CBSE Class 9 Science
Important Questions
Chapter 9
Forces and Laws of Motion

1 Marks Questions

1. A batsman hits a cricket ball which then rolls on a level ground. After covering a short distance, the ball comes to rest. The ball slows to a stop because
(a) the batsman did not hit the ball hard enough.

(b) velocity is proportional to the force exerted on the ball.

(c) there is a force on the ball opposing the motion.

(d) there is no unbalanced force on the ball, so the ball would want to come to rest.

Ans. (c) there is a force on the ball opposing the motion.

2. What is the momentum of an object of mass *m*, moving with a velocity *v*?
(a) $(mv)^2$
(b) mv^2
(c) $\frac{1}{2}mv^2$
(d) ***mv***

Ans. (d) mv

3. Using a horizontal force of 200 N, we intend to move a wooden cabinet across a floor at a constant velocity. What is the friction force that will be exerted on the cabinet?

Ans. 200 N

4. What is the S.I. unit of momentum?
(a) Kg ms.

(b) ms / Kg

(c) $\mathbf{Kg\ ms^{-1}}$

(d) Kg / ms

Ans. (c) $Kg\ ms^{-1}$

5. What is the numerical formula for force?

(a) F = ma

(b) F = $\frac{m}{a}$

(c) $\mathbf{F = ma^2}$

(d) $\mathbf{F = a^2m}$

Ans. (a) F = ma

6. If the initial velocity is zero then the force acting is :-

(a) Retarding

(b) Acceleration

(c) Both

(d) None.

Ans. (a) Retarding

7. What is the S.I. unit of force.

(a) $\mathbf{Kg\ m / s^2}$

(b) Kg m/s

(c) $\mathbf{Kg\ m^2 / s^2}$

(d) $\mathbf{Kg\ m^2 s^2}$

Ans. (a) $Kg\ m / s^2$

8. Newton's first law of motion is also called:

(a) Law of Inertia

(b) Law of Momentum

(c) Law of Action & Reaction

(d) None of these

Ans. (b) Law of Momentum

9. Which law explains swimming?

(a) Newton's first law

(b) Newton's second law

(c) Newton's third law

(d) All of these

Ans. (c) Newton's third law

10. The S.I. unit of weight is:

(a) Newton

(b) Newton m

(c) Newton/sec

(d) Newton m/s

Ans. (a) Newton

11. Which equation defines Newton's Second law of motion?

(a) F = ma = $\frac{dp}{dt}$

(b) F = m $\frac{da}{dt}$ **= P**

(c) $\frac{df}{dt}$ **= ma=P**

(d) F = ma = P

Ans. (d) F = ma = P

12. The people in the bus are pushed backwards when the bus starts suddenly due to:-

(a) Inertia due to Rest

(b) Inertia due to Motion

(c) Inertia due to direction

(d) Inertia.

Ans. (a) Inertia due to Rest

13. If the force acting on the body is zero. Its momentum is

(a) zero

(b) constant

(c) Both

(d) None

Ans. (b) constant

14. The inability of the body to change its state of rest or motion is :-

(a) Momentum

(b) Force

(c) Inertia

(d) Acceleration.

Ans. (c) Inertia

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2 Marks Questions

1. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.

Ans. No, it is not possible for the object to be travelling with a non-zero velocity if an object experiences a net zero external unbalanced force since unbalanced forces cannot be equal to zero.

2. When a carpet is beaten with a stick, dust comes out of it. Explain.

Ans. When a carpet is beaten with a stick, dust comes out of it because carpet fibres vibrate in forward and backward direction as carpet is beaten but the loosely bound dust particles due to inertia remain at rest and so they come out.

3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?

Ans. It is advised to tie any luggage kept on the roof of a bus with a rope because when bus moves the luggage also gets moving with the velocity same as that of the bus and in the same direction but when bus changes direction or deaccelerates, due to inertia of motion luggage moves in the same direction and may get thrown away from roof of buses.

4. A stone of 1 kg is thrown with a velocity of $20\ \mathrm{m\ s^{-1}}$ across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

Ans. since $v^2 = u^2 + 2as$

$0 = 20^2 + 2 \times a \times 50$ (object comes to rest so v=0)

-100 a = 400

a = 400/-100 = $-4\ mm/s^2$

therefore, the force of friction between the stone and the ice

F = m x a = 1 x (-4)N = -4 N

5. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of $1.7\ \mathrm{m\ s^{-2}}$?

Ans. since $\mathrm{F = m \times a = 1500 \times -1.7}$ = -2550 N (negative sign symbolises acceleration in opposite direction)

6. An object of mass 100 kg is accelerated uniformly from a velocity of $5\ \mathrm{m\ s^{-1}}$ to $8\ \mathrm{m\ s^{-1}}$ in 6 s. Calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.

Ans. Initial momentum of the object = 100×5 = 500 kg m/s

Final momentum of the object = 100×8 = 800 kg m/s

since v = u + at

$8 = 5 + a \times 6$

a = 3/6 = $0.5\ \mathrm{m/s^2}$

since $\mathrm{F = m \times a = 100 \times 0.5}$ **= 50 N**

7. Akhtar, Kiran and Rahul were riding in a motorcar that was moving with a high velocity on an expressway when an insect it the windshield and got stuck on the windscreen. Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in

momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a larger velocity, it exerted a larger force on the insect. And as a result the insect died. Rahul while putting an entirely new explanation said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

Ans. Since the mass of insect is negligible in comparison to the mass of motorcar therefore there will be no any change in the momentum of motorcar.

v = $\sqrt{16}$

v = 4 m/s

momentum = $mv = 10 \times 4$ = 40 kg m/s

8. State Newton's second law of motion?

Ans. According to Newton's second law of motion, the rate of charge of momentum of a body is equal to the force acting on it and the change in momentum takes place in the same direction as the force applied.

9. What is the momentum of a body of mass 200 g moving with a velocity of 15 m/s.

Ans. Mass of Body = 200 g = $\frac{200}{1000} = 0.2Kg$

Velocity of Body = 15 m/s

Momentum of the Body = $Mass \times Velocity$

$= \frac{0.12 \times 15}{10}$

$= \frac{30}{10}$

= 3 Kg M/S

10. Define force and what are the various types of forces?

Ans. Force is the push or pull which can produce the change in state or shape of the body. The various types of force are:

(a) Gravitational force

(b) Electrostatic force

(c) Electromagnetic force

(d) Nuclear force.

11. A force of 25 N acts on a mass of 500 g resting on a frictionless surface. What is the acceleration produced?

Ans. Force is the push or pull which can produce the change in state or shape of the body. The various types of force are:

(a) Gravitational force

(b) Electrostatic force

(c) Electromagnetic force

(d) Nuclear force.

12. State Newton's first law of Motion?

Ans. According to Newton's first law of motion, a body at rest will continue to be at rest and a body in motion will continue to be in motion until and unless it is acted upon by an external force.

13. A body of mass 5 Kg starts and rolls down 32 m of an inclined plane in 4s. Find the force acting on the body?

Ans. Initial velocity = u=0

Time = t 4 sec.

Distance = S = 32 m

M= mass = 5 Kg

S = **ut** + $\frac{1}{2}at^2$

$$32 = \frac{1}{2} \times a \times (4)^2$$

$$\frac{32 \times 2}{16} = a$$

$$a = 4m/s^2$$

Force = F=Ma

$$= 5 \times 4$$

= 20 N

14. On a certain planet, a small stone tossed up at 15 m/s vertically uploads takes 7.5 s to return to the ground. What is the acceleration due to gravity on the planet?

Ans. Initial velocity = u=15 m/s

V=Final velocity = 0

V=u+at

O=15+at

t= $\frac{-15}{a}$ sec

Time taken to reach the highest = $\frac{-15}{a}s$ point

Time taken to reach the downward = $\frac{-15}{a}s$

Time taken for the entire journey = 2 $\left(\frac{-15}{a}\right)$

$$2\left(\frac{-15}{a}\right)=7.5s$$

$$a=-4m/s^2$$

The acceleration due to gravity on the planet $= \ -4m/s^2$

15. Why is the weight of the object more at the poles than at the equator?

Ans. Weight of the object is more at the poles than at the equator because w=weight = mg. because g at equator is less because its radius is more and hence weight is less and vice – versa for poles.

16. Why does the passenger sitting in a moving bus are pushed in the forward direction when the bus stops suddenly?

Ans. The passengers sitting in the moving bus are pushed in the procured direction when the bus stops suddenly because of inertia due to rest. The bus comes to rest so the passengers feet comes to rest but due to inertia his upper part of body is still in motion and so he falls forward.

17. Why does the boat moves backwards when the sailor jumps in the forward direction?

Ans. When the sailor jumps in the forward direction, the boat moves backwards because while jumping the sailor pushes the boat backwards (action) and by Newton's third law the boat pushes him in the forward direction (reaction).

18. Derive the law of conservation of momentum from Newton's third law?

Ans. Acc. to Newton's third law every action has an equal and opposite reaction and it acts on two different bodies.

From law of conservation of momentum, for an isolated system, the total initial momentum for an event is equal to total initial momentum.

Let FAB = force exerted by body A on body B

FBA = force exerted by body B on A.

Let the mass of body A = mA

Mass of body B = mB

Initial velocity of Body A = uA

Initial velocity of Body B = uB

Final velocity of Body A = VA

Final velocity of Body B = VB

Rate of change of velocity of A = $\frac{VA-uA}{t}$

$$\text{Rate ofchange of velocity of B} = \frac{VB-uB}{t}$$

Rate of change of Momentum of A = $\frac{m(VA-uA)}{t}$

Rate of change of Momentum of B = $\frac{m(VB-uB)}{t}$

From Newton's second law,

F = $\frac{dP}{dt}$ (Rate of change of Momentum)

$$FBA = \frac{mB\,(VB-uB)}{t}$$

$$FAB = \frac{mA(VA - uA)}{t}$$

From Newton's third law,

FAB = - FBA

$$\frac{mA(VA - uA)}{t} = -\frac{mB(VB - uB)}{t}$$

So, mA uA + mB uB = mA VA + mB VB

Law of conservation of Momentum.

19. An astronaut has 80 Kg mass on earth.

i) What is his weight on earth?

ii) what will be his mass are weight on mars where $\mathbf{g = 3.7\ m/s^2}$

Ans. Mass of astronaut on earth = 80 Kg=M

Acceleration due to gravity = $g = 10 m/s^2$ of earth.

i) Weight on earth = Mg

$= 80 \times 10$ = 800 N

ii) Acceleration due to gravity = $g = 3.7 m/s^2$ on Mars

Weight on mars = Mg

$$80 \times \frac{3.7}{10}$$

= 296 n

The Mass of astronaut on Mars = 80 Kg because Mass remains constant.

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3 Marks Questions

1. Which of the following has more inertia:

(a) a rubber ball and a stone of the same size?

(b) a bicycle and a train?

(c) a five rupees coin and a one-rupee coin?

Ans. (a) as tone of the same size will have more inertia than a rubber ball.

(b) A train will have more inertia than a bicycle.

(c) A five rupees coin will have more inertia than a one-rupee coin.

2. In the following example, try to identify the number of times the velocity of the ball changes:

"A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team".

Also identify the agent supplying the force in each case.

Ans. In the given example the velocity of football changes four times. As described below:

(i) when the football player is supplying the force when he kicks the football to another player.

(ii) when the other player kicks football towards the goal.

(iii) When the goalkeeper of other team stops the ball.

(iv) When the goalkeeper kicks the football towards player of his team.

3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.

Ans. Some of the leaves may get detached from a tree if we vigorously shake its branch because the some of the leaves due to property of inertia remain at rest while we vigorously shake branch of the tree as a result those leaves detach and fall off.

4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?

Ans. when a moving bus brakes to a stop we fall in the forward direction because we are also moving with the speed of bus due to the inertia of motion and when suddenly it puts brakes i.e. comes to rest the lower half of our body also comes to rest but the upper half of our body not being in close contact with bus is still in the phase of motion so we fall in the forward direction.

When the bus accelerates from rest, we are also at rest being on the resting seat as the engine applies force in forward direction we fall backwards due to the inertia now.

5. If action is always equal to the reaction, explain how a horse can pull a cart.

Ans. With a balance force the overall impact is absence of movement but with unbalanced forces, the resultant or the bigger force causes the motion. Same is true in the case where a horse pulls a cart. Horse exerts more force on the cart than the cart exerts to resist its movement hence this is an unbalanced force and the cart moves in the direction of horse's pull.

6. Explain, why is it difficult for fireman to hold a hose, which ejects large amounts of water at a high velocity.

Ans. It is difficult for fireman to hold a hose, which ejects large amounts of water at a high velocity because of the third law of newton when the hose ejects large amounts of water at a high velocity in forward direction the water coming out pushes the hose pipe in backward

direction and it becomes difficult to hold it.

7. From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of $35 m\ s^{-1}$ .Calculate the initial recoil velocity of the rifle.

Ans. Initial Momentum of rifle and bullet (before fire)

= mv

$= (4kg + 50g) \times 0\ m/s$ = 0

Final Momentum of rifle and bullet (after fire)

$= m_1 v_1 + m_2 v_2$

$= 4 \times v + 0.05 \times 35$ where(50g = 0.05kg)

$v = (0.05 \times 35)/4$ = - 0.44m/s

8. A 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate:

(a) the net accelerating force;

(b) the acceleration of the train; and

(c) the force of wagon 1 on wagon 2.

Ans. (a) The net accelerating force = Force exerted by engine - frictional force of track = 40000 - 5000 = 35000 N

(b) the acceleration of the train = a = F/m = 35000/(5 x 2000) = 35000/10000 = $3.5\ m/s^2$

(c) the force of wagon 1 on wagon 2

Wagon 1 will have to exert force on all 4 wagons next to it

so mass of other 4 wagons = $2000 \times 4 = 8000kg$

F = ma $= 8000\ kg \times 3.5\ m/s^2 = 28000N$

9. Two objects, each of mass 1.5 kg, are moving in the same straight line but in opposite directions. The velocity of each object is 2.5 m s^{-1} before the collision during which they stick together. What will be the velocity of the combined object after collision?

Ans. Momentum before collision took place $= m_1v_1 + m_2v_2$

$= 1.5 \times 2.5 + 1.5 \times (-2.5)$

= 0

Since the objects stick together after collision hence

momentum after collision $= (m_1 + m_2) \times v$

$= (1.5 + 1.5) \times v$ = 3v

momentum before collision = momentum after collision

0 = 3v, v= 0/3 = 0

the velocity of the combined object after collision (v)= 0

10. According to the third law of motion when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive truck parked along the roadside, it will probably not move. A student justifies this by Answering that the two opposite and equal forces cancel each other. Comment on this logic and explain why the truck does not move.

Ans. According to the third law of motion when we push on an object, the object pushes back on us with an equal and opposite force result is the two opposite and equal forces cancel each other but when one of these forces is bigger than inertia so the object moves in the direction of force applied. As this student explains the truck is massive so the force applied

cannot overcome force caused by inertia. Therefore, the truck does not move.

11. A hockey ball of mass 200 g travelling at $10\ \text{m s}^{-1}$ is struck by a hockey stick so as to return it along its original path with a velocity at $5\ \text{m s}^{-1}$. Calculate the change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.

Ans. mass of hockey ball = 200 g = 0.2 kg

$v_1 = 10m/s,\ v_2 = -5m/s$ (return velocity)

initial momentum of hockey ball $= 0.2\ kg \times 10\ m/s$ = 2 kg m/s

final momentum of hockey ball $= 0.2\ kg \times -5m/s$ = -1 kg m/s

change in momentum of hockey ball = 2 - (-1) = 2 + 1 = 3 kg m/s

12. A bullet of mass 10 g travelling horizontally with a velocity of $150\ \text{m s}^{-1}$ strikes a stationary wooden block and comes to rest in 0.03 s. Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.

Ans. v =u + at

$0 = 150 + a \times 0.03\ s$

$a = -150/0.03 = -5000m/s^2$

the distance of penetration of the bullet into the block $(s) = ut + \frac{1}{2}at^2$

$= 150 \times 0.03 + \frac{1}{2} \times -5000 \times 0.03^2$

= 4.5 - 2.25

= 2.25 m

the magnitude of the force exerted by the wooden block on the bullet

m = 10 g = 0.01 kg

$$F = m \times a = 0.01kg \times -5000m/s^2 = -50N$$

13. An object of mass 1 kg travelling in a straight line with a velocity of $10\ \mathrm{m\ s^{-1}}$ collides with, and sticks to, a stationary wooden block of mass 5 kg. Then they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.

Ans. Wooden block is stationery (at rest) so its velocity $(u_2) = 0$

mass of combined object is = 1 kg + 5 kg = 6 kg

total momentum before the impact $= 1 \times 10 + 5 \times 0$ = 10 kg m/s

law of conservation of momentum:

total momentum just before the impact = total momentum after the impact= 10 kg m/s

thereforethe velocity of the combined object: $10 = 6 \times v$ = 6v

v = 10/6 = 1.67 m/s

14. How much momentum will a dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be $10\ \mathrm{m\ s^{-2}}$.

Ans. height from which dumb bell falls = 80 cm = 0.8 m

since we know

$$v^2 = u^2 + 2gh$$

$v^2 = 0 + 2 \times 10 \times 0.8$ = 16

15. A force of 15 N acts for 5s on a body of mass 5 Kg which is initially at rest. Calculate.

a) final velocity of the body

b) the displacement of the body

Ans. a) Force = F = 15 N

Time t = 5s

Mass = M = 5 Kg

Initial velocity =u=0

V = Final velocity = ?

Displacement = ?

F = Ma

$$15 = 5 \times a$$

$$a = \frac{15}{5} = 3m/s^2$$

Now, 1) $V = u + at$

$$V = 0 + 3 \times 5$$

V=15 m/s

b) $S = ut + \frac{1}{2}at^2$

$$S = 0 \times t + \frac{1}{2} \times 3 \times (5)^2$$

$$S = 37.5m$$

16. Differentiate between mass and weight?

Ans.

	Mass	Weight
1.	It is the matter contained by a body	It is force which the body exerts on the earth.
2.	It remains the same	It changes from place to place.
3.	It is always positive.	It can be positive and zero.
4.	It is a scalar quantity	It is a vector quantity
5.	Its S.I. unit is Kg	Its S.I. unit is Newton(N)

17. A scooter is moving with a velocity of 20 m/s when brakes are applied. The mass of the scooter and the rider is 180Kg. the constant force applied by the brakes is 500 N.

a) How long should the brakes be applied to make the scooter comes to a halt?

b) How far does the scooter travel before it comes to rest?

Ans. Initial velocity = u=20 m/s

Final velocity = V=O

Mass of scooter = M = 180 Kg

& Rider

Force = F = 500 N

a) F=Ma

500=180 a

$$a = 2.78 m/s^2$$

Since the final velocity is zero, the acceleration is negative (Retardation)

So, $a = 2.78 m/s^2$

Now, V=u + at

$$O = 20 - (2.78) \times t$$

2.78 t=20

$$t = \frac{20}{2.78} = 7.2 \text{sec.}$$

b) S=ut+ $\frac{1}{2}at^2$

$$S = 20 \times 7.2 + \frac{1}{2} \times (-2.78) \times (7.2)^2$$

$$S = 144 - 72.1 = 71.9m$$

18. State Newton's third law of motion and how does it explain the walking of man on the ground?

Ans. According to Newton's third law of motion, if a body A exerts a force F on the body B then the body B exerts a force -F on the body A and the forces act along the same line.

When a person walks on the ground, then he pushes the ground backwards with a force F and in reaction the ground also pushes the man in the forward direction and hence the man walks forward.

Acc. to Newton's third law:

Every action has an equal and opposite reaction.

19. With what speed must a ball be thrown vertically up in order to rise to a maximum height of 45m? And for how long will it be in air?

Ans. Initial velocity = u = ?

Final velocity = (∵ Body comes to rest)

Acceleration due to gravity= $-10m/s^2$

Distance = S = 45 m

$V^2 = u^2 + 2gs$

1) $o^2 = ou^2 + 2(-10) \times 45$

$u^2 = 900$

U = 30 m/s

2) V=Vo+at

O=30+(-10) t

t =3s.

The ball takes 3s to go up

The ball takes 3s to come down

The total time of flight=6 sec.

20. State Newton's second law of motion and derive it mathematically?

Ans. According to Newton's second Law of motion, rate of change of momentum is equal to the force acting on it and both take place in the same direction

Mass of Body = m kg

Initial velocity = u

Force = F

Let the direction of the force be the same as the direction of motion of the body.

Let force act for time = t sec

Final velocity = V

Initial Momentum = Pi = mv

Final momentum = Pf

Change in Momentum = Pf - Pi = mv - mu

Rate of change in Momentum = $\frac{m(v-u)}{t} \rightarrow (1)$

Now, Acceleration = $a = \frac{v-u}{t} \rightarrow (2)$

Use (2) in (1)

Rate of change in Momentum = ma from Newton's second law of motion, F = ma

21. A bullet travelling at 360 m/s; strikes a block of soft wood. The mass of the bullet is 2.0g. The bullet comes to rest after penetrating 10 cm into the wood?

a) Find the average deceleration force exerted by the wood.

b) Find the time taken by the bullet to come to rest.

Ans. Initial velocity = u = 360 m/s

Final Velocity =0

Distance Travelled = S = 10 cm = 0.1 m

Acceleration = ?

Force = ?

$V^2 = u^2 + 2as$

$O = (360)^2 + 2a(0.1)$

1) $a = \frac{-129600}{2} = -648000 m/s^2$

m = Mass = 2g = 0.002 Kg

Force = F = Ma

$= 0.002 \times (-648000)$

$= -1296N$

Average decelerating force = 1296 N

$V = u + at$

b) $O = 360 + (-648000)t$

$t = 5.56 \times 10^{-4} s$

22. Two objects A and B are dropped from a height the object B being dropped. S after A was dropped. How long after A was dropped will A and B be 10 m apart?

Ans. Initial velocity = u = O

Let A for s → acceleration = a = $-9.8\ m/s^2$

For object A: - Distance Travelled = S_1

$$S_1 = ut + \frac{1}{2}gt^2$$

$$S_1 = O - \frac{1}{2} \times 9.8t^2$$

$$S_1 = -\frac{1}{2} \times 9.8t^2 \qquad \rightarrow a)$$

For object B, time = (t-1) s

$\text{Distance tranelled} = S_2$

$$S_2 = ut + \frac{1}{2}gt^2$$

$$S_2 = -\frac{1}{2}9.8(t-1)^2 \qquad -b)$$

Subtracting equation b) & a)

$S_1 - S_2 = -10\text{m}$

$S_1 - S_2 = -10\text{m}$

$-10 = 4.9\left[t^2 - 2t + 1 - t^2\right]$

$-10 = 4.9\left[-2t + 1\right]$

$-10 = -9.8t + 4.9$

$-9.8t = -14.9$

The objects will be 10 m apart 1.52 s after A is dropped.

23. A boy throws a stone up with a velocity of 60 m/s.

1) How long will it take to reach the maximum height $\left(\mathbf{g = -10m\ /\ s^2}\right)$

2) What will be the maximum height reached by the stone?

3) What will be its velocity when it reaches the ground?

Ans. Initial velocity = u = 60 m/s

Final velocity = V = O

Acceleration due to gravity = $g = -10m/s^2$

1) V = u + gt

$O = 60 - 10 \times t$

10 t = 60

T = 6 sec

2) $h = ut + \frac{1}{2}gt^2$ h = height

$= 60 \times 6 + \frac{1}{2}(-10) \times 6^2$

= 360 -180

= 180 m

3) The velocity when it reaches the ground = 60 m/s.

24. A certain particle has a weight of 30 N at a place where the acceleration due to gravity is $9.8\text{m}/\text{s}^2$

a) What are its mass and weight at a place where acceleration due to gravity is $3.5\text{m}/\text{s}^2$.

b) What will be its mass & weight at a place where acceleration due to gravity is zero.

Ans. Weight of particle = w = 30 N

Acceleration due to gravity = $9.8m/s^2$

m = Mass of particle

1) w = mg

$30 = m \times 9.8$

$\frac{30 \times 10}{9.8} = m$

$\Rightarrow m = \frac{300}{98} Kg$

W = mg g at the place $= 3.5\text{m}/\text{s}^2$

$$= \frac{300}{98} \times \frac{3.5}{10}$$

= 10.71 N

Mass at the place = 3.061 Kg

2) At a place where g O; w = weight = O

But Mass = 3.061 Kg because mass is a constant quantity.

25. Why does a person while firing a bullet holds the gun tightly to his shoulders?

Ans. A person while firing a bullet holds the gun tightly to his shoulder because while firing the bullet, the bullet moves in the forward direction with a greater force and as a reaction by Newton's third law the gun will also move with the same force in the backward direction, so to prevent the shoulder of the person getting injured he must hold the gun tightly so that the force is not felt that strongly.

26. A car is moving with a velocity of 16 m/s when brakes are applied. The force applied by the brakes is 1000 N. The mass of the car its passengers is 1200 Kg.

a) How long should the brakes be applied to make the car come to a halt?

b) How for does the car travel before it comes to rest?

Ans. Initial velocity = u = 16 m/s

Final velocity = v = o

Force = F = 1000 N

Mass = M = 1200 Kg

F = Ma

$$1000 = 1200 \times a$$

$$\frac{1000}{1200} = a$$

$$a = \frac{-5}{6} m/s^2$$

The acceleration is negative because it retards the body.

a) v = u + at

$$o = 16 - \frac{5}{5} \times t$$

$$\frac{5}{6} t = 16$$

$$t = \frac{16 \times 6}{5} = 19.2 \text{sec}$$

b) $v^2 - u^2 = 2as$ s = Distance Travelled

$$(o)2 - (16)2 = 2 \times \frac{-5}{6} s$$

$$256 = \frac{-10}{6} s$$

$$s = \frac{256 \times 6}{10}$$

S = 153.6 m

CBSE Class 9 Science

Important Questions

Chapter 9

Forces and Laws of Motion

5 Marks Questions

1. Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of $2 m s^{-1}$ and $1 m s^{-1}$, respectively. They collide and after the collision, the first object moves at a velocity of $1.67 m s^{-1}$. Determine the velocity of the second object.

Ans. Given,

m_1 = 100 g = 0.1 kg

m_2 = 200 g = 0.2 kg

velocity of the first object = $v_1 = 2 m/s$

velocity of the second object = $v_2 = 1 m/s$

Momentum before the collision = $m_1v_1 + m_2v_2$

$= 0.1 \times 2 + 0.2 \times 1$

= 0.4 kg m/s

since velocity of first object after collision = 1.67 m/s

If we suppose that velocity of second object = v

As per law of conservation of momentum,

$m_1v_1 + m_2v_2 = m_1v_1 + m_2v_2$ (initial momentum = final momentum)

$0.4 = 0.1 \times 1.67 + 0.2 \times v$

0.4 = 0.167 + 0.2v

0.2v = 0.4 - 0.167

v = 0.2333/0.2 = 2.33/2 = 1.16 m/s

2. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20 s. Find its acceleration. Find the force acting on it if its mass is 7

metric tonnes (*Hint*: 1 metric tonne = 1000 kg.)

Ans. According to the question,
In velocity of truck (u) = 0
distance = s= 400m and time = 20s
mass of truck = 7metric tones = 7000kg

$$S = ut + \frac{1}{2}at^2$$

$$400 = 0 \times 20 + \frac{1}{2} \times a \times 20^2$$

400 =0 + 200a
400 = 200a
a = 400/200 = $2\ m/s^2$
therefore, $F = m \times a = 7000 \times 2$ = 14000N

3. A stone is dropped from a 100m high tower. How long does it take to fall?

a) the first 50m and

b) the second 50m.

Ans. Initial velocity = u=0
Total height = h = 100m

a) Let for first 50m the time stone takes is 't' sec.
S=-50 m (-ve sign shows the stone falls in downward direction)

$$g = -10m/s^2$$

$$h = s = ut + \frac{1}{2}gt^2$$

$$-50 = 0 + \frac{1}{2}(-10)t^2$$

$$-50 = -5t^2$$

$$\frac{50}{5} + t^2$$

$$t^2 = 10$$

$t = \sqrt{10}$

t = 3.16 sec.

b) for the entire journey,

u = 0

S = -100 m

$a = -10m/s^2$

$S = ut + \frac{1}{2}at^2$

$-100 = 0 + \frac{1}{2} \times (-10)t^2$

$t^2 = 20$

$t = \sqrt{20}$

4. A body of mass 10Kg starts from rest and rolls down an inclined plane. It rolls down 10m in 2S? t = 4.47sec

a) What is the acceleration attained by the body.

b) What is the velocity of the body at 2S?

c) What is the force acting on the body?

Ans. Mass = m = 10kg

Initial velocity = 0

Distance = S = 10m

Time = t = 25

a) $S = ut + \frac{1}{2}at^2$

$10 = O + \frac{1}{2} \times 9 \times 4$

$\frac{10 \times 2}{4} = a$

$a = 5m/s^2$

b) $V = u + at$

final $=V=5\times2$
Velocity=10m/s

c) $Force = Mass \times Acceleration$
$= 10 \times 5$
F = 50 N

5. A body of mass 2Kg is at rest at the origin of a frame of reference. A force of 5 N acts on it at t = 0. The force acts for 4S and then stops.

a) What is the acceleration produced by the force on the body.
b) What is the velocity at t= 4s
c) Draw the v – t graph for the period t = 0 to t = 6S.
d) Find the distance travelled in 6S.

Ans. Force = F = 5N Mass = m = 2kg

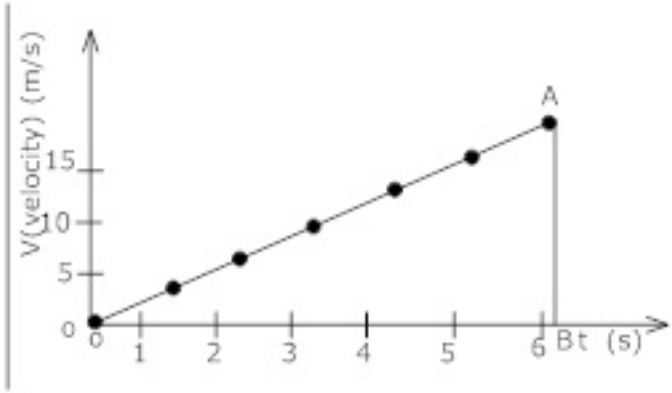
a) F = Ma; a = acceleration
$5 = 2\times a$
$2.5m/s^2 = a$

b) Final velocity = v = o?
Initial velocity = u = o (body starts from Rest)
Time = t = 4s.
v = u +at v = 2.5×4
v = 10 m/s

c)

For t = o	1	2	3	4	5	6
V = o	2.5	5	7.5	10	12.5	15

d) Distance Travelled = Area under v-t curve = Area of ΔAoB



$$= \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \frac{1}{2} \times OB \times AB$$

$$= \frac{1}{2} \times \overset{3}{6} \times 15$$

= 45 M