: A stone tied to a string is whirled. If the string is released, the stone flies away tangentially.

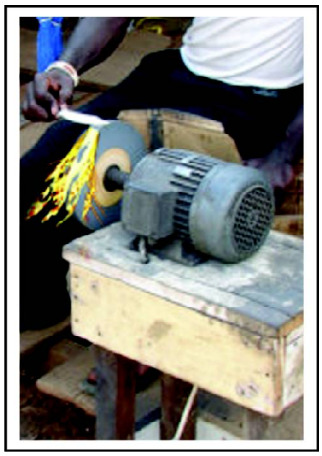
Reason: If a stone tied to a string is whirled, the direction of motion, at any instant is the tangential direction as shown below:



Due to inertia of direction, the stone tries to maintain its direction every moment. This can be confirmed, when the stone flies tangentially on release of the string as shown below:



Example 2: When a knife is sharpened by placing it on a rotating iron disc, the sparks move tangentially to the disc due to inertia of direction.



ACTIVITY

Place a coin on a card board placed over a tumbler. now flip the card quickly with your finger. what happen? The coin will neatly drop into the tumbler and the card flies off. the tendency of the coin to remain in its state of rest is called inertia of rest

NEWTON'S LAWS OF MOTION WORKSHEET-1

CUQ 1. According to Newton's first law of motion, unless some external force acts, a body will continue in its

1) state of rest
2) state of motion in a straight line
3) both (1) and (2)
4) none of these

2. The tendency of a body to continue in its state of rest or uniform motion in a straight line, even when some external force acts on it is called

1) pressure 2) momentum 3) inertia 4) force

3. The measure of inertia of a body is its

1) density 2) mass 3) volume 4) acceleration

4. If mass of a body is more, then inertia of the body

1) less 2) more 3) equal 4) can't say

5. The passengers sitting in a stationary bus tend to fall backward, when the bus accelerates suddenly on account

1) sitting carelessly 2) inertia of rest 3) inertia of motion 4) none of these

6. Which of the following is the most significant law of motion given by Newton?

1) First law of motion
2) Second law of motion
3) Third law of motion
4) Zeroth law of motion

7. The physical cause which changes or tends to change the state of rest (or) the state of motion of a body is _____.

1) Inertia 2) mass 3) force 4)velocity

8. When a fan is switched off, it continues to move due to

1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force

9. The tendency of a body to maintain its direction of motion is_____.

1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force

10. The statement "acceleration is *zero* if and only if the net force is *zero*" is valid in

1) non-inertial frames
2) inertial frames
3) both in an inertial frames and non-inertial frames
4) neither inertial frames nor non-inertial frames

JEE MAINS

Single Correct Choice Type:

1. The behaviour of a body under zero resultant force is given by

1) Newton's third law of motion
2) Newton's second law
3) Newton's first law
4) Newton's law of gravitation

2. Which of following has the largest inertia
   1) a pen 2) a pin
   3) your loaded school bag 4) your physics book
3. The inertia of a body tends to cause the body to
   1) speed up 2) slow down
   3) resist any change in its motion 4) all of these
4. The quantity of motion of a body is best represented by
   1) its mass 2) its speed 3) its velocity 4)its linear momentum
5. Under zero resultant force
   1) Body remains in rest 2) Body is accelerated
   3) Both in non-uniform motion 4) both(1) & (2)
6. Which law of Newton defines an 'inertial frame of reference'?
   1) First law of motion 2) Second law of motion
   3) Third law of motion 4) Law of gravitation
7. There are two similar spheres, such that one is made from lead and other from wood. Which will have more inertia ?
   1) Lead sphere 2) Wooden sphere
   3) Both lead and wooden sphere 4) None of these
8. There are two spheres of equal mass, made of iron and wood. Which will have more inertia?
   1) iron 2) wood
   3) Both have same inertia 4) can't say
9. If a body is moving with constant velocity on a frictionless horizontal surface, then an external force
   1) is acting continuously 2) is a variable
   3) is not acting 4) is acting opposite to the direction of motion.
10. You lunge forward when your car suddenly comes to a halt and you are thrown backward when your car rapidly accelerates. Which law of Newton in involved in these?
    1) third law 2) second law 3) first law 4) law of gravitation
11. When a knife is sharpend by placing it on a rotating iron disc, the sparks more tangentially to the disc due to _____.
    1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force
12. You are thrwon outer side when your car suddenly takes a turn, whcih law of Newton is involved in this?
    1)I law 2) II law 3)III law 4)IV law
13. Newton's first law defines the following
    1) speed 2) volume 3) inertia 4) acceleration

14. Newton's first law of motion is also called _____ law of inertia.
    1) Newton's 2) Charles 3) Galileo's 4) Coulombs
15. The property of inertia is by virtue of which the body is unable to change by itself
    1) The state of rest only 2) The state of uniform motion only
    3) The direction of motion only 4) The state of rest or uniform motion.
16. Inertia of a body has a direct dependence on
    1) Velocity 2) Mass 3) Area 4) Volume

JEE ADVANCED

Matrix Match Type

17.

Column-I	Column-II
a) Newton's first law of motion defines	1) Linear momentum
b) A passenger standing in a bus falls forward, when the bus stops suddenly due to	2) Inertia of rest
c) While dusting a carpet we suddenly jerk or beat it with a stick, it is an example of	3) Inertia of motion
d) When a bus suddenly takes a turn the passengers are thrown outward because of	4) Inertia of direction

18. choose the correct option;
    1) Newton's first law of motion is also called Galileo' s law of inertia
    2) Inertia of a body may be defined as the tendency of a body to oppose any change in its state of rest or uniform motion
    3) The quantity of motion of the moving body is proportional to mass of the body
    4) The tendency of a body to oppose any change in its direction of motion by itself is known as inertia of rest

Comphrensive type

Inertia of 3 types

1. Inertia of rest
2. Inertia of motion
3. Inertia of direction

19. Before taking a long jump, an athlete runs a certain distance due to
    1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force
20. A whirled stone tries to maintain its direction
    1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force
21. A runing boy falls in the farward direction if he is tripped by a stone because
    1) Inertia of rest 2) Inertia of motion 3) Inertia of direction 4)Force

NEWTON'S LAWS OF MOTION SYNOPSIS-2

1.Linear momentum :-

Consider two balls A and B. Let ball A be heavier than the ball B. i.e. mass (m_1) of ball A is greater than the mass (m_2) of the ball B. Suppose both balls are moving with same velocity $\vec{v}$. The force require to stop ball A is more than the force required to stop ball B. This shows that the heavier ball has more quantity of motion than the lighter ball. **Thus, quantity of motion of a body is directly proportional to the mass of the body.**

Now consider two balls of same mass moving with different velocities. The force required to stop the fast moving ball is more than the force required to stop the slow moving ball. So the quantity of motion of the body is directly proportional to the velocity of the ball.

Conclusion : The quantity of motion of the moving body is proportional to

(i) mass of the body (ii) velocity of the body.

This quantity of motion possessed by a moving body is known as momentum of the body. (or) The total quantity of motion contained in a body is called momentum.

Mathematical expression : Momentum of a body is equal to the product of the mass (m) of the body and the velocity $(\vec{v})$ of the body. It is denoted by $\vec{p}$.

Thus, momentum = mass × velocity

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

momentum is a vector quantity

Note :- The direction of momentum of a body is same as that of the direction of the velocity of the body.

Units of momentum : S.I. unit of momentum = S.I unit of mass × S.I unit of velocity = kg × m/s = kg m/s. Similarly C. G. S. unit of momentum is **g cms^{-1}.**

Change of momentum : If 'u' and 'v' are the initial and final velocity of a body then its, initial momentum = mu final momentum = mv

Now change of momentum = final momentum – initial momentum = mv – mu

NEWTON'S LAWS OF MOTION WORKSHEET-2

CUQ

1. The product of mass and velocity of a body is called

1) force 2) momentum 3) moment of force 4) pressure

2. The total quantity of motion is called _____.

1) mass 2)velocity 3) linear momentum 4) acceleration

3. The linear momentum of a body is denoted by the letter

1)V 2)P 3) m 4)w

4. The quantity of motion of a body is directly proportional to its

1) mass 2) velocity 3) both (1) & (2) 4) none of these

5. The momentum of a body is

1)vector quantity 2)scalar quantity 3)both(1) and (2) 4)neither (1) nor (2)

6. The quantity of motion possessed by a moving body is known as _____ of the body

1) mass 2)velocity 3) momentum 4) force

7. The S.I. unit of momentum is_____.

1) kg m/s 2) kgm/s^2 3) kg m 4) m s^{-1}

8. The C.G.S unit of momentum is

1) g cm/s 2) g cm/s^2 3) g m 4) cm s^{-1}

JEE MAINS

1. If 'm' is the mass of the body and 'v' is the velocity of the body, then the momentum 'P' of the body is given by _____.

1)P = m/V 2) P = mV 3) P = m+V 4)P = m–V

2. What will be the momentum of the body of mass 20g moving with a velocity 5cm/s is

1) 4 g.cm/s 2) 100 g.cm/s 3) 25 g.cm/s 4)15 g.cm/s

3. What will be the momentum of the body of mass 200g moving with a velocity 2cm/s is _____.

1) 400 kg.m/s 2) 400 g.cm/s 3) 400 kg.cm/s 4) 400 g.m/s

4. What will be the momentum of the body of mass 15kg moving with a velocity 5 m/s is_____.

1) 20 kg.m/s 2) 75 kg.m/s 3) 25 kg.m/s 4) 10 kg.m/s.

5. What will be the momventum of the body of mass 10 kg moving with a velocity 10 m/s is

1) 100 kg.m/s 2) 100 g.cm/s 3) 100 kg.cm/s 4) 100 g.m/s

6. What will be the momentum of a toy car of mass 200g moving with a speed of 5m/s ?

1)1kg m/s 2) 6kg m/s 3)14kg m/s 4) 23kg m/s

7. A cricket ball of mass 100g is moving with velocity 25m/s. Then the momentum of the ball is

1) 7.5kg m/s 2)19.5kg m/s 3)2.5kg m/s 4) 27.5kg m/s

8. If 'u' and 'v' are the initial and final velocity of a body of mass 'm' its initial momentum is given by

1) m + u 2) mu 3) m/u 4)m – u

9. In question(8) the final momentum is given by

1) m + v 2) m – v 3) mv 4)m – v

10. In question(8) the change momentum is given by

1) mv 2) mu 3) mv – mu 4) mv – mu

11. If a body of mass 2 kg moving with a velocity 4 m/s, after some time velocity becomes 8 m/s, change in momentum is given by

1) 8 kg m/s 2)16 kg m/s 3) 32 kg m/s 4) 4 kg m/s

12. Choose the correct option

1) p = v/m 2) p =mv 3) p = m/v 4) m = pv

13. If a body of mass 5 kg moving with a velocity 5 m/s, then the momentum of the body is given by

1) 1 kg m/s 2)10 kg m/s 3) 25 kg m/s 4) 15 kg m/s

14. Velocity of a body of mass 20 kg whose momentum is 800kg m/s is

1) 40 m/s 2)80 m/s 3) 8 m/s 4) 4 m/s

15. Two bodies of masses m_1,m_2 are moving with velocities v_1,v_2 respectively then ratio of their momentum will be,

1) $m_1v_1 : m_2v_2$ 2) $m_1m_2 : v_1v_2$ 3) $m_1 : m_2$ 4) $v_1:v_2$

16. Two bodies of equal masses moving with velocities v_1 and v_2, then the ratios of their momentums is

1) $v_1 + v_2 : v_1 - v_2$ 2) 1:2 3) 2 : 1 4) $v_1:v_2$

17. Two bodies A and B of same mass are moving with velocitys V and 3v respectively, then the ratio of their momentum will be

1)1:2 2)2:1 3)3:4 4)1:3

18. The momentum of a body of mass 'm' is 20 kg m/s, which is moving with a velocity 5 m/s then m is_____.

1)20 kg 2)5 kg 3) 4 kg 4)100 kg

19. The momentum of a body of mas 10 kg is 200 kg m/s the velocity of the body with which it is moving is _____.

1) 2 m/s 2) 20 m/s 3)200 m/s 4)2000 m/s

20. Two bodies of mass are in the ratio 1:2 and velocities are in the ratio 2 :1, then the momentum of the bodies are in the ratio

1) 1 : 1 2) 1 : 2 3) 2:1 4) 1:4

JEE ADVANCED

Mutli correct choice type:

21. Unit of momentum is

1) Kg m/s 2) kg ms^{-1} 3) g cm/s 4) g cms^{-1}

Comphresive type

If 'u' and 'v' are the initial and final velocities of a body = mv – mu
mass 'm' then change in momentum

22. Initial momentum of the body

1) mu 2) m/u 3) m + v 4) m – u

23. Final momentum of the body

1) mv 2) m/v 3) m + v 4) m – v

24. Change in momentum of the body

1) mv – mu 2) m(v – u) 3) both (1) & (2) 4) v – u

Matrix Match Type

25.

Column-I	Column-II
a) Initial momentum of body	1) mv-mu
b) Rate of change of momentum	2) m/(v–u)
c) change in momentum of body	3) m(v-u)/t
d) final momentum of body	4) mv
	5) mu

Comphresive type

A body of mass 3 kg moving a velocity 10 m/s after sometime its velocity becomes 20 m/s

26. Initial momentum of the body (kg m/s)

1)3 2) 10 3) 30 4) 60

27. Final momentum of the body (kg m/s)

1)2 2) 20 3) 60 4) 30

28. Change in momentum of the body (kg m/s)

1)3 2) 20 3) 30 4) 180

Matrix Match Type:

29.

Column-I	Column-II
a) Unit of momentum	1) kg m/s
b) Unit of change in momentum	2) g cm/s
c) S.I. unit of momentum	3) kg ms^{-1}
d) C.G.S. unit of momentum	4) g cm s^{-1}
	5) kg m

NEWTON'S LAWS OF MOTION SYNOPSIS-3

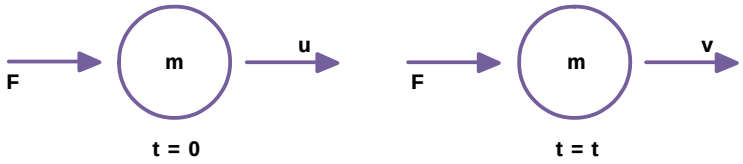
Newton's IInd law, F_{net}= ma ; Units of force ; Relation between them)

Newton's Second Law :- The magnitude of the resultant force acting on a body is proportional to the product of the mass of the body and its acceleration (F=ma). The direction of the force is the same as that of the acceleration.

Newton's 2nd Law in terms of momentum :

The rate of change of momentum of an object is proportional to the net force applied on the object. The direction of the change of momentum is the same as the direction of the net force.

Derivation of F=ma: Consider a body of mass 'm' moving with initial velocity 'u'. Let a force 'F' acts on the body for time 't' so that the velocity of the body after time 't' is 'v'.



Initial momentum of the body (P_i) = m u

Final momentum of the body (P_f) = m v

Now, change in momentum of the body = $P_f - P_i$ = mv – mu = m (v – u)

Time taken for this change in momentum = (t – 0) = t

$$\therefore \text{ Rate of change of momentum} = \frac{\text{change of momentum}}{\text{time taken}} = \frac{m(v-u)}{t} = m\,a$$

$$\left(\because a = \frac{(v-u)}{t}\right)$$

Note :

i. Newton's first law of motion is a special case of Newton's second law of motion

We know that $F = ma = m\left(\frac{v-u}{t}\right)$

If velocity of the body is constant i.e. u = v, then $F = m\left(\frac{v-v}{t}\right) = 0$

Thus, no force is required to move a body with constant velocity or uniform velocity. If u = 0, then v is also zero, it means that the body will remain at rest, if no external force is applied on the body. This is first law of motion.

ii. The net force, F_{net} = ma, includes only the forces that the environment exerts on the object of interest. Such forces are called external forces.Incontrast, internal

forces are forces that one part of an object exerts on another part of an object and are not included in the equation, F_{net} = ma. Example : Passengers sitting inside the bus cannot push the bus from inside the bus.

Units of Force :

i) Absolute Units of Force : S.I unit of force = kg m/s^2 or newton

C.G.S unit of force = g cm/s^2 or dyne.

Definition of newton (N) : 1 newton is that much force which produces an acceleration of 1 m/s^2 in a body of mass 1 kg.

Definition of dyne : The force is said to be 1 dyne if it produces 1 cm/s^2 acceleration in a body of mass 1 g.

Relation between newton and dyne :

1 newton (N) = 1 kg m/s^2 = 1000 g × 100 cm/s^2

= 100000 g cm/s^2 = 10^5 gcm/s^2 = 10^5 dyne

ii) Gravitational Units of force : Gravitational unit of force is the force which produces an acceleration equal to the acceleration due to gravity in a unit mass.

a) Gravitational unit of force in S.I. system is kilogram weight or kilogram force.

1 kg wt = 1 kg × 9.8 m/s^2 (on earth)

1 kg wt (kgf) = 9.8 kg m/s^2 = 9.8 N (on earth)

b) Gravitational unit of force in C.G.S. system is 1 gram weight or gram force.

1 g wt = 1g × 980 cm/s^2 (on earth)

1 g wt = 980 g cm /s^2 = 980 dyne (on earth)

Ask two students to pull the object on the table from opposite sides and from one side. What is observed?

NEWTON'S LAWS OF MOTION WORKSHEET-3

CUQ

1. Newton's II-Law is represented as

1) F= m/a 2)F= ma 3)F = a/m 4) F = m+a

2. Magnitude of resultant forece is directly proportional to

1) mass 2)weight 3) density 4) volume

3. Magnitude of resultatnt force is directly porportional to

1) density 2)volume 3)weight 4) acceleration

4. The direction of force is the same as that of the

1) mass 2) distance 3)accelaration 4) volume

5. The direction of the change in momentum is the same as that of the

1) mass 2) distance 3) volume 4)net force

6. The C.G.S unit of force is
   1) newton 2) dyne 3) newton 4) m/s^2
7. The S.I. unit of force is
   1) dyne 2) m/s 3) newton 4) m/s^2
8. The symbol of S.I.unit of force is
   1) n 2) m 3) M 4) N
9. 1 N = _____.
   1) kg m/s^2 2) kg ms^{-2} 3) both (1) & (2) 4) None
10. 1dyne = _____.
   1) g cms^{-2} 2)g cm/s^2 3) both (1) & (2) 4) None

JEE MAINS

1. A force of 250 N acts on a body of mass 100 kg. The acceleration produced in the body is
   1) 25 ms^{-2} 2) 12.5 ms^{-2} 3) 125 ms^{-2} 4) 2.5 ms^{-2}
2. A body of mass 20kg, moving with an acceleration 5 m/s^2, then net force on body (g = 10 m/s^2)
   1) 20 N 2) 30 N 3) 100 N 4) 50 N
3. A force of 10 kgf produces an acceleration of 4.9 ms^{-2} in a body. The mass of the body is
   1) 20 kg 2) 10 kg 3) 4.9 kg 4) 98 kg
4. A force of 20 kgf produces how much acceleration on a body of mass 2 kg (in m/s^2)
   1) 10 2)20 3) 100 4) 200
5. A force 3gf produces an acceleration 980cm/s^2 in a body the mass of the body is ____.
   1) 980 g 2) 3g 3) 2940 g 4) 320 g
6. A force of 200N acts on a body of mass 1000 g. The acceleration produced in the body is _____ m/s^2.
   1) 200 2) 0.2 3) 300 4) 0.3
7. A force of 20 kg f produces an acceleration of 19.6 m/s^2 in a body of mass is ____kg
   1) 10 2) 40 3) 1 4) 4
8. A force of 10 gf produces an acceleration on 20 kg mass is
   1) 100 cm/s^2 2) 300 cm/s^2 3)400 cm/s^2 4) 500 cm/s^2
9. A body of mass 200 g moving with an accelaration of 10 m/s^2 then force acting on the body is _____ $\times 10^5$dynes.
   1) 20 2) 2 3) 0.2 4) 200
10. 1 Newton = _____.
   1) 1 kg m/s 2) 1 kg m/s^2 3) 1000g×1001 cm/s^2 4) 104 gcm/s^2

11. 1gm.weight is_____.

1) 9800gm.cm/s^2 2) 980 dyne 3) 98 dyne 4) 9.8 dyne

12. A body of mass 30 kg moving with an acceleration 4 m/s^2 then force on the body is ____dyne.

1) 12 × 10^5 2) 120 × 10^5 3)1.2 × 10^5 4) 1.2 × 10^6

13. A body of mass 20 g moving with an acceleration 2 cm/s^2 then force on the body is _____ Newton

1) 40 × 10^{-5} 2)4 × 10^{-4} 3)40 × 10^{-4} 4) both (1) & (2)

14. A force of 10 N produced how much acceleration on a body of mass 10 kg (in m/s^2)

1) 1 2)2 3)3 4)4

15. A force of 100gf produces an acceleration of 980 cm/s^2, on a body of mass is ____ gm

1)100 2) 200 3)300 4)400

16. 1 gm. wt is _____.

1)1gf 2) 1 kg f 3) 1 kgwt 4) 1N

17. An accelerated body should have

1) An unbalanced force acting on it. 2) All balanced forces acting on it.
3) No unbalanced force acting on it. 4) Constant velocity.

18. A body of mass m is dropped from a height h on a hard smooth horizontal surface it bounces back to same height, the magntiude of change in momentum of body is (-ve is for away from the floor).

1) $-m\sqrt{2gh}$ 2) $+m\sqrt{2gh}$ 3) 0 4) $+2m\sqrt{2gh}$

19. A body of mass 10 kg is dropped from a height 1m on a hard smooth surface it bounces back to same height the magnitude of change in momentum (kgm/s) is

1) $+20\sqrt{5}$ 2) $-20\sqrt{5}$ 3) $10\sqrt{5}$ 4) $40\sqrt{5}$

20. 1 kg f = _____ dynes

1) 98 × 10^4 2)9.8 × 10^4 3).98 × 10^4 4)98 × 10^5

JEE-ADVANCED

Multi Correct Choice Type:

21. 1 gf =_____(on earth)

1) 1gwt 2) 980dyne 3)1kgwt 4)9.8N

Comprehension Type

A ball of mass 2kg moving with initial velocity 5m/s is hit in the direction of initial velocity by a bat for 0.1s, the ball velocity becomes $6ms^{-1}$.

22. Find the acceleration of the ball

1) $5ms^{-2}$ 2) $10ms^{-2}$ 3) $1.25ms^{-2}$ 4) $2.5ms^{-2}$

23. Find the change in momentum of the ball (in $kgms^{-1}$)

1) 0.5 2) 1 3) 2 4) 4

24. Find the force acted on the ball in newton.

1) 5 2) 10 3) 15 4) 20

Matrix Match Type

25.

Column-I	Column-II
a) S.I unit of force	1) 980 dyne
b) F =	2) mv – mu
c) change in momentum	3) ma
d) 1 gwt	4) newton
	5) dyne

Comprehension Type

A force 100N acts on a body for 10s

26. The change in momentum is _____ kg m/s

1) 1000 2) 100 3)10 4)1

27. If mass of the body is 20kg, Then change in velocity is _____m/s.

1) 50 2)500 3)5 4)0.5

28. If mass of the body is 20 kg, then acceleration is _____m/s^2.

1) 5 2)50 3)500 4)0.5

Multi Correct Choice Type:

29. Choose the correct option

1) The acceleration produced in a body is directly proportional to the force acting on it
2) The acceleration produced in a body is inversely proportional to the mass of the body
3) 1 newton = 10^{-5} dynes
4) 1 gm weight = 980dynes [on earth]

NEWTON'S LAWS OF MOTION SYNOPSIS-4

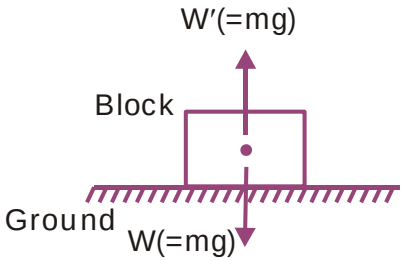
Newton's Third Law :

'To every action, there is an equal and opposite reaction'

Note : Action and reaction force are equal in magnitude but opposite in direction.

i.e. Action = – Reaction

In other words, whenever two bodies interact with each other, the force exerted by the first body on the second body (called action) is equal and opposite to that exerted by the second body on the first body (called reaction).



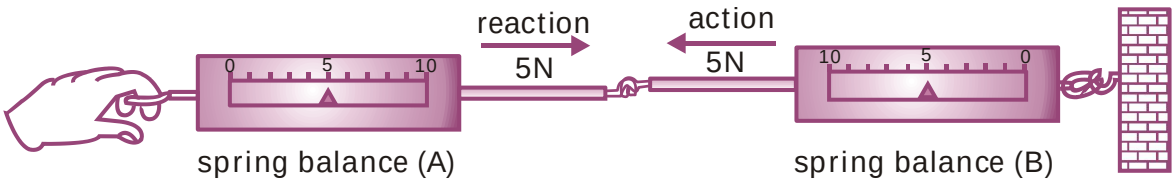
action (weight of the block acting downward)

For example, a block when placed on the ground, exerts a force acting downwards equal to its weight W (mg) on the ground (due to the attraction by the earth). This is called action. The ground exerts an equal and opposite force W (mg) on the block in the upward direction. This is called reaction. From the above examples it is clear that,

1) Both action and reaction are forces [In this case, F = mg]
2) Action and reaction act simultaneously but act on different bodies (In this case the block and the ground are two different bodies on which action and reaction act simultaneously)
3) Action and reaction acts on different bodies. For this reason, they cannot cancel each other.
4) Action and reaction forces occur in pairs only (In this case if the block was not placed on the ground, no reaction W would have developed)

Action and reaction are always equal and opposite

Example : To show that action and reaction are equal and opposite, set up two similar spring balances as shown in the figure.



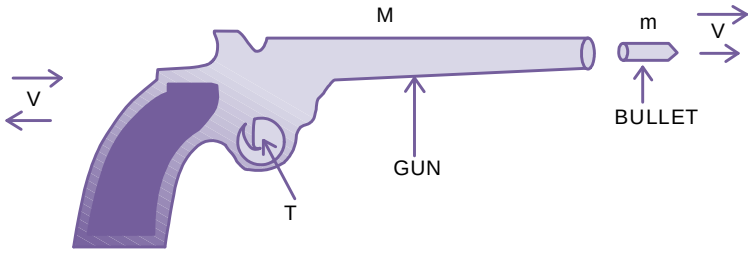
A simple experimental set up to show that action and reaction are equal but act in opposite directions and on different bodies.

When spring balance A is pulled towards left, it exerts a force (say 5N) on the balance B. As a result, the spring balance B reads 5 N (action). The balance A also reads 5 N. This means the balance B also exerts a force of 5 N on the balance A (reaction). Therefore, we see that action and reaction are equal but act in the opposite directions.

Examples of Newton's third law of motion :

1. A gun recoils when a shot is fired from it :

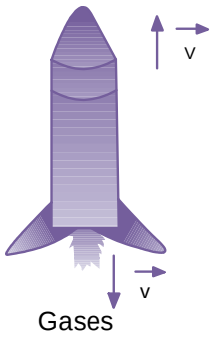
When a gun is fired, the bullet goes out due to the force applied on it through the trigger (this is action). According to Newton's third law of motion, the gun recoils backwards due to the reaction acting on it in the opposite direction. This gives a backward jerk to the shoulder of the gunman



Gun and bullet.

2. In case of jet aeroplanes and rockets :

In jet engines and rockets, the fuel is burnt to produce a large quantity of hot gases. These hot gases come out of a nozzle (a fine opening) with a great force (this is action). According to Newton's third law of motion, the equal and opposite reaction pushes the jet aeroplane and rockets forward with a great speed (this is reaction)



3. In case of a person moving forward during swimming :

When a person swims, he pushes the water in the backward direction with his hands (this is action). As the reaction, the water pushes the person in the forward direction with an equal force.

4. How do we walk ?

When we walk on the ground, then our foot pushes the ground backwards (this is action). In return, the ground pushes our foot forward with an equal and opposite

force, (this is reaction). The forward reaction exerted by the ground on our foot makes us walk forward

5. Rowing of a boat :

During the rowing of a boat, the boatman pushes the water backwards with the oars (this is action). According to Newton's third law of motion, the water exerts an equal and opposite push on the boat which moves forward. (this is reaction). In fact, harder the boatman push back the water with oars (i.e. greater is the action)) greater is the reaction force exerted by water an faster the boat moves forward.

NEWTON'S LAWS OF MOTION WORKSHEET-4

CUQ 1. According to Newton's III laws to every action there is an _____ and___reaction.

1) equal, equal 2) opposite, opposite 3) equal, opposite 4) None

2. The force exerted by the first body on the second body is called ____.

1) action 2)reaction 3) both (1) & (2) 4) None

3. The force exerted by the second body on first body is called _____

1)action 2) reaction 3) both (1) & (2) 4) None

4. Action and reaction forces act on

1) the same body 2) two different bodies

3) both (1) and (2) 4) None of these

5. Both action and reaction _____.

1) accelerations 2) distance 3) displacements 4) forces

6. Action and reaction act simultaneously but act on

1) same body 2) different bodies 3) both (1) & (2) 4) None

7. If action is 5N, then reaction is _____.

1) 15 N 2) 50 N 3) 5 N 4) 20 N

8. It is difficult to walk on sandy beaches, because due to the action of foot :

1) the sand yields 2) the reaction of sand is not much as action

3) our feet sink in the sand 4) both (1) and (2)

9. A runner covers more distance on land in a certain time, as compared to the distance covered by a swimmer in water because

1) water offers less reaction 2) land offers more reaction

3) water offers more reaction 4) both (1) and (2)

10. The rising of the rocket can be best explained by

1) Newton's first law of motion 2) Newton's second law of motion

3) Newton's third law of motion 4) None of these

JEE MAINS

Single Correct Choice Type:

1. Rocket derives the necessary thrust to move forward according to newton's
   1) I law 2) II law 3) III law 4) none of these
2. Which of the following works on the principle of newtons III-law
   1) rowing of a boat 2) a man walking on a floor
   3) both (1) & (2) 4) neither (1) nor (2)
3. The action and reaction forces referred to in newton's third law
   1) must act on the same objects 2) must act on different objects
   3) need not be equal in magnitude but must have the same direction
   4) None of these
4. A gun recoils after firing due to
   1) newton's first law of motion 2) newton's second law of motion
   3) newton's third law of motion 4) none of these
5. Rocket works on the principle of
   1) newton's first law of motion 2) newton's second law of motion
   3) newton's third law of motion 4) none of these
6. Jet plane works on the principle of
   1) newton's first law of motion 2) newton's second law of motion
   3) newton's third law of motion 4) none of these
7. A car accelerates on a horizontal road due to the force exerted by the
   1) road on the car 2) engine of the car
   3) car on the earth 4) driver of the car
8. When a horse pulls a cart, the force which helps the horse to move forward is the force exerted by
   1) cart on the ground 2) ground on the cart
   3) horse on the ground 4) ground on the horse
9. When we jump out of a boat standing in water, it moves
   1) backward 2) forward 3) sideways 4) None of these
10. A man is walking from east to west on a level rough surface. The force on the man is directed
   1) from west to east 2) from east to west
   3) along the north 4) along the west

11. In jet engines and rockets, the hot gasses come out of a nozzle with a great force is

1) Reaction 2)action 3) both (1) & (2) 4)None

12. A body exerts a force of 10 N on the ground then, the reaction of the ground on the body is

1) 10 N 2) 20 N 3) 30 N 4) 40 N

JEE ADVANCED

Multi correct Choice type:

13. which of the following are works on the principle of Newton's III law

1) Rowing a boat 2) Jet plane 3) Rocket 4) walking

14. Action and reaction are _____.

1) forces
2) equal in magnitude
3) opposite in direction
4) acts on same body

Statement Type

15. *Statement I:* Action and reaction forces are equal in magnitude but opposite in direction

Statement II: Newton's third law defines the force.

1) Both statements I and II are correct.
2) Both statements I and II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct.

Matrix Match Type

16.

Column-I	Column-II
a) W =	1) rocket
b) action =	2) – reaction
c) mv – mu =	3) change of momentum
d) newton's third law	4) mg
	5) rowing of a boat

Statement Type

17. *Statement I :* The sum of action and reaction will never becomes zero

Statement II : The forces of action and reaction acts on same body.

1) Both statements I and II are correct.
2) Both statements I and II are incorrect.
3) Statement I is correct and statement II is incorrect.
4) Statement I is incorrect and statement II is correct

NEWTON'S LAWS OF MOTION SYNOPSIS-5

Recap of formula related to Newton's second law of motion :

According to Newton's 2nd law, Force = mass × acceleration i.e. F = ma

$$F = \frac{\text{change in momentum}}{\text{time interval}} \Rightarrow F = \frac{mv - mu}{t}$$

Impulsive Force : A large force which acts for a small interval of time is called Impulsive force.

Impulse : Impulse of a force is defined as the change in momentum produced by the given force and it is equal to the product of force and the time for which it acts.

According to Newton's 2nd law of motion

$$\vec{F} = m\vec{a} = m\left(\frac{\vec{v} - \vec{u}}{t}\right) = \frac{m\vec{v} - m\vec{u}}{t} \Rightarrow \vec{F}t = m\vec{v} - m\vec{u}$$

Impulsive force = change in momentum.

Note : Impulse is a vector quantity, whose direction is same as that of force.

Unit : S. I. unit of impulse = N s or kg m/s

C.G.S unit of impulse = dyne second or g cm/s

Ex : 1) The force with which a hammer strikes a nail.

2) The force with which a bat hits a cricket ball.

NEWTON'S LAWS OF MOTION WORKSHEET-5

CUQ

1. According to Newton's II law

1) F = ma 2) F = m/a 3) F = m+a 4) F = m–a

2. A large force which acts for a small interval of time is called_____.

1) velocity 2) displacement 3) momentum 4)impulsive force

3. Change in momentum is same as

1) force 2) impulse 3) velocity 4) acceleration

4. Impulse is given by

1) Ft 2) Vt 3) at 4) st

5. Impulsive force = _____.

1) change in momentum 2) change in force

3) change in acceleration 4) change in distance

6. S.I. unit of impulse

1) Ns 2) kg m/s 3) NS^{-1} 4)both (1) & (2)

7. C.G.S. Unit of impulse
   1) dyne second 2) g cm/s 3) dyne/second 4)both (1) & (2)
8. Change in momentum = _____.
   1) f × t 2) f / t 3) f + t 4) f – t
9. Impulse is a _____ quantity
   1) scalar 2) vector 3) both (1) & (2) 4) None
10. kgm/s is the unit of
    1) force 2) velocity 3) acceleration 4) impulse

JEE MAINS

Single Correct Choice Type:

1. A force 10 N acts on a body for 3s, then impulse
   1) 100 NS 2) 30 NS 3) 300 NS 4) 10 NS
2. A force of 200 dynes acts on a body for 8s, Then impulse
   1) 1600 dyne-sec 2) 50 dyne sec 3) 2008 dyne sec 4) 208 dyne sec
3. The change in momentum is given by _____.
   1) mv – mu = f × t 2) mv = mu 3) mu =f×t 4) mv=f×t
4. A force of 50 N acts on a body for 10 s. What will be the change in momentum?
   1) 200 Ns 2) 400 Ns 3) 500 Ns 4) 1000 Ns
5. A force of 2.5 N acts on a body for 0.1 sec what is the change in momentum?
   1) 2.5 Ns 2) 0.25 Ns 3) 25 Ns 4) 250 Ns
6. A force of 30 dyne acts on a body for 0.1 sec, what is the change in momentum _____dyne sec.
   1) 30 2) 20 3) 3 4) 3
7. What will be the impulse on a body at rest when acted upon by a force of 4N for 2 sec is _____Ns.
   1) 6 2) 7 3) 8 4) 9
8. Howmuch force will produce an impulse of 10 NS, and acts for 0.2 sec on a body
   1) 1N 2) 5 N 3) 20 N 4) 50 N
9. How much force will produce an impulse of 100dyne sec, if it acts 0.1 sec on a body
   1) 1000 dyne 2) 100 dyne 3) 10 dyne 4) 1dyne
10. A force 7N acts on a body for 0.1 sec, then impulse is _____. (dyne sec)
    1) 700 2) 70000 3) 70 4) 7
11. A force 200 dynes acts on a body for 0.3 sec, then impulse ____ Ns.
    1) 0.6 2) 0.06 3) 6 4) 0.0006
12. What will be the impulse on a body at rest when acted upon by a force 8 N for 0.2 sec is _____ Ns
    1) 16 2) 1.6 3) 4 4) 40

13. A force of 2.5 N acts on a body 0.01 sec what is the impulse acting on the body is _____Ns.

1) 25 2) 250 3) 0.025 4) 0.25

14. How much force will require to produce 10 m/s change in velocity of a body of mass 1 kg if it acts for 0.1 secs is _____N

1) 10 2) 100 3) 1000 4) 1

15. How much force is required to produce impulse of 1NS, if that forcw will acts for 0.02 sec is _____dyne.

1) 50×10^4 2) 50×10^3 3) 50×10^5 4) 50×10^6

16. What is the change in velocity produced by a force of 2 N on a body of mass 2kg if its acts for 1sec is _____ m/s.

1) 4 2) 2 3) 3 4) 1

17. What is the change in velocity produced by a force of 200dyne on a body of mass 20g if its acts for 2sec is _____cm/s

1) 2 2) 20 3) 200 4) 2000

18. What is the change in velocity produced by a force of 2N on a body of mass 4 kg, if its acts 1sec is _____m/s.

1) 0.1 2) 0.5 3) 0.3 4) 0.2

19. In the Q.NO 22, the change in velocity is _____cm/s

1) 1 2) 50 3) 10 4) 1000

20. A body of mass 30×10^{-3} kg when acted upon by a force for 5 s attains a velocity of 100 m/s, if the same force is applied for 2 minutes on a body of mass 10 kg at rest what will be its velocity?

1) 4.2 m/s 2) 5.2 m/s 3) 6.2 m/s 4) 7.2 m/s

JEE ADVANCED

Multi Correct Choice Type

21. Choose the correct statements:

1) Change in momentum is the measure of mass.

2) Impulse and acceleration acts in opposite direction to the change in momentum

3) Change in momentum is the measure of impulse.

4) Linear momentum is a measure of quantity of motion contained by the body

Comprehensive Type

A force of 5N acts on a body of mass 2 kg for 10s

22. What is the impulse _____ (in Ns)

1) 5 2) 10 3) 20 4) 50

23. What is the change in momentum _____in (Ns)
1) 5 2) 10 3) 20 4) 50

24. What is the change in velocity _____(m/s)
1) 25 2) 100 3) 400 4) 250

Matrix Match Type

25.

Column-I	Column-II
a) Impulse	1) mv–mu
b) change in Momentum	2) $F \times t$
c) Force	3) Changes or try to change state of body
d) acceleration	4) rate of change of velocity
	5) ma

Comprehensive Type:

A force of 200 dynes acts on a body of mass 200g for 20 sec

26. What is the impulse _____(Ns)
1) $4\times10^{+2}$ 2) 4×10^{3} 3) 4×10^{-2} 4) 4×10^{-3}

27. What is the change in momentum _____(dyne sec)
1) 4×10^{3} 2)4×10^{2} 3) 4×10^{-3} 4) 4×10^{-2}

28. What is the change in velocity _____(cm/s)
1) 2 2)20 3) 200 4) 200

Comprehensive Type:

A force 3.5 N acts on a body of mass 200g acts for 2 sec

29. What is the change in momentum
1) 7 N 2) 7×10^{5} dyne 3) 7×10^{-5} dyne 4) both (1) & (2)

NEWTON'S LAWS OF MOTION_ SYNOPSIS-6

Force : The product of mass and acceleration is called force.

$\therefore$ force = mass × acceleration or F = ma

Types of forces : We come across large number of forces in nature some of the important forces are described below.

(a) Muscular forces : The force applied by the muscles of our body is called muscular force or biological force.

Ex : Lifting of heavy weight pulling of wheel cart, pushing a lawn roller etc. involves muscular forces.

(b) Mechanical forces : The forces generated by a machine are called mechanical forces.

Ex : 1. The force used to run a motor car engine is produced by using the energy of petrol.The force used to run steam engine, is produced by using the energy of coal.
2. The wind turbines use the energy of wind to produce force which is used for grinding which is used for grinding wheat. Sail boats also use the energy of wind to produce force which moves the boat.
3. The energy of flowing water is used to produce necessary force which runs a generator to produce electric current are examples of mechanical force.

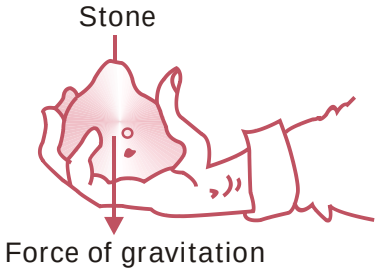
(c) Gravitational force :

The force of attraction exerted by the earth on all the objects is called the force of gravity or gravitational force.

Ex: 1. A stone falls downwards due to gravitational force.

2. It is the gravitational force of the sun that keeps the planets in their orbits.

3. It is the gravitational force of the earth which keeps the moon in its orbit.



(d) Electrostatic force :

The force exerted by electrostatic charge is called electrostatic force.

Ex : Charged comb attracts small pieces of paper.

(e) Magnetic force : The force by which a magnet attracts or repels objects of iron, steel, nickel and cobalt is called magnetic force.

Comb the dry hair many times and bring the comb near to the pieces of paper. Take a glass slab and rub it with woolen cloth and bring it near to the pieces of paper. Observe what happens. Pieces of paper are attracted by comb and glass slab.

NEWTON'S LAWS OF MOTION WORKSHEET-6

CUQ

1. The product of mass and acceleration is called _____.

1) Force 2) velocity 3) density 4) volume

2. Muscular force is also called_____.

1)Graviational force 2) Biological force

3) Electro state force 4)Magnetic force

3. The force generated by a machine is called_____.

1) Graviational force 2) Mechanical force

3) Magnetic force 4) state force

4. The force of attraction exerted by the earth on all the objects is called _____.

1)force of gravity 2) gravitational force

3) magnetic force 4)both (1) & (2)

5. The force exerted by electro state charge is called _____.

1) force of gravity 2)gravitational force

3) electro state force 4)both (1) & (2)

6. The force exerted by magnet is called _____.

1) gravitational force 2) mechanical force

3) magnetic force 4)both (1) & (2)

7. Magnetic force is

1) only attractive in nature 2) repulsive in nature

3) both attractive and repulsive in nature 4) none of these

8. Gravitational force is _____.

1) repulsive force 2) attractive force 3) both (1)& (2) 4) None

9. Force exerted by the bullock while ploughing a field is called

1) mechanical force 2) magnetic force

3) biological force 4) none of these

10. While driving a nail into a piece of wood with the help of a hammer we use

1) gravitational force 2) magnetic force

3) biological force 4) none of these

JEE MAINS

1. The force applied by the muscles of our body is

1) muscular force 2) magnetic force

3)electrostatic force 4)gravitational force

2. The force by which objects of iron, steel, nickel and cobalt are attracts or repels

1) magnetic force 2)electrostatic force

3)gravitational force 4)none

3. The forces generated by a machine are

1) magnetic force 2)electrostatic force

3)gravitational force 4)mechanical force

4. It is required to increase the speed of a scooter weighing 80 kg from 5 m/s to 25 m/s in 2 second. How much force is required ?

1) 800 N 2) 700 N 3) 600 N 4) 500 N

5. How much is the acceleration produced in a body of mass 50g when acted upon by a force of 20N ?

1) 600 m/s^2 2) 500 m/s^2 3) 400 m/s^2 4) 300 m/s^2

6. How much force is required to produce an acceleration of 20 m/s^2 on a body of mass 20 kg

   1) 10N 2) 20N 3) 300N 4) 400 N

7. What is the mass of a body on which a force of 300 dynes produces an acceleration of 30 m/s^2 is

   1) 10×10^{-5} kg 2) 1×10^{-4} kg 3) 1×10^{-5} kg 4) both (1) & (2)

8. How much acceleration will be produced in a body of mass 10 kg acted upon by a force of 2 kgf ($g = 9.8\ m/s^2$) ?

   1) 4.96 m/s^2 2) 3.96 m/s^2 3) 2.96 m/s^2 4) 1.96 m/s^2

9. How much acceleration in m/s^2 is produced in a body of mass 100g acted upon by a force of 2000 g f ($g = 9.8\ m/s^2$)

   1) 1.96 2) 19.6 3) 196 4) 1960

10. How much force is required is required to produce an acceleration of 9.8 m/s^2 on a body of mass 200g (in dynes)

    1) 19600 2) 196000 3) 1960 4) 196

11. How much acceleration in cm/s^2, is produced in a body of mass 20 kg acted upon by a force of 20 kgf

    1) 98 2) 980 3) 9800 4) 9.8

12. If no force acts on a body it will

    1) get displaced

    2) move with increasing speed

    3) move with decreasing speed

    4) either remain at rest or move in a straight line

13. A force of 40N is applied on a body which moves with an acceleration of 5 m/s^2. Then the mass of the body is _____kg

    1) 5 2) 6 3) 7 4) 8

14. A force of 30 N is applied on a body which moves with an acceleration of 6 m/s^2. Then the mass of the body is _____ g

    1) 18000 2) 5000 3) 500 4) 180

15. A car of mass 120 kg is moving with a uniform velocity of 30m/s find the force required to stop the car in 10 seconds

    1) 36000 N 2) 40 N 3) $\frac{1}{4}$N 4) 360 N

16. A vehicle of mass 200 kg is moving with a uniform velocity of 4 m/s. Find the force required to stop the vehicle in 5 seconds

    1) 160 N 2) 170 N 3) 180 N 4) 190 N

17. A lorry of mass 2000 kg is moving with a uniform velocity of 9.8 m/s. Find the force required to stop the vehicle in 20 seconds.

    1) 980 N 2) 100 kg f 3) 980 kg f 4)both (1) & (2)

18. A force of 20 N acts on a body of mass 2 kg at rest for 4 sec. How much force is required to bring the body into rest in 2 sec.

1) 160 N 2) 80 N 3) 40 N 4) 20 N

19. A force F_1 acting on a 2.0 kg body produces an aceleration of 2.5 m/s^2. Another force F_2 acting on a 5.0 kg body produces an acceleration of 2.0 m/s^2, then the ratio of $\frac{F_2}{F_1}$ is

1) 4 2) 6 3) 2 4) 8

20. A force 10 N acting on a 2kg body produces an acceleration a_1, another force 20N acting on a body mass 4 kg produces an acceleration a_2, then $\frac{a_1}{a_2}$.

1) 1 2) 2 3) 3 4) 4

JEE ADVANCED

Statement Type

21. *Statement I :* The force of attraction exerted by the earth on all the objects is the force of gravity or gravitational force

Statement II : The force exerted by electrostatic charge is electrostatic force.

1) Both statements I and II are correct.

2) Both statements I and II are incorrect.

3) Statement I is correct and statement II is incorrect.

4) Statement I is incorrect and statement II is correct

22. Different types of forces are

1) Muscular force 2) Mechanical force

3) Electro state force 4) Magnetic force

Comprehension Type:

A vechicle is moving with a uniform velocity of 19.6 m/s, whose mass is 200 kg

23. What is force required to stop the vehicle in 10 sec

1) 300 N 2) 392 N 3) 400 N 4) 492 N

24. What is force required to stop the vehicle in 20 sec

1) 196 2) 100 3) 296 4)200

25. In QNO (23) & (24) the value of force in kg f is

1) 400,200 2)20,400 3) 40,20 4) 200,40

Matrix Match Type

26.

Column-I	Column-II
a) Muscular force	1) force used to run a motor car engine
b) Mechanical force	2) Charged comb attracts small pieces of paper
c) Gravitational force	3) A stone falls downwards
d) Electrostatic force	4) force used to run steam engine
	5) pushing a lawn roller

Comprehension Type:

A force f acting on a body of mass m produces an acceleration a , then f = ma

27. If f_1 = 20 N, m_1 = 3 kg and f_2 = 30 N, m_2 = 2 kg then $\frac{a_2}{a_1}$ = _____.

1) 9:4 2) 4:9 3) 3:2 4) 2:3

28. If f_1 = 20 N, a_1 = 2 m/s^2 and f_2 = 30 N, a_2 = 3 m/s^2 then $\frac{m_2}{m_1}$ = _____.

1) 1:1 2) 2:3 3) 3:4 4) 4:5

29. If m_1 = 2 kg, a_1 = 3 kg and m_2 = 3 kg, a_2 = 2 kg then $\frac{f_2}{f_1}$ = _____.

1) 2 :3 2) 3:2 3) 1:1 4) 4:5

Comprehension Type:

A hammer with a 500 gm head is to be used to drive nails horizontally into a wall. A force of 450N required to penetrate the wall each blow should force the nail 5 mm into the wall.

30. Find the acceleration of hammer

1) 30 m/s^2 2) 300 m/s^2 3) 90 m/s^2 4) 900 m/s^2

31. Find the distance moved by hammer after striking nail?

1) 5 mm 2) 2.5 mm 3) 10 mm 4) 15 mm

NEWTON'S LAWS OF MOTION

NEWTON'S LAWS OF MOTION WORKSHEET-1_KEY

CUQ: 1) 3 2)3 3) 2 4) 2 5)2 6) 1 7) 3 8) 2
9) 3 10) 2

JEE MAINS AND ADVANCED:

1) 3 2) 3 3) 3 4) 4 5) 1 6) 1 7) 1 8) 3
9) 3 10) 3 11) 3 12) 1 13) 3 14) 3 15) 4 16) 2
17) a-2,3,4;b-3;c-2;d-4 18) 1,2,3 19) 2 20) 3 21) 2

NEWTON'S LAWS OF MOTION WORKSHEET-2_KEY

CUQ: 1) 2 2) 3 3) 2 4) 3 5) 1 6) 3 7) 1 8)1

JEE MAINS AND ADVANCED: 1) 2 2) 2 3)2 4)2 5) 1
6) 1 7) 3 8) 2 9) 3 10) 3 11) 1 12) 2 13) 3
14)1 15) 1 16) 4 17)4 18) 3 19) 2 20) 1 21) 1,2,3,4
22)1 23) 1 24) 3 25) a-t;b-r;c-p;d-s 26) 3 27) 3
28) 3 29)a-1,2,3,4;b-1,2,3,4;c-1,3;d-2,4

NEWTON'S LAWS OF MOTION WORKSHEET-3_KEY

CUQ: 1) 2 2) 1 3) 4 4)3 5) 4 6) 2 7) 3 8)4
9) 3 10)3

JEE MAINS AND ADVANCED:

1) 4 2) 3 3) 1 4) 3 5) 2 6) 1 7) 1 8) 4
9) 2 10) 2 11) 2 12) 2 13) 4 14) 1 15) 1 16) 1
17) 1 18) 4 19) 4 20)1 21) 1,2 22) 2 23) 3 24) 4
25) a-4;b-3;c-2;d-1 26) 1 27) 1 28) 1 29) 1,2,4

NEWTON'S LAWS OF MOTION WORKSHEET-4_KEY

CUQ: 1)3 2) 1 3) 2 4) 2 5) 4 6) 2 7) 3 8)2
9) 3 10) 3

JEE MAINS AND ADVANCED:

1) 3 2) 3 3) 2 4) 3 5) 3 6) 3 7) 1 8) 4
9) 1 10) 2 11) 2 12) 1 13) 1,2,3,4 14) 1,2,3
15) 3 16) a-4;b-2;c-3;d-1,5 17) 3

NEWTON'S LAWS OF MOTION WORKSHEET-5_KEY

CUQ: 1) 1 2) 4 3) 2 4)1 5) 1 6) 4 7) 4 8) 1
9) 2 10) 4

JEE MAINS AND ADVANCED:

1) 2 2) 1 3) 1 4) 3 5) 2 6) 3 7) 3 8) 4
9) 1 10) 2 11) 4 12) 2 13) 3 14) 2 15) 3 16) 4
17) 2 18) 1 19) 2 20) 4 21) 3,4 22) 4 23) 4 24) 1
25)a-q,p;b-p,q;c-r,t;d-s 26) 3 27) 1 28) 2 29) 4

NEWTON'S LAWS OF MOTION WORKSHEET-6_KEY

CUQ: 1)1 2) 2 3) 2 4) 4 5) 3 6) 3 7) 3 8) 2
9) 3 10) 3

JEE MAINS AND ADVANCED:

1) 1 2) 1 3) 4 4) 1 5) 3 6) 4 7) 4 8) 4
9) 3 10) 2 11) 2 12) 4 13) 4 14) 2 15) 4 16) 1
17) 4 18) 3 19) 3 20) 1 21) 1 22) 1,2,3,4 23) 2
24) 1 25) 3 26) a-t;b-p,s;c-r;d-q 27) 1 28) 1 29) 3 30) 4
31) 1

NOTES