Chapter 3. Laws of Motion

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Solution 1:
The property by which a body neither changes its present state of rest or of uniform motion in a straight line nor tends to change the present state is known as inertia.

Solution 2:
A book lying on a table will remain placed at table unless it is displaced by some external force. This is an example of inertia of rest.
A ball rolling on the ground will continue to roll unless the external force , the force of friction between the ball and the ground stops it.

Solution 3:
The greater is the MASS , the greater is the inertia of the object

Solution 4:
An object possess two kind of inertia, inertia of rest and inertia of motion.A book lying on a table will remain placed at table unless it is displaced by some external force. This is an example of inertia of rest.
A ball rolling on the ground will continue to roll unless the external force , the force of friction between the ball and the ground stops it.

Solution 5:
1 Newton is the force which when applied to a body of unit mass produces a unit acceleration in it. 1 newton would produce acceleration of 1 ms^{-2} in a mass of 1 kg.

Solution 6:
The acceleration produced bya force in an object is directly proportional to the applied FORCE and inversely proportional to the MASS of the object.

Solution 7:
SI unit of force is Newton (N).

Solution 8:
Acceleration is the physical quantity associated with N kg^{-1}.

Solution 9:
1 N = 10^5 Dyne.

Solution 10:
As mass of loaded van is greater than sports car so it would require more force to stop.

Solution 11:
We know force = mass x acceleration.
a= f/m = 12 N / 4 kg. = 3 ms^{-2}
so acceleration of the body would be 3 ms^{-2}.

Solution 12:
SI unit of force is Newton whereas CGS unit of force is dyne.
1 newton / 1dyne = 10^5.

Solution 13:
SI unit of momentum is $kgms^{-1}$.

Solution 14:
Momentum is defined as the amount of motion contained in the body. It is given by the product of the mass of the body and its velocity.

Solution 15:
Momentum is the physical quantity associated with the motion of the body.

Solution 16:
Momentum is possessed by bodies in MOTION.

Solution 17:
A fast pitched soft ball has more momentum.

Solution 18:
SI unit of momentum is $kgms^{-1}$ and CGS unit of momentum is g cms^{-1}.
And their ratio is = 1000 x 100 gms^{-1}= 1:10.

Solution 19:
A body at rest has zero momentum as its velocity is zero.

Solution 20:
According to Newton’s third law, for every action there is always an equal and opposite reaction.

Solution 21:
When a force acts on a body then this is called an action.

Solution 22:
No, action and reaction never act on a same body they always act simultaneously on two different bodies.

Solution 23:
2nd law of motion gives the definition of force.

Solution 24:
Newton’s third law explains this statement.

Solution 25:
Force is a vector quantity.

Solution 26:
This means these forces are balanced forces.

Solution 27:
Passengers tend to fall sideways when the bus takes a sharp turn due to the inertiaof

direction.

Solution 28:
Passengers are thrown in the forward direction as the running bus stops suddenly because due to their inertia of motion, their upper body continues to be in the state of motion even though the lowerbody comes to rest when the bus stops.

Solution 29:
Passengers tends to fall in backward direction when bus starts suddenly because due to their inertia of rest, as soon as the bus starts, their lower body comes in motion but the upper body continues to be in the state of rest.

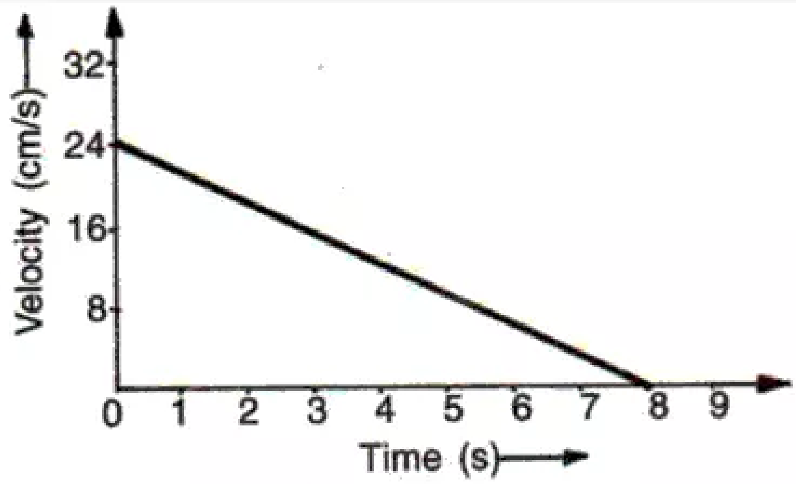
Solution 30:
No, internal forces cannot change the velocity of a body.

Solution 31:
When a hanging carpet is beaten using a stick, the dust particles will start coming out of the carpet because the part of the carpet where the stick strikes, immediately comes in motion while the dust particle sticking to the carpet remains at rest . Hence a part of the carpet moves ahead alongwith the stick, and the dust particles fall down due to the earth’s pull.

Solution 32:
When we shake the branches of a tree, the fruits and leaves remain in state of rest while branches comes in rest so fruits and leaves are detached from the tree.

Solution 33:
We know force = mass x acceleration
F_1 = 10 x 5 = 50 dyne.
F_2 = 20 x 2 = 40 dyne.
So first body require more force.

Solution 34:



As we know that slope of velocity time graph gives acceleration so acceleration of the coin is = $(v - u)/t = (0 - 24)/8 = -3\ ms^{-2}$

And force = mass × acceleration

Force = 20/1000 × -3/100 N.

Force = -6×10^{4} N.

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Solution 35:

initial velocity of the object = 0 ms^{-1}

Acceleration of the object = 8 ms^{-2}.

Time = 5 s.

Distance covered would be $S = ut + 1/2\ at^2$.

S = 1/2 x 8 x 5 x 5 = 100 m.

Solution 36:

Initial velocity of the truck = 0 ms^{-1}

Distance covered by truck = 100 m

Time taken to cover this distance = 10 s.

We know Distance covered would be $S = ut + 1/2\ at^2$.

100 =1/2 x a x 100

a= 2 ms^{-2}.

Mass of truck = 5 metric tons = 5000 kg.

Force acted on truck = mass x acceleration

Force = 5000 x 2 = 10000 N.

Solution 37:

Momentum is used for quantifying the motion of body.

Solution 38:

When we fire a gun, a force is exerted in the forward in the forward direction as the bullets comes out; in reaction to which an equal and opposite force is act in the backward direction and hence, we feel a backward jerk on the shoulder.

Solution 39:
A person applies force on water in backward direction and water according to third law of motion water apply an equal and opposite force in forward direction which helps a person to swim.

Solution 40:
Newton's third law of motion is involved in the working of a jet plane.

Solution 41:
Yes, a rocket can propel itself in a vacuum once it is given initial velocity.

Solution 42:
Action is equal and opposite to reaction but they act on different bodies and object moves as movement requires an unbalanced force and these are provided once inertia is overcome.

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Solution 1:
Sir Isaac Newton stated the law of gravitation.

Solution 2:
Every object in the universe attracts every other object with a force directly proportional to the product of their masses and inversely proportional to the square of distance between them.

Solution 3:
Gravity is the force of attraction between the object and the earth whereas gravitation refers to the force of attraction that exists between any two bodies that possess mass.

Solution 4:
Acceleration due to gravity is the acceleration experienced by a body during free fall.

Solution 5:
$g = GM/R^2$.

Solution 6:
We know that law of gravitation.
$F = G (m_1 \times m_2)/R^2$.
Here G is universal constant and is called constant of gravitation. It doesnot depend upon on the value of m_1, m_2 or R.
Its value is same between any two objects in the universe.

Solution 7:
SI unit of constant of gravitation is Nm^2kg^{-2}.

Solution 8:
we know that law of gravitation.
$F = G (m_1 \times m_2)/R^2$.

- If distance between them is halved then put R = R/2.
  $F = 4 \times G(m_1 \times m_2)/ R^2$.
  $F_1 = 4 F$.
- If distance between them is doubled then put R = 2R.
  $F = G(m_1 \times m_2)/ 4R^2$.
  $F_1 = F/4$.
- If distance between them is made four times then put R = 4R.
  $F = G(m_1 \times m_2)/16 R^2$.
  $F_1 = F/16$.
- If distance between them is infinite then put R = infinite.
  $F = G(m_1 \times m_2)/ R^2$.
  $F_1 = 0$.
- If distance between them is almost zero then put R = 0.
  $F = G(m_1 \times m_2)/ 0$.
  F_1 = infinite.

Solution 9:
All objects in the universe attract each other along the line joining their CENTRES.

Solution 10:
The force of attraction between any two material objects is called FORCE OF GRAVITATION.

Solution 11:
The gravitational force of the earth is called earth's GRAVITY.

Solution 12:
The Gravity is a particular case of GRAVITATIONAL FORCE OF EARTH.

Solution 13:
The value of G is extremely SMALL.

Solution 14:
Yes the law of gravitation is also applicable in case of the sun and moon.

Solution 15:
we know that law of gravitation.
$F = G (m_1 \times m_2)/R^2$.
Mass of earth = 6×10^{24}kg.
Mass of the person = 100 kg.
G = 6.7 x 10-11 Nm^2kg^{-2}.
Radius of earth = 6.4×10^{14}.
$F = (6.7 \times 10^{-11} \times 100 \times 6 \times 10^{14})/ (6.4 \times 6.4 \times 10^{12}) = 981.4N$
Force of gravity due to earth acting on a 100 kg person is 981.4 N.

Solution 16:
Objects fall towards the earth due to force of gravitation.

Solution 17:
Because the masses of persons are not large enough to overcome the value of small constant of gravitation so the force of gravitation is very small and negligible to feel.

Solution 18:
Initial speed of ball is = 4.9 ms^{-1}.
Acceleration due to gravity = -9.8 ms^{-2}.

- We know $v^2 - u^2 = 2as$
  At highest point final velocity is zero so
  $0 - 4.9 \times 4.9 = 2 \times (-9.8)\ S$
  S = 1.125 m
- We know v = u + at
  $0 = 4.9 - 9.8\ t$
  T = 0.5 sec.
- for highest point initial velocity is zero
  Acceleration due to gravity is = 9.8 ms^{-2}.
  Final velocity at ground is v
  $V^2 - 0 = 2 \times 9.8 \times 1.125$
  V = 4.9 ms^{-1}.

Time taken to reach ground from highest point
V = u + at
4.9 = 0 + 9.8 t
T = 4.9/9.8 = 0.5 sec.
So time of ascent is equal to time descent.

Solution 19:
$g = GM/R^2$.

Solution 20:
Value of the g at the surface of the earth is 9.8ms^{-2}.

Solution 21:
Mass of the body is constant at all positions so mass will not change. But weight will change as gravity on the surface of earth is almost 6 times than on the surface of the moon, so its weight will increase almost 6 times on the surface of earth.

Solution 22:
We will weigh more on the surface of the earth.

Solution 23:
Beam balance is used to measure the mass of a body.

Solution 24:
Spring scale is used to measure the weight of a body.

Solution 25:
The weight is greater at the poles than the equator.

Solution 26:
Newton 1N = 9.8 kgwt.

Solution 27:
We will weigh more on earth surface as value of g is greater on earth surface.

Solution 28:
No, the force of gravitation between two objects does not depend on the medium between them.

Solution 29:
we know that law of gravitation.
$F = G (m_1 \times m_2)/R^2$.
Now $m_1 = 2 m_1$
$m_2 = 2 m_2$
R = 2 R
$F_1 = G (2m_1 \times 2m_2)/4R^2$.
$F_1 = F$
So force between them remains same.

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Solution 30:
Yes, in absence of gravity all freely falling body have same force acting on them.

Solution 31:
$g= GM/R^2$
it means acceleration due to gravity is directly proportional to the mass of body and inversely proportional to the square of distance between earth and object.

Solution 35:
Yes a body falling freely near the earth surface has a constant acceleration.

Solution 36:
As we know
$g= 1/R^2$
so value of g is more at poles than equator so value of g is maximum near a camp site in Antarctica as this lie on the pole.

Solution 37:

As we know

$g = GM/R^2$

So let at height H the value of g is half that of the earth surface

then g at R + H would be equal to

$g' = GM/(R+H)^2$.

Now $g'/g = 1/2$

$\frac{1}{2} = R^2 / (R+H)^2$

$(R + H)^2 = 2R^2$

$R + H = \sqrt{2}\, R$

$H = (\sqrt{2} - 1)\, R$.

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Solution 1:
Force is that external agency which tends to change the state of rest or the state of motion of a body.

Solution 2:
1 Newton is the force which when applied to a body of unit mass produces a unit acceleration in it.

Solution 3:
Newton is the SI unit of force whereas dyne is the CGS unit of force.
1 N = 10^5 dyne.

Solution 4:
No, force is a vector quantity.

Solution 5:
A force can produce MOTION in an objectat rest. It can ACCELERATE an object and can change its DIRECTION of motion.

Solution 6:

- force changes the shape of skin.
- force produces stretching in the rubber.
- force provides retardation to the car and finally stops the car.
- force decreases the momentum of ball and finally stops the ball.

Solution 7:
No, every force does not produce motion in every type of body.

Solution 8:
The amount of inertia of a body depends on its MASS.

Solution 9:
You can change the direction in which an object is moving by APPLYING FORCE ON IT.

Solution 10:
A man riding on a car has INERTIA of motion.

Solution 11:
When a body is at rest , it will continue to remain at rest unless some external force is applied to change its state of rest. This property of body is called inertia of rest.

Solution 12:

- Weight of the book is action and normal force applied by table on book is reaction.
- Force applied by man on ground is action and force of friction is the reaction.
- Force applied by hammer on nail is action and normal force applied by nail on hammer is reaction to this force.
- Firing of bullet is the action and recoiling of gun is the reaction.
- Force applied by us on wall is action and opposite force applied by wall on us or we can say that resistance of wall to our force is reaction.

Solution 13:
A book lying on a table will remain placed on table unless it is displaced by some external force. This is an example of inertia of rest.
A ball rolling on the ground will continue to roll unless the external force , the force of friction between the ball and the ground stops it.This is an example of inertia of motion.

Solution 14:
Unbalance external force causes motion in the body.

Solution 15:
Linear Momentum is defined as the amount of motion contained in a body. It is given by the product of the mass of the body and its velocity.

Solution 16:
SI unit of momentum is $kgms^{-1}$.

Solution 17:
According to Newton’s first law force is that external agency which tends to change the state of rest or the state of motion of a body.

Solution 18:
According to Newton’s first law, everybody continues in its state of rest or in uniform motion in a straight line unless compelled by some external force to act otherwise.

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Solution 19:
Out of all these, as mass of truck is greatest and mass is measure of inertia so a truck has maximum inertia.

Solution 20:
It is advantageous to run before taking a long jump because after running we get motion of inertia which helps in long jumping.

Solution 21:
Ball moving on a table top stops eventually due to force of friction between the ball surface and table surface.

Solution 22:
Force is equal to the rate of change of linear momentum.

Solution 23:
According to newton second law of motion, when a force acts on a body, the rate of change in momentum of a body is equal to the product of mass of the body and acceleration produced in it.
Yes, Newton's first law is contained in the second law as if force is zero then acceleration would be zero which means body would remain in its state of rest or in state of constant motion.

Solution 24:
1 Newton is the force which when applied to a body of unit mass produces a unit acceleration in it.
1 newton / 1dyne = 10^5.

Solution 25:
1 newton = 1 kg x 1 ms^{-1} = 1000 g x 100 cms^{-1} = 10^5 cms^{-1}.
1 dyne 1 g x 1 cms^{-1} = $1cms^{-1}$.
So 1 newton = 10^5 dyne.

Solution 26:
No, the body will not move as the two forces are equal and opposite and they constitute balanced forces.

Solution 27:
As these forces are balanced so they will not affect the motion and motion of the body will remain unaffected.

Solution 28:
According to Newton's third law, for every action there is always an equal and opposite reaction. Rocket works on the same principle. The exhaust gases produced as the result of the combustion of the fuel are forced out at one end of the rocket. As a reaction , the main rocket moves in the opposite direction.

Solution 29:
According to Newton's third law, every action has equal and opposite reaction so force exerted by the wall on the boy is 30 N.

Solution 30:
Newton stated the law of inertia.

Solution 31:
Every object in the universe attracts every other object with a force directly proportional to

the product of their masses and inversely proportional to the square of distance between them.
Law of gravitation is called universal because it applies to all bodies of universe.

Solution 32:
Gravity is the force of attraction betwen the object and the earth whereas gravitation refers to the force of attraction that exists between any two bodies that possess mass.

Solution 33:
Person will weigh more at Delhi as we know that gravity decreases with increase in height. Now as Shimla is at a height from Delhi so weight is less in Shimla and more in Delhi.

Solution 34:
Spring scale is used to measure the weight of a body.

Solution 35:
Gravity is another kind of FORCE. It exerts all through the UNIVERSE. The sun's gravity keeps the PLANETS in their orbits. Gravity can only be felt with very large MASS.

Solution 36:

- Objects fall on the earth due to gravitational force between the earth and object.
- Atmosphere doesnot escape because molecules of atmosphere are attracted by earth due to gravitational force of earth.
- A moon rocket needs to reach a certain velocity because during its motion earth attracts the rocket towards it by its gravitational force.

Solution 37:
'g' is acceleration due to earth's gravity and 'G' is universal gravitational constant.

Solution 38:
Free fall means motion of a body under the gravity of earth only.

Solution 39:
Yes, we have a gravitational force of attraction between us and a book. But our mass is very small so the force between us and book is very small almost negligible.

Solution 40:
Yes, the force of gravitation of earth affects the motion of moon, because moon is revolving around earth and centripetal force for this revolution is provided by earth's gravitation.

Solution 41:
Inertial mass is measure of inertia of the object. According to second law of motion F = m x a
m= F/a and this mass is called as inertial mass.
Newton law of gravitation gives another definition of mass.
$F = (G\ m_1 m_2)/R^2$
Thus m_2 is the mass of the body by which another body of mass m1 attracts it towards it by law of gravitation. This mass is called gravitational mass.

Solution 42:

Newton law of gravitation is that Every object in the universe attracts every other object with a force directly proportional to the product of their masses and inversely proportional to the square of distance between them.

- Gravity is the force of attraction between the object and the earth whereas gravitation refers to the force of attraction that exists between any two bodies that possess mass.
- 'g' is acceleration due to earth's gravity and 'G' is universal gravitational constant.

Solution 43:

Yes, it is true that apple attracts the earth towards it with same force but the mass of earth is so huge that acceleration produced in it due to this force is very much small and negligible to notice.

Solution 44:

we know that law of gravitation is

$F = G (m_1 x m_2)/R^2$

Here the F is force due to attraction and this force is equal to weight of the body m2g.

So $m2g = G (m_1 x m_2)/R^2$

$g= (G x m_2)/R^2$.

Here R is the distance between earth centre and the object centre. Now if we go on higher altitude say 'H' then this R would increase to (R + H)

And value of gravity at height H becomes

$g'= (G x m_2)/(R +H)^2$.

As denominator increases so g' would be less than g and hence we can say that gravity decreases on higher altitudes.

Solution 45:

- The force exerted by the block on is the weight of box and that is equal to 20N.
- The force exerted by string on block is equal to the tension in the string and this is also equal to the 20N.

Solution 46:

we know F = m x a

m= F/a

so we can calculate mass of each body

Mass of body 1 m_1 = 4/8 = 0.5 kg.

Mass of body 2 m_2 = 4/20 = 0.2 kg.

Total mass when two masses are tied together M = 0.5 + 0.2 = 0.7 kg.

Now as force is acting on total mass so acceleration produced is

a= 4/0.7 = 5.71 ms^{-2}.

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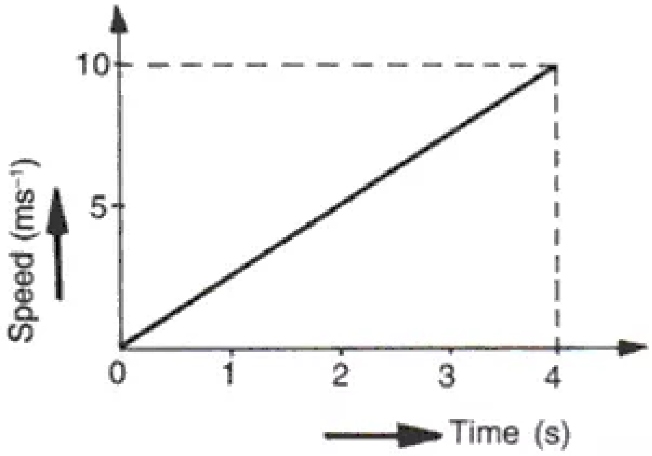
Solution 47:



As we know slope of speed time graph gives acceleration so we can find acceleration of body

$a = (v - u)/t = (10 - 0)/(4 - 0) = 5/2 = 2.5\ ms^{-2}$.

Mass of the body is = 100g = 0.1 kg.

force = mass × acceleration.

Force = 0.1 × 2.5 = 0.25 N.

Solution 48:

Initial speed of body = 5 ms^{-1}
Final speed of body = 8 ms^{-1}
Time taken to acquire this speed = 2s.
Acceleration of body = (v- u)/t
a= (8- 5)/2 = 1.5 ms^{-2}.
Force applied on body = 0.9 N.
we know F = m x a.
m = f/a = 0.9/1.5 = 0.6 kg
mass of the body is 600 gm.

Solution 49:

Time (s)	Distance (m)	Velocity (ms^{-1}) = distance/time	Acceleration (ms^{-2}) = $(v - u)/(t_2 - t_1)$
0	0	0	0
1	1	1	1
2	8	4	3
3	27	9	5

So object moves with increasing acceleration.

Solution 50:

The force that acts on a body for a very short time but produces a large change in its momentum, is known as impulsive force.

Solution 51:

initial velocity of body = 0 ms^{-1}.
Final velocity of body = 100 ms^{-1}.
Mass of body = 20 kg.
Force applied = 100N.
We know that
F x t = m (v – u)
100 t = 20 (100 -0)
T = 2000/100 = 20 s.

Solution 52:

SI unit of retardation is ms^{-2}.

Solution 53:

Force applied is equal to the product of mass and acceleration produced in the body.
F = mass x acceleration.

Solution 54:

According to Newton's second law of motion, when a force acts on a body, the rate of change in momentum of a body equals the product of mass of the body and acceleration produced in it due to that force, provided the mass remains constant.
Mass of body = 400 g = 0.4kg
Force applied on body = 0.02 N
Acceleration = force/mass = 0.02/0.4 = 0.05 ms^{-2}.

Solution 55:

Linear Momentum is defined as the physical quantity which is associated with bodies in linear motion. It is given by the product of the mass of the body and its velocity.
Mass of body = 1 kg
Acceleration produced = 10 ms^{-2}.
Force applied would be = 1 x 10 N = 10 N.
Mass of second body = 4 kg.
As same force has to be applied on second body so force = 10N.
Acceleration produced is = F/M =10/4 = 2.5 ms^{-2}.

Solution 56:

Mass of P is m_1= m.
Velocity of P is v_1 =2 v
Mass of Q is m_2 = 2m
Velocity of Q is v2 = v.

- inertia of P/inertia of Q = m_1/m_2 = 1/2.
  So ratio of inertia of two bodies is 1:2.
- Momentum of P/momentum of Q = m_1v_1/m_2v_2 = 1
  So ratio of momentum of two bodies is 1:1.
- As force required to stop them is equal to change in their momentum from moving to rest.
  So ratio would be same as the ratio of their momentum i.e 1: 1.

Solution 57:

According to newton second law

F = m x a

a= (v – u)/t.

F = m(v -u)/t

F = (mv – mu)/t

As F= m x a

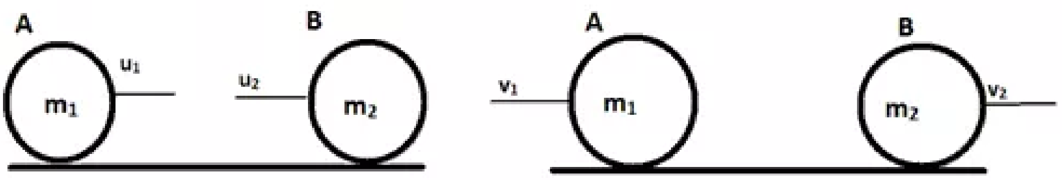
ma = (mv – mu)/t

so rate of change of momentum = mass x acceleration.

This relation holds good when mass remains constant during motion.

Solution 58:

Conservation of momentum in case of a collision between two bodies means the total momentum before and after collision remains unchanged or conserved, provided no net force acts on the system.



Before collision **After collision**

Consider two bodies A and B having masses m_1 and m_2 and initial velocities u_1 and u_2 respectively. The bodies collide head on with each other and their collision lasts for t seconds. Suppose the velocities of A and B after collision are v_1 and v_2 respectively. Assume that no external forces are acting on the bodies.

Rate of change of momentum of ball A = $m_1(v_1 - u_1)/t$.

Rate of change of momentum of ball B = $m_2(v_2 - u_2)/t$.

If F_{AB} is the force exerted by A on B and F_{BA} is the force ex

Rated by B on A, we can write

$F_{AB} = m_1(v_1 - u_1)/t$.

$F_{BA} = m_2(v_2 - u_2)/t$.

$F_{AB} = - F_{BA}$

$m_1(v_1 - u_1)/t = - m_2(v_2 - u_2)/t$.

$m_1(v_1 - u_1) = - m_2(v_2 - u_2)$.

$m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2$.

So total momentum after collision = total momentum before collision.

This proves conservation of momentum during collision.

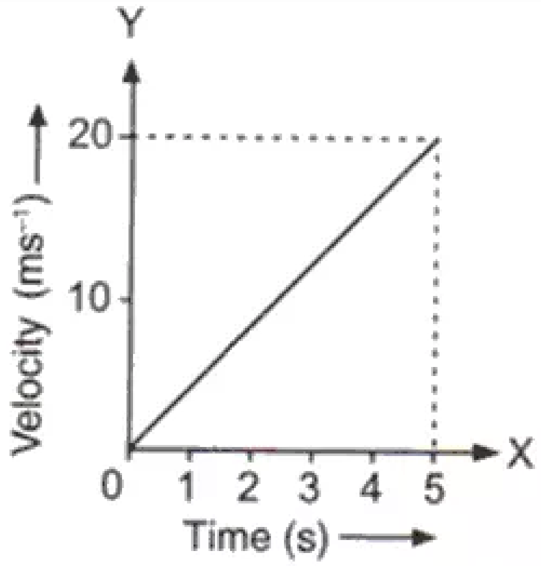
Solution 59:
According to newton third law, for every action there is always an equal and opposite reaction.
To demonstrate newton third law blow a balloon and hold its neck tightly facing downwards. When we release the balloon, the balloon will moves up instead of falling to the ground. As air is releasing from bottom of balloon and this air apply equal and opposite force to the balloon and this force helps balloon to move upwards.

Solution 60:
time for which force is applied = 0.1 s.
Mass of body = 2 kg
Initial velocity of body = 0 ms^{-1}
Final velocity of body = 2 ms^{-1}.
We know F x t = m (v – u)
F x 0.1 = 2 (2 – 0)
F = 4 /0.1 = 40 N.

Solution 61:
mass of ball = 500g = 0.5 kg.
Initial speed of the ball = 30 ms^{-1}
Final speed of ball = 0 ms^{-1}
Time taken by player to stop the ball = 0.03 s.
We know F x t = m (v – u)
F x 0.03 = 0.5 (0 – 30)
F = – 1.5 / 0.03 = – 500 N
(-) sign shows that player has to apply force in opposite direction of the motion of the ball.

Solution 62:
Time for which force is applied =0.1 s.
Mass of the body = 3.2 kg.
Initial speed of body = 0 ms^{-1}
After removal of forces body covers a distance of 3m in 1 second so final speed of body = 3/1 = 3ms^{-1}.
We know F x t = m (v – u)
F x 0.1 = 3.2 (3 -0)
F = 9.6/0.1 = 96 N.
So applied force is 96 N.

Solution 63:



As we know that slope of velocity time graph gives acceleration so acceleration of the body is = (v – u)/ (t_2 - t_1) = (20 – 0)/(5-0) = 4 ms^{-2}

Mass of the body is = 200 g = 0.2 kg

Force applied is equal to = 0.2 × 4 = 0.8 N.

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Solution 64:

Time for which force is applied =3s.
Mass of the body = 2 kg.
Initial speed of body = 0 ms^{-1}
Force applied = 10 N.

- We know F x t = m (v – u)
  10 x 3 = 2 (v- 0)
  v = 15 ms^{-1}.
  Final velocity is 15 ms^{-1}.
- As m(v – u) is change in momentum and this is equal to the F x t so change in momentum is equal to the 30 kgms^{-1}.

Solution 65:

- We always prefer to land on sand instead of hard floor while taking a high jump because sand increases the time of contact.As F x t = m (v – u) and our change in momentum is constant so if time increases then force experienced would decrease.
- Again while catching a fast moving ball, we always pull our hands backwards to increase reaction time so force experienced would decrease.

Solution 66:

Height of cliff = 98 m.

Initial velocity of stone = 0 ms^{-1}.
Acceleration due to gravity = 9.8 ms^{-2}.

- We know $H = ut + 1/2\ gt^2$.
  $98 = 1/2 \times 9.8 \times t^2$.
  $t^2 = 98 \times 2/9.8 = 20$
  t= 4.47 sec.
- Final velocity when it strikes the ground
  $v^2 - u^2 = 2\ g\ H$
  $v^2 = 2 \times 9.8 \times 98$
  $v^2 = 1920$
  v= 44.6 ms^{-1}.

Solution 67:

Initial speed of ball is = 9.8 ms^{-1}.
Acceleration due to gravity = -9.8 ms^{-2}.
Final speed at maximum height = 0 ms^{-1}.
We know v = u + at
0 = 9.8 – 9.8 t
T = 1 sec.
We know $v^2 - u^2 = 2as$
At highest point final velocity is zero so
0 – 9.8 x 9.8 = 2 x (-9.8) S
S = 4.9 m.
for highest point initial velocity is zero
Acceleration due to gravity is = 9.8 ms^{-2}.
Final velocity at ground is v
$V^2 - 0 = 2 \times 9.8 \times 4.9$
V = 9.8 ms^{-1}.
Time taken to reach ground from highest point
V = u + at
9.8 = 0 + 9.8 t
T = 9.8/9.8 = 1 sec.
Total time = time of ascent + time of descent.
Total of flight = 1+ 1 = 2 seconds.

Solution 68:

Initial speed of ball = 10 ms^{-1}.
Acceleration due to gravity on ball = – 9.8 ms^{-2}
We know that from first equation of motion
v= u + gt.
After 1 sec
v= 10 – 9.8 x 1
v= 0.2 ms^{-1}
so velocity after 1 sec would be 0.2 ms^{-1}.
Velocity after 2 seconds

$v = 10 - 9.8 \times 2 = 10 - 19.6 = -9.6\ ms^{-1}$.

Here negative sign shows that velocity is in downward direction and magnitude is 9.6 ms^{-1}.

Solution 69:

Maximum Height attained by ball = 19.6 m

Let initial speed of ball = u ms^{-1}.

Acceleration applied on ball due to gravity = -9.8 ms^{-2}.

Final speed of ball at maximum height = 0 ms^{-1}.

We know that from second equation of motion

$v^2 - u^2 = 2as$

$0 - u^2 = 2 \times (-9.8) \times 19.6$

$u^2 = 19.6 \times 19.6$

$u = 19.6\ ms^{-1}$

so initial speed of ball to attain maximum height of 19.6 m should be 19.6ms^{-1}.

Solution 70:

Height of tower = 98 m

Acceleration due to gravity on stone = 9.8 ms^{-2}.

Initial speed of ball= 0 ms^{-1}.

Let initial speed of second stone is v ms^{-1}.

We know from second equation of motion

$S = ut + 1/2\ a \times t^2$.

$98 = 0 + 1/2 \times 9.8 \times t^2$.

$t^2 = 20$

t= 4.47 sec.

As second stone is thrown 1 sec later so time taken by second body to cover distance of 98 m is = 4.47 – 1 = 3.47sec.

So again put t= 3.47 sec and S = 98 m in second equation of motion we get

$98 = v \times 3.47 + 1/2 \times 9.8 \times 3.47 \times 3.47$.

$98 = 3.47 \times v + 59$

$3.47 \times v = 98 - 59$

$v = 39/3.47 = 11.23\ ms^{-1}$.

Initial speed of second stone should be 11.23 ms^{-1}.

Solution 71:

Mass of object 1 m1 = 200 mg = 200×10^{-6} kg = 2×10^{-4} kg.

Mass of object 2 m2= 200 mg = 200×10^{-6} kg = 2×10^{-4} kg.

Distance between the two objects = 1 mm = 10^{-3} m

We know law of gravitation is

$F = G\ (m1 \times m2)/R^2$

$F = (6.67 \times 10^{-11} \times 2 \times 10^{-4} \times 2 \times 10^{-4})/(10^{-3} \times 10^{-3})$

$F = 6.67 \times 2 \times 2 \times 10^{-11-4-4+3+3}$

$F = 26.68 \times 10^{-13}$ N

So these two objects would experience a force of 26.68×10^{-13} N.

Solution 72:

Radius of earth = 6.38 x 103 km = 6.38 x 10^6 m

G = 6.67 x 10^{-11}

Acceleration due to gravity = 9.8 ms^{-2}.

We know that

g= (G x M)/R^2.

9.8 = (6.67 x 10^{-11} x M)/ (6.38 x 10^6 x 6.38 x 10^6)

9.8 x 6.38 x 6.38 x 10^{12} = 6.67 x 10^{-11} x M

398.9 x 10^{12} = 6.67 x 10^{-11} x M

M = 398.9 x 10^{12}/6.67 x 10^{-11}

M = 59 x 10^{23} kg

So mass of earth is 59 x 10^{23} kg.