NCERT SOLUTIONS
CLASS IX SCIENCE
CHAPTER 9- LAWS OF MOTION

1. Choose the one which has more inertia.

i-A Toy thrown up by a boy (or) A coin thrown up by a boy

ii-An apple falling from a tree (or) A rose falling from a plant

iii-A motorcycle (or) A bus

Answer

i-A Toy thrown up by a boy

ii-An apple falling from a treeiii-A bus

iii-A bus

Reason

The measure of inertia is proportional to mass of an object, So more the mass more inertia acts on the body.

2. Find the number of times the velocity of the ball changes in the following example

' Dhoni hits the ball in the offside, the ball is fielded by morgan where he collects the ball and throws it to the wicket keeper'

Answer

Force applied by the player	The velocity change
i-Dhoni hits the ball	Velocity changes from **zero** to '**u**'
ii-Morgan collects the ball	Velocity changes to **zero**
iii-Morgan throw the ball to wicket keeper	Change in Velocity takes place

The velocity of the cricket ball changes three times in the above example.

3. What may be the main reason for leaves shedding down when we forcefully shake its branch?

Answer

The main reason behind this concept is Newton's first law of motion.
It states that an object may either remain at rest or at motion unless or until an external force is applied on it.
So when the branch is forcefully shaken, the branch tends to be in motion but the leaves of the branch remain at rest. This creates a strain between branch and leaves. Due to the presence of strain leaves are shed down from the branch.

4. Why does person tend to fall backwards in a car when it accelerates from rest and move forward when the car brakes?

Answer

When the car is moving, the body continues to be in the state of motion, if sudden brakes are applied, the lower half of the body comes to rest while the upper half tends to be in motion and that is why the person moves forward when brakes are applied. The reason behind this action is **inertia of motion.**
Similarly, when the car suddenly starts from rest, the lower half of the body which is in contact with the floor tends to be in motion while the upper half remains at rest and that is why the person moves backward.

The reason behind this action is **inertia of rest.**

5. State newton's third law. Explain it with example?

Answer

The Newton's third law states that,

For every action there is always an equal and opposite reaction between bodies. Take an example of a swimmer,

The person who is swimming pushes water backward, while water pushes the person forward. This is because of the frictional force between the movement of hand and the water he swims.

6. It is difficult for a fireman to control a hose, which ejects water at a high velocity. Explain the statement?

Answer

The water coming out of the hose in forward direction hits the specified target with a larger force and this force acts in an equal and opposite direction to the fireman it. So the fireman is being pushed backwards, which makes him difficult to control the hose so that he has to apply some additional force to withstand it.

7. From a pistol of mass 5 kg and a bullet of mass 30 g is fired with an initial velocity of 50 m/s. Calculate the initial recoil velocity of the pistol?

Answer

The mass of the pistol (m_1)= 5kg

The mass of the bullet (m_2)= 30g= 0.03kg

The velocity with which bullet is travelled (v_1)= 50m/s

The recoil velocity of the rifle = ?

By the law of conservation of momentum

Momentum of pistol = Momentum of bullet

$m_1v_1 = m_2v_2$

5kg * v_1 = 0.03 * 50m/s

$v_1 = \frac{(0.03*50)}{5} = \frac{1.5}{5}$

v_1 = 0.3

The recoil velocity of rifle = 0.3m/s

8. There are two objects with masses 200g and 300g are moving with velocities of 3m/s and 2m/s respectively, along the same direction. The two objects collide and after the collision the first object moves with a velocity of 1.8m/s. Find the velocity of second object?

Answer

Mass of the first object(m_1)=200g = 0.2kg

Mass of the second object(m_2) = 300g = 0.3kg

Before the collision takes place,

Velocity of first object(u_1) = 3m/s

Velocity of second object(u_2) = 2m/s

After the collision takes place,

Velocity of the first object(v_1)= 1.8m/s

Velocity of the second object(v_2)= ?

$m_1u_1+m_2u_2 = mv_1 + mv_2$

(0.2*3) + (0.3*2) = (0.2*1.8) + (0.3* v_2)

0.6 + 0.6 = 0.36 + 0.3v_2

1.2 – 0.36 = 0.3v_2

$\frac{(1.2-0.36)}{0.3}$ = v_2

$\frac{0.84}{0.3}$ = v_2

v_2 = 2.8m/s

Therefore the velocity of the second object after collision = 2.8m/s

9. Is there any possibility for the body to be travelling with the same non-zero velocity if it tend to experience a net-zero unbalanced external force. Justify the statement?

Answer

The answer **is yes.**

It is possible for the body to travel with non-zero velocity even though it experiences a net-zero unbalanced external force according to the first law of motion i.e) The body

It is possible for the body to travel with non-zero velocity even though it experiences a net zero unbalanced external force according to the first law of motion i.e) The body tends to move with constant velocity in a particular direction. However to change the state of motion, a net-zero unbalanced external force must be applied on the body.

10-Why does dust comes out of the carpet when it beaten up with a stick?

Answer

The reason is based in accordance to the newton's first law of motion.

Itstates that an object may either remain at rest or at motion unless or until an external force is applied on it.
The dust continues to be in state of rest unless or until an external force is created with the help of stick.
This is the main reason for dust particles coming out of the carpet.

11. If you are travelling by a bus, then you might have seen people tie their bags with the help of a rope. What is the reason behind it?

Answer

The motion of the bus changes rapidly while applying sudden brakes, or taking a sharp turn or constant speed is maintained where there is less traffic.
Due to inertia force, the luggage tends to resist at its original position i.e (state of rest or motion) and therefore falls from the roof in any direction.
So to avoid this the luggage is tied with a rope.

12. A football player kicks the ball which travels in the air for a while and lands on the ground where the ball travels on the ground for a short distance and stops. What may be the reason behind it?

Answer

The reason is **frictional force.**

There is always a contact between the ball and the ground. The opposing force always acts against the ball thereby stopping the movement of the ball.

13. A disc of 2 kg is thrown with a velocity of 15m/s across the surface of the pond and the disc after travelling a distance of 40m comes to rest. Find the force of friction between the disc and the pond.

Answer

Mass of the disc (m) = 2kg

Initial Velocity of the disc (u) = 15m/s

Distance travelled (s) = 40m

Final Velocity of the disc (v) = 0 (rest condition)

Force of friction = ?

Acceleration = ?

According to equation of motion

$v^2 - u^2 = 2*a*s$

$0^2 - 15^2 = 2*a*40$

Therefore

$-225 = 80*a$

$a = \frac{-225}{80}$

$a = -2.8125 m/s^2$

Force of friction, $F = m*a$

$= 2*-2.8125$

$F = -5.625N$

14. 60000 kg engine has the capacity to pull a train of 6 compartments, each being 1000 kg along the track. If 60000N is the force exerted by the train engine and the track gives a frictional force of 4000N,

Calculate

I. Net accelerating force of the engine

II. The total acceleration of the train

III. The force of compartment 1 on compartment 2

Answer

I. Force exerted by the engine (F)= 60000N

Frictional force offered by the surface of the track (f) = 4000N

The net accelerating force of the engine = F-f

= 60000-4000

= 56000N

II. The acceleration of the train(a)

The engine exerts a force of 60000N on all 6 compartments

Accelerating force on the compartments(F) = 60000N

Number of compartments (n) = 6

Mass of the compartment (m_1)=1000kg

The mass of 6 compartments carried by the engine(m) = m_1*n

= 6*1000

m = 6000kg

According to second law of newton

F= m*a

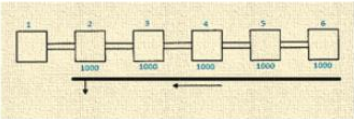
60000 = 6000*a

a = $\frac{60000}{6000}$

a = 10m/s^2

The acceleration of the train and the compartment (a) = 10m/s^2

III. Force of compartment 1 on compartment 2



(Numbers and diagram needed to be modified according to the question.

6 compartments to be drawn)

Force of the compartment = ?

Mass of all the compartments except 1st compartment = 5*1000

= 5000kg

The acceleration of the train and the compartment (a) = 10m/s^2

The total force exerted on all compartments except 1st compartment

F = m*a

= 5000*10

F = 50000N

Therefore the force exerted by compartment 1 on compartment=50000N

15. A bus with the mass of 1000kg is to be stopped with a negative acceleration of 2m/s^2.Calculate the force between the bus and the road.

Answer

Mass of the bus (m) = 1000kg

Negative acceleration of the bus (a) = $-2m/s^2$

Force between bus and the road (F) = ?

According to second law of newton,

F= m*a

F= 1000*-2

F= -2000N

The force between the bus and the road is -2000N

16. Write the formula for momentum.

Answer

Momentum = mass of the object(m)* velocity of the object in m/s(v)

= m*v

It is a vector quantity having both magnitude and direction

17. The table is moved across the floor with a constant velocity where the horizontal force acting in it is 400N.What will be the frictional force that will be acting on the table?

Answer

According to third law of newton, for every action there will be an equal and opposite reaction.

Taking into consideration,

The net force acting on the table is zero only when the table moves with constant velocity in forward direction. The equal amount of frictional force will take place in opposite direction of the table i.e) F=400N

18. There are two bodies each of mass 3kg, are moving in same line but in different directions. Each object is having a velocity of 2 m/s before the collision where they stay together. Calculate the velocity of the combined bodies after collision?

Answer

The mass of the first body (m_1) = The mass of the second body (m_2) = 3kg

Velocity of first body (u_1) = 2m/s

Velocity of second body (u_2) = -2m/s (opposite direction)

The momentum before the collision takes place (p_1) = $m_1u_1 + m_2u_2$

= (3*2) + (3*-2)

= 0

The momentum after the collision takes place (p_2) = $m_1 + m_2$

= 3+3

= 6kg

After the collision takes place, the combined velocity (v) = ?

By law of conservation of momentum

Momentum taking place before the collision = momentum taking place after the collision

$$(m_1v + m_2v) = m_1u_1 + m_2u_2$$

6*v = (3*2) + (3*-2)

v = 0 m/s

19. By third law of newton, a student explains the following concept

A student named vivek tries pushing a heavy vehicle, the result being no movement is observed. And vivek justifies that opposite and equal forces cancels away. Justify the statement and explain why the heavy vehicle does not move?

away. Justify the statement and explain why the heavy vehicle does not move?

Answer

The measure of inertia is proportional to mass of an object, So more the mass more inertia acts on the body. As the vehicle is heavy, a small force cannot create a serious impact in the vehicles movement. To overcome the friction between tires and the road an external unbalanced force must be applied.

20. A cricket ball of 150g is travelling at 15m/s when struck with the help of a cricket bat and it has to return along its original path with a velocity of 8m/s. Find the actual change in momentum occurred during the motion of cricket ball by the force applied with cricket bat.

Answer

Mass of the cricket ball (m)= 150g = 0.15kg

The Initial velocity of the cricket ball (u) = 15m/s

The Cricket ball travelling in opposite direction with velocity (v) = -8m/s

The initial momentum of the ball (p) = mass*velocity

= m*u

= 0.15*15

= 2.25 kg m/s

The final momentum of the cricket ball(p) = mass*velocity

= m*v

= 0.15*-8

= -1.2 kg m/s

Therefore the change in momentum is calculated by

= Final momentum of the cricket ball- initial momentum of the cricket ball

= 2.25-(-1.2)

= 3.45kg m/s

21. The arrow of mass 8g travelling horizontally with a velocity of 160m/s hits a tree and comes to rest in 0.02s. Find the distance of penetration of the arrow into the tree. Calculate the magnitude of the force exerted by the tree on the arrow?

Answer

Initial velocity of the arrow (u) = 160m/s

Final velocity of the arrow (v) = 0 (comes to rest fnally)

Time taken by the arrow to come to rest(t) = 0.02

Mass of the arrow = 8g = 0.008kg

According to equation of motion,

v = u + (a*t)

0 = 160 + a*0.02

a = $\frac{-160}{0.02}$

a = 8000m/s^2

To find,

Distance of penetration(s) = ?

Force exerted by the tree(F) = ?

According to equation of motion

$v^2 - u^2 = 2*a*s$

$(0^2)- (160^2) = (2*8000*s)$

s = $\frac{160*160}{(2*8000)}$

s= 1.6m

The magnitude of the force (F)= m*a

= 0.008*8000

F = 64N

Therefore,

The distance of penetration of the arrow in the tree(s) = 1.6m
The magnitude of force is calculated to be = 64N

22. A bullet of mass 1kg is travelling along the same line with a velocity of 8 m/s collides and sticks with a wooden board of mass 4kg and they move together in the same line. Find the total momentum before the impact and after the impact and also calculate the combined velocity of the object(bullet and wooden board)?

Answer

Mass of the bullet (m_1) = 1kg

Velocity of the bullet (v_1) = 8m/s

The mass of the wooden board (m_2) = 4kg

Combined weight of the bullet and board ($m_1 + m_2$) = 4+1= 5kg

Velocity of the wooden block before collision (v_2) = 0 m/s

To find,

i. The velocity of the combined object (v) =?

ii. Momentum before the impact (p_1) =?

iii. Momentum after the impact (p_2) =?

Total momentum before the collision (p_1) = $m_1 v_1 + m_2 v_2$

= (1*8) + (4*0)

= 8 kg m/s

After collision the wooden board and the bullet sticks together,

According to the law of conservation of momentum:
Total momentum before collision = Total momentum after collision
$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v$

(1*8) + (4*0) = (5) v

v = $\frac{8}{5}$

v = 1.6m/s

The total momentum after the collision (p_2) **=** ($m_1 + m_2$) v

= 5*1.6

p_2 = 8kg m/s

i. The velocity of the combined object (v) =1.6m/s

ii. The total momentum before the impact (p_1) = 8kg m/s

iii. The total momentum after the impact (p_2) = 8kg m/s

23. Find the initial momentum and final momentum of the body, if the body of mass 80kg is accelerated with a uniform velocity from 7m/s to 10m/s in the time interval of 7 s. In addition to this, calculate the magnitude of the force exerted on the body.

Answer

Mass of the body (m) = 80kg

Initial velocity of the body (v_1) = 7 m/s

Final velocity of the body (v_2) = 10m/s

Time interval for the body to be accelerated = 7s

To find

i. Initial momentum (p_1)

ii. **Final momentum (p_2)**

iii. Force exerted on the body (F)

i. The initial momentum of the body (p_1) = m*v_1

= (80*7)

p_1 = 560 kg m/s

ii. The final momentum of the body (p_2) = m*v_2

= (80*10)

p_2 = 800 kg m/s

According to laws of motion

v = u + a*t

a = $\left(\frac{v-u}{t}\right)$

a = $\left(\frac{10-7}{7}\right)$

a = $\frac{3}{7}$

a = 0.428m/s^2

iii. Force exerted on the body (F) = m*a

= 80*0.428

F = 34.24N

24. Hari, Ram and Akash were riding in a car that was moving with a high velocity on a flyover, suddenly a butterfly from nowhere hit the windshield and got stuck in it. Hari and Ram started thinking about the situation of the butterfly. Ram stated that the insect suffered a larger change in momentum compared to the change in momentum of the car (because the change in the velocity of the butterfly was much more than that of a car). Hari stated that car was moving with a greater velocity, it exerted a larger force on the butterfly. So it led to the death of the butterfly. Akash gave a different explanation stating both car and the butterfly experienced the same force and a change in their momentum. Justify their suggestion.

Answer

The reasons gave by hari and ram were wrong. However, akash gave the right logic stating both butterfly and the car experienced same force and a change in their momentum.
The collision between the butterfly and car, experiences the same force as the action and reaction are always equal and opposite in accordance to newton's third law.
By law of conservation of momentum

Initial momentum before the collision = Final momentum after the collision.

The change in momentum were same but they experienced in opposite directions, since the mass of the butterfly is less it has to suffer a greater change in velocity.

25. The wall clock of mass 6 kg is hanged to the roof, due to some fault the wall clock falls down from the height of 90 cm to the floor. How much momentum does the wall clock transfers to the floor? Take the downward acceleration to be 12m/s^2.

Answer

The mass of the wall clock (m) = 6kg

The distance from which the wall clock falls (s) = 90cm = 0.9m

Acceleration in downward direction (a) = 12m/s^2

Initial velocity of the wall clock (u) = 0 m/s

Final velocity of the wall clock (on hitting the floor) = v m/s

According to the equation of motion

According to the equation of motion

$v^2 - u^2 = 2*a*s$

$v^2 = u^2+2*a*s$

$v^2 = 0 + 2*12*0.9$

$v = \sqrt{21.6}$

v = 4.64 m/s

The momentum can defined as (p) = mass*velocity

= 6*4.64

p = 27.84 kg m/s

26. ***The following table is based on distance-time which is related to object in motion***

Time in seconds(t)	Distance in meters (s)
0	0
1	1
2	6
3	36
4	66
5	126
6	220
7	348

(a) Do the acceleration change in a constant way or is it increasing, decreasing, or zero?

(b) What do you conclude about the forces acting on the object?

Answer

a) From equation of motion W.K.T

$s = u*t + \frac{1}{2}*a*t^2$

Here the initial velocity (u) = 0

$s = \frac{1}{2}*a*t^2$

$a = \frac{(2*s)}{t^2}$

For example,

Acceleration (a_1) = $\frac{2*1}{1^2}$=2m/s^2

Acceleration (a_2) = $\frac{2*6}{2^2}$=3m/s^2

Acceleration (a_3) = $\frac{2*36}{3^2}$=8m/s^2

And so on……

The change in distance is unequal and it is taking place at regular intervals of time. Since the velocity of the object increases with time, the acceleration is increasing. The object is having a non-uniform motion because velocity, acceleration and time are proportional to each other, so if one parameter increases other two parameter also increases.

b) By second law of newton, the force acting on the object is directly proportional to acceleration produced in the object. So we can conclude by saying that the object is in accelerated condition and unbalanced force is acting on the object.

27. Deva and Barath combine their strength and push a car of mass 1000 kg at a uniform velocity along a straight road. The same car can be pushed by three different persons to produce an acceleration of 0.1 m s^{-2}. What is the force applied by each person to push the car?
(Note: All persons push the motorcar with the same muscular effort)

Answer

Mass of the motor car = 1000kg

If two persons namely deva and barath puts their effort in pushing a car, then their combined effort will be 2F which is balanced by the frictional force due to road and car. Hence the acceleration acquired by the car is given by the third person alone.
Now, if three people puts their effort in pushing a car then their combined effort will be 3F.
By comparing both situations let us calculate the effort put by third person alone which is the difference between

Unbalanced force= Force applied by 3 persons-Force applied by 2 persons

= 3F-2F

Unbalanced force = F

By second law of newton

F= m*a

F= 1000*0.1

F= 100N

Thus third person applies a force of 100N

So, in that way each person applies a force of **100N**

28. A ball hammer of 600g mass, is moving at 40m/s penetrates a nail through the wall. The ball hammer action comes to rest in a short time of 0.02s since the nail is completely penetrated through the wall. What is actual force of the nail on the hammer?

Answer

The mass of the ball hammer (m) = 600g = 0.6kg

Initial velocity of ball hammer (u) = 40m/s

Final velocity of the hammer (v) = 0 (hammer comes to rest)

Time taken by the nail to stop the hammer (t) = 0.02s

From equation of motion,

v = u + a*t

a = $\frac{(v-u)}{t}$

a = $\frac{(0-40)}{0.02}$

a = -2000m/s^2

According to second law of Newton

Force applied by the nail on ball hammer (F) = ?

F = m*a

F = 0.6*-2000

F = -1200N (-ve sign because nail force is opposing the motion of ball hammer)

29. A car of mass 1000kg is moving along a straight line with an uniform velocity of 72km/h. The velocity of the car is slowed down to 20km/h in 6s by an external unbalanced force. Find the acceleration and change in momentum of the car. Also, calculate its magnitude of force required.

Answer

The mass of the car (m) = 1000kg

Initial velocity of the car = 72km/h= $72 * \frac{5}{18} m/s$ = 20m/s

Final velocity of the car = 20km/h= $20 * \frac{5}{18} m/s$ = 5.5m/s

Time taken by the car to slow down = 6s

From equation of motion,

v = u + a*t

a = $\frac{(v-u)}{t}$

a = $\frac{(5.5-20)}{6}$

a = -2.41m/s^2

To find the change in momentum of the car,

m*v – m*u = m(v-u)

= 1000(5.5-20)

= -14500kg m/s

Magnitude of force (F) = m*a

F = 1000*-5.5

F = -5500N

(The –ve sign of acceleration, change in momentum, force suggests that force is opposing the motion of the car)

30. A lorry and a swift car moving with a velocity of magnitude v, have a head-on collision and both of them coming to a halt position after the collision. If the collision lasts for 2s.

Which vehicle experiences the

a) Greater force of impact

b) Greater change in momentum

c) Greater acceleration

d) Which suffers more damage Lorry/swift car.

State the reasons for all.

Answer

M – mass of lorry, m – mass of swift car, u- initial velocity, v – final velocity

a) The vehicle which has a higher mass will experience a greater force of impact. So the lorry experiences a greater force of impact than a swift car.

b) Let us consider,

Initial momentum of the swift car = m*u

Final momentum of the swift car = 0

Change in momentum = m*u

Initial velocity of the lorry = M*u

Final momentum of the swift car = 0

Change in momentum = M*u

Since the mass of the lorry is greater than that of swift car, the lorry will experience a greater change in momentum.

c) Even though the forces on the swift car and the lorry are equal in magnitude, the swift car experiences the greater acceleration because from equation of motion we can come to a conclusion that acceleration produced is

independent of the mass of the system.

d) From Newton's third law we can state that , for every action there will be an equal and opposite reaction

The lorry experiences a greater force of impact (action),this larger impact force is also experienced by the swift car (reaction). So the swift car suffers a greater damage than the lorry. Since the acceleration of the swift car is greater, the velocity and momentum change, drops in short time.

31. What is the SI unit of force?

Answer

The SI unit of force is newton.

32. Define momentum?

Answer

Momentum of a body is defined as the product of mass multiplied by its velocity.

33. The net force applied on the body is proportional to

a) Velocity of the body

b) Mass of the body

c) Change of momentum of an object

d) Acceleration of the body

Answer

c) Change of momentum of an object

34. Why two balls of different mass dropped from the same height reach ground at the same time ?

Answer

The reason behind this is, both experience the same acceleration,

g (9.81 m/s^2). From equation of motion, we know that acceleration is independent of mass. So when they are dropped from the same height, they will always maintain the same velocity and travel the same distance (neglecting air resistance of course) in the same time.

35. What happens when the coin is placed over the glass at rest position as shown in the figure.

a) No presence of unbalanced force acting on it

b) Inertia of rest

c) The two forces acting on the coin balance each other.

d) All the above.

Answer

d) All the above.

36. If a force of 50N acts on the body, then the frictional force of the body will be

a) More than the initial force

b) Less than the initial force

c) No force

d) None of these

Answer

b) less than the initial force

37. Give an example of Newton's third law of motion.

Answer

Take an example of a swimmer,

The person who is swimming pushes water backward, while water pushes the person forward.

38. State yes or no

Action and reaction forces acts on different bodies

Answer

Yes

39. When we stop pedaling the bicycle, it stops because

a) No acceleration

b) No unbalanced force acting on it

c) Frictional force acting on it

d) Earths gravitational force

Answer

c) Frictional force acting on it

40. A basketball and a stone has same mass

a) Both having same momentum

b) Both having different inertia

c) Both having different momentum

d) Both have same inertia

Answer

e) Both have same inertia

41. Explain the term force?

Answer

Force is defined as the push or pull on an object that cause a physical change by producing acceleration in the body on which it acts.

F= Mass (m) * acceleration (a)

42. Define the term one newton of force?

Answer

One newton of force is defined as the amount of force needed to accelerate 1 kilogram (kg) of mass at a rate of 1 meter per second square (m/s^2).

$1N = 1\ kg\ m/s^2$

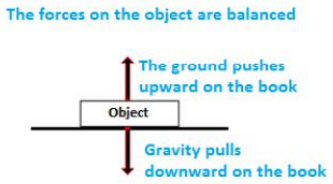
43. What is the difference between balanced and unbalanced force?

Answer

Balanced force:

When two forces are acting in the opposite directions of an object, which does not cause any change in the state of motion of the object.

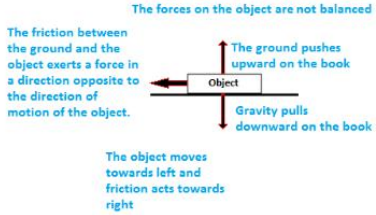
They are equal in magnitude.



Unbalanced force:

When two forces are acting in the opposite directions of an object, which cause change in the state of motion of the object.

They are unequal in magnitude.



44. Define frictional force.

Answer

The force which tend to oppose the motion of the object is called frictional force.

45. Define the term inertia.

Answer

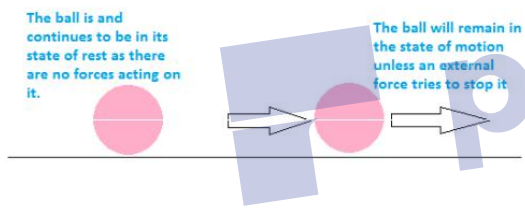
Inertia is defined as the property of an object to resist a change in their state of rest or of uniform motion is called inertia.

46. State Newton's law of motion.

Answer

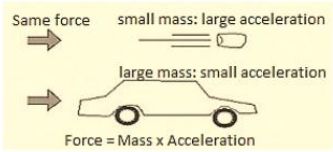
Newton's first law:

A body tends to be in a state of rest or of uniform motion unless or until an external force is applied on it.



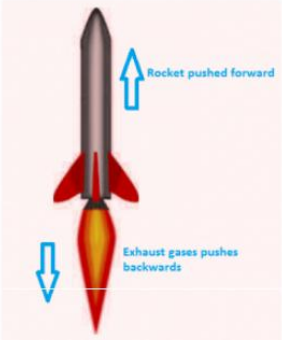
Newton's second law:

The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of force.



Newton's third law:

For every action, there is always an equal and opposite reaction acting on two different bodies.



47. Explain momentum.

Answer

It is defined as the product of mass and velocity and the direction is same as that of the velocity. The S.I unit is Kg m/s

P = m*v

48. Two bodies have a mass of 10 Kg and 20 Kg respectively. Which one has more inertia?

Answer

The measure of inertia is proportional to mass of an object, So more the mass more inertia acts on the body. So the 20kg mass will have more inertia.

49. Mention any two factors which determine the momentum of a body?

Answer

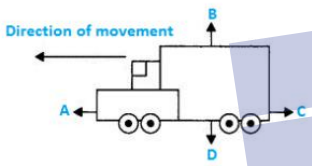
The momentum of body depends upon mass and velocity of a body.

50. What determines the change in momentum of an object?

Answer

The rate of change of momentum of an object is always proportional to the applied unbalanced force in the direction of force.

51. Mention the type of force acting on the truck mentioned below.



Answer

The force A is known as driving force

The force B is known as Reacting force

The force C is known as frictional force

The force D is known as gravitational force

52. Mention some of the changes that a force can bring in a body.

Answer

Force can change the speed of the object.

Force can change the direction of motion of a body.

Force can change the speed of the body.

53. What is force and explain about its different types?

Answer

Force is defined as the push or pull on an object that cause a physical change by producing acceleration in the body on which it acts.

F= Mass (m) * acceleration (a)

Its SI Unit is 1N = 1 kg m/s^2

Balanced force:

When two forces are acting in the opposite directions of an object, which does not cause any change in the state of motion of the object.

Unbalanced force:

When two forces are acting in the opposite directions of an object, which cause change in the state of motion of the object.

Frictional force:

The force which tend to oppose the motion of the object is called frictional force.

54. When a car makes a turn at a very high speed, we tend to get thrown to one side. Explain the statement.

Answer

The reason behind this is law of inertia. While moving in a car along a straight line, we tend to be in our same state of motion. But when an external unbalanced force acts on a body there will be a change in direction of the motion of the car, so we get thrown to one side.

55. It is not recommended to jump out of the moving bus. Why?

Answer

The reason behind this is inertia of motion. The body tends to be in motion while travelling in a moving bus, so on jumping out a bus our feet comes to rest with the surface but the upper part of the body is still in motion which is due to inertia of motion, so we may fall forward.

To avoid this, we need to get down by running along the moving bus.

56. In a cricket match, a fielder who is trying to attempt a catch generally pull his hand along the moving ball. Why is that?

Answer

A fielder who is trying to attempt a catch does this because it consumes time so that momentum of the ball is reduced to zero.

W.K.T

Force is defined as the change in momentum by time. So, when the time is increased the player has to apply a smaller force in taking a catch which reduces the overall force and thus saving the hand from getting injured.

57. Athletes always have a special posture by resting their right foot in solid supporter, why?

Answer

On the occasion of the race, athletes have to run the heats and they rest their foot on the solid support before the start, so this gives lot of force during the start of the race and this support gives him equal and opposite push to get a very good start.

58. The safety belts in the car help in preventing accidents. Justify the statement.

Answer

Yes, safety belt helps in preventing accidents. When the car is moving with a high speed, our body tends to be in movement due to inertia of motion in the forward direction. So when there is a sudden collision, serious injuries can happen. However, seat belt exerts a force on our body to slow down the forward motion.

59. Karate player breaks the pile of tiles with a single blow. Explain the statement.

Answer

The karate player strikes the pile of tiles by applying a very large velocity. The overall momentum of fast moving hand is reduced to zero in a very short interval. So this creates a force on the tiles and eventually breaks.

60. Athletes are made to fall on a sand bed while performing a high jump. Give reason.

Answer

During the high jump event the athlete is made to fall on the sand bed because it increases the time to attain the rest position, therefore he takes less damage. We know that $F = \frac{(m*v)}{t}$

So force and time are inversely proportional to each other. If there is an increase in time, there is a decrease in rate of change of momentum and therefore the force or the impact is reduced.

61. Explain law of conservation of momentum.

Answer

The law of conservation of momentum states that the momentum of two bodies before the collision is always equal to the momentum after collision.

However for an isolated system, the total momentum always remain constant.

62. The roads of mountain are tend to be inclined at turns. Give reason.

Answer

The roads of the mountain are tend to be inclined at turns because it helps the driver to counteract the momentum of the vehicle which tend to push the vehicle towards the outside of the curve due to sudden change in line of motion.
So inclining the roads help in providing a force which help helps in preventing the vehicle from falling down the mountain.

63. Explain the concept of momentum being conserved in two bodies.

Answer

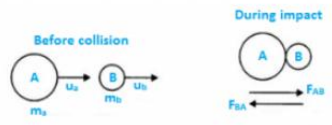
Let us consider two bodies namely A and B, the mass and the initial velocity are m and u respectively.

Before collision

For body A, momentum = $m_a * u_a$

For body B, momentum = $m_b * u_b$

The two bodies collide and force is exerted by each body and velocity change is also observed due to collision.



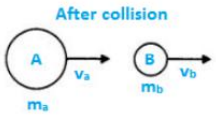
After collision

For body A, momentum = $m_a * v_a$

For body B, momentum = $m_b * v_b$

The rate of change of momentum for the body A = $m_a * \frac{(v_a - u_a)}{t}$

The rate of change of momentum for the body B = $m_b * \frac{(v_b - u_b)}{t}$



According to Newton's third law of motion

The force F_{AB} exerted by ball A on ball B and the force F_{BA} exerted by the ball B on ball A must be equal and opposite to each other. Therefore

$F_{AB} = F_{BA}$

$$m_a * \frac{(v_a - u_a)}{t} = m_b * \frac{(v_b - u_b)}{t}$$

$m_a * u_a + m_b * u_b = m_a * v_a + m_b * v_b$

Therefore, **($m_a * u_a + m_b * u_b$)** is the total momentum of the two bodies A before collision and **($m_a * v_a + m_b * v_b$)** is the total momentum of the two bodies A after collision.

So the total momentum of the two bodies remain constant when no external force acts on it.

64. The football easily flies in air when it is kicked by the player but it is not the same in case of stone? Why?

Answer

The measure of inertia is proportional to mass of an object, So more the mass more inertia acts on the body.
So in that way the mass of the football is less so we experience less inertia leading to larger displacement of the football.
But in case of stone which has a heavier mass offers larger inertia.
Therefore, when we kick the stone (action) it exerts an equal and opposite force (reaction) on the foot which hurts the foot.

65. The person jumping from a certain height on a concrete floor gets hurt. Why?

Answer

The person jumping from a certain height is in the state of inertia of motion.
Once the person comes in contact with the concrete floor, the person comes to rest in a very short interval of time.
We know that F = $\frac{(m*v)}{t}$, So force and time are inversely proportional to each other.
If the time taken is less, the person experiences more force causing more hurt.

66. State examples for Newton's third law of motion.

Answer

Newton's third law:

For every action, there is always an equal and opposite reaction acting on two different bodies.

Take an example of a swimmer,

The person who is swimming pushes water backward (action), while water pushes the person forward (reaction).

Take an example of balloon

Air rushes down in the balloon(action), the balloon goes up(reaction)

Take an example of firing gun

A bullet fired from a gun where gun exerts a force on the bullet(action)

and bullet exerts an equal and opposite force on the gun(reaction).

67. An arrow of mass 10g is horizontally fired with a velocity of 120m/s from a rifle of mass 1 kg. What is the recoil velocity of the pistol?

Answer

Arrow	Rifle
m_1 = 10g = 0.01kg	m_2 = 1kg
u_1 = 0	u_2 = 0
v_1 = 120m/s	v_2 = ?

The total momentum of the arrow and rifle before firing, when the rifle is at rest

= $m_1*u_1 + m_2*u_2$

= (0.01*0) + (1*0)

= 0 kg m/s

The total momentum of the arrow and rifle after it is fired

= $m_1*v_1 + m_2*v_2$

= (0.01*120) + (1* v)

= 1.2 + v

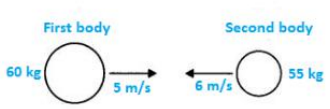
Therefore, by law of conservation of momentum

Total momentum after firing = Total momentum before firing

1.2 + v = 0

v = -1.2m/s (-ve sign indicates that the direction of the rifle would recoil in opposite direction of the arrow).

68. Two objects as shown in figure collides with each other and join thereafter. Calculate the velocity with which they will be moving after combining.



Answer

Object 1	Object 2
m_1 = 60kg	m_2 = 55kg
u_1= 5m/s (+ve direction)	u_2= -6m/s(-ve direction)
v = ?	v = ?

Total momentum of two objects **before collision**

= m_1*u_1 + m_2*u_2

= (60*5 + 55*-6)

= -30 kg m/s

If v is the velocity of the both objects combined together.

After collision, the total momentum will be

= m_1*v_1 + m_2*v_2 (v_1 = v_2 = v)

= (m_1 + m_2)*v

= (60 + 55)*v

= 115 v

According to law of conservation of momentum

Momentum before collision = Momentum after collision

m_1*u_1 + m_2*u_2 = m_1*v_1 + m_2*v_2

-30 kg m/s = 115*v

v = $\frac{-30}{115}$

v = -0.26 m/s

The two objects will move with a velocity of 0.26 m/s in the direction of the second body.

69. Define the term inertia. Explain its types and state some examples in daily life.

Answer

Inertia:

The tendency of a body to resist change in their state of rest or of motion is called inertia.

The two conditions are

An object at rest tends to stay at rest.
An object in motion tends to stay in motion.

Types of inertia

Inertia of rest:

The ability of a body to resist any change in its state of rest.

Inertia of motion:

The ability of a body to resist any change in its state of motion.

Inertia of direction:

The ability of a body to resist any change in its state of direction

Examples of inertia in our day to day life applications

When bus suddenly takes a turn and we fall in direction opposite to it.
The car applies a sudden brake, we tend to fall forward.
When a carpet is beaten with a stick, the dust falls down

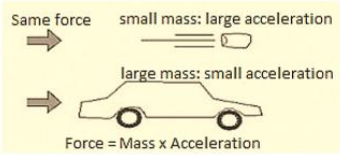
When a carpet is beaten with a stick, the dust falls down

70. Explain the concept of Newton's second law of motion with the help of an example and also explain its importance in sports?

Answer

Newton's second law:

The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of force.



With the help of an example we will understand the concept clearly

Let us consider an object of mass (m), moving along a straight line with an initial velocity (u), final velocity (v) with time (t).

Initial momentum of the object = p_1 = m*u

Final momentum of the object = p_2 = m*v

The change in momentum = $p_2 - p_1$

= (m*v) – (m*u)

= m*(v-u)

The rate of change in momentum = $m * \frac{(v-u)}{t}$

Therefore,

The applied force is F

$F \propto m\frac{(v-u)}{t}$

$F = mk\frac{(v-u)}{t}$ (where k is proportionality constant)

W.K.T

From equation of motion

v = u + a*t

a = $\frac{(v-u)}{t}$

So,

F = k*m*a (F is expressed in kg m/s^2 or Newton)

The second law is related to sports in the following examples

In a cricket match, a fielder who is trying to attempt a catch generally pull his hand along the moving ball because it consumes time so that momentum of the ball is reduced to zero.

W.K.T

Force is defined as the change in momentum by time. So, when the time is increased the player has to apply a smaller force in taking a catch which reduces the overall force and thus saving the hand from getting injured.

Elastic force of tennis racket exerting a force on a tennis ball, making it accelerate.

Activity based questions

71. Make a pile of similar carom coins on a table, as shown in the figure. • Attempt a sharp horizontal hit at the bottom of the pile using another carom coin or striker. If the hit is strong enough the bottom coin moves out quickly. Once the lowest coin is removed, the inertia of the other coins makes them 'fall' vertically on the table.

Answer

Inertia:

The tendency of a body to resist change in their state of rest or of motion is called inertia.

The two conditions are

An object at rest tends to stay at rest.
An object in motion tends to stay in motion.

72. Do the following.

1. ***Set a five-rupee coin on a stiff card covering an empty glass tumbler standing on a table as shown in the figure.***
2. ***Give the card a sharp horizontal flick with a finger. If we do it fast then the card shoots away, allowing the coin to fall vertically into the glass tumbler due to its inertia.***
3. ***The inertia of the coin tries to maintain its state of rest even when the card flows off.***


Quickly flicking the coin leads the coin to falling in the cup

Answer

The force applied on the card due to flicking changes the inertia of the card but he coin resist this change and stays at rest

i.e) Due to change the in inertia and gravity the coin falls down into the tumbler.

73.Do the following.

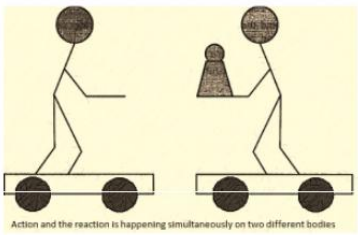
1. ***Place a water-filled tumbler on a tray.***
2. ***Hold the tray and turn around as fast as you can***
3. ***We observe that the water spills. Why?***

Answer

The water filled in the tumbler and tray are at rest. On moving/turning around the tray at faster rate, the water spills because the tray and the tumbler comes into motion while the water in the tumbler remain at inertia of rest.

74. Request two children to stand on two separate carts as shown on the next page. Give them a bag full of sand or some other heavy object. Ask them to play a game of catch with the bag. Does each of them receive an instantaneous reaction as a result of throwing the sand bag (action)? You can paint a white line on cartwheels to observe the motion of the two carts when the children throw the bag towards each other.

Answer

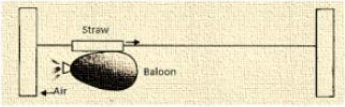

Action and the reaction is happening simultaneously on two different bodies

Yes, in this case each of them receives an instantaneous reaction as a result of throwing the sand bag. This activity explain Newton's 3rd law of motion i.e., the force is exerted forward in throwing the bag full of sand and the person who is throwing it gets pushed backward.

75. Do the following.

1. ***Take a big rubber balloon and inflate it fully.***
2. ***Tie its neck using a thread. Also using adhesive tape, fix a straw on the surface of this balloon.***
3. ***Pass a thread through the straw and hold one end of the thread in your hand or fix it on the wall.***
4. ***Ask your friend to hold the other end of the thread or fix it on a wall at some distance.***
5. ***The arrangement is shown in the figure below***

5. *The arrangement is shown in the figure below.*
6. ***Now remove the thread tied on the neck of balloon. Let the air escape from the mouth of the balloon.***
7. ***Observe the direction in which the straw moves.***



Answer

When the air escapes out from the balloon the straw moves in the opposite direction of the air moved out of the balloon. This activity explains the law of conservation of momentum

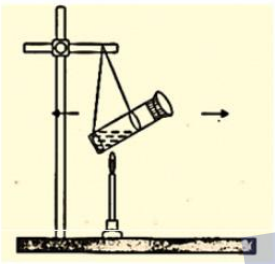
Initial momentum = Final momentum

This activity is also based on Newton's third law of motion

For every action, there is always an equivalent and opposite reaction between two bodies.

76.Do the following.

1. ***Take a test tube of good quality glass material and put a small amount of water in it.***
2. ***Place a stop cork at the mouth of it.***
3. ***Now suspend the test tube horizontally by two strings or wires as shown in the figure on next page.***
4. ***Heat the test tube with a burner until water vaporises and the cork blows out.***
5. ***Observe that the test tube recoils in the direction opposite to the direction of the cork.***



Answer

The cork is pushed out in forward direction by the hot steam. The test tube is pushed in the backward direction.

This activity is based on Newton's third law of motion

For every action, there is always an equivalent and opposite reaction between two bodies.

This activity also explains the law of conservation of momentum

Initial momentum = Final momentum

Value based question

77. Class V students were playing cricket with the cork hall in the school campus. Dileep a senior student told them about the accidents that can occur due to cork ball in the campus and also advised them to bring soft cosco ball to play the game. (a) Why it was safe to play with soft ball and not with hard cork ball? (b) A player pulls his hands backwards after holding the ball shot at high speed. Why? (c) What value of Dileep is seen in this act?

Answer

(a) The soft ball will have less inertia as compared to the heavy ball and it would not hurt the players.

(b) By pulling the hand backwards it reduces the force exerted by the ball on hands.

(c) Dileep showed the value of being responsible and helpful by nature.

78.Ram saw his karate expert friend breaking a slate. He tried to break the slate but Ram's friend stopped him from doing so and told him that it would hurt, one needs lot of practice in doing so. (a) How can a karate expert break the slate without any injury to his hand? (b) What is Newton's third law of motion? (c) What value of Ram's friend, is seen in the above case?

Answer

a) A karate player applies the blow with large velocity in a very short interval of time on the slate, therefore large force is exerted on the slate and it breaks.

b) To every action there is an equal and opposite reaction, both act on different bodies

b) To every action there is an equal and opposite reaction, both act on different bodies.

c) Ram's friend showed the value of being responsible and caring friend.

Chapter 8:

Questions:

1. A man walks around a square street of side 10 m in 40 sec. Calculate the displacement of the man at the end of 2 minutes 20 seconds.

Answer:

The man takes 40 sec to cover (4 * 10) 40 metres. This shows he covers one metre in one sec.

In 2 min 20 sec (140 sec) , he will cover a distance of 140 metres.

Thus he completes $\frac{140}{40}$ = 3.5 rounds in 2 min 20 sec.

Hence it is noticed that he will be at the opposite side from where he started.

Now considering two simple cases.

Case (i)

If the man started at a corner of the square street:

In this case, the man would be diagonally opposite to the place from where he started

Displacement = diagonal of square with side 10 metre.

= $\sqrt{10^2 + 10^2}$

= $\sqrt{100}$

=14.1m

Case (ii)

The man started from the middle of the road.

After the end time, he is in the opposite side of the road.

Hence, the displacement is 10 metre.

2) Explain why the below statements about displacements are not true.

1. ***Displacements cannot be zero***
2. ***The magnitude of displacements are always greater than the distance travelled.***

Answer:

1. The statement is not correct because when the object reaches the same point where it started, after its movement, its displacement is zero as the definition states that it is the distance between the starting point and the ending point.
2. The magnitude of displacement may or equal to the distance travelled but never greater than it because it is the measure of the shortest distance between the initial and final positions of the travelling object.

3) What is the difference between speed and velocity?

Answer:

Speed	Velocity
Defined as the ratio of distance travelled by the object in a given time.	Defined as the ratio of displacement by the object during the given time period.
Doesn't have any direction. A scalar quantity	Has an unique direction. A vector quantity.
Can never be negative because the distance travelled is always positive	Can be a negative quantity as the displacement can be negative

4) State the conditions when the average velocity of an object will be magnetically equal to its average speed.

Answer:

The average speed is defined as, Avg Spd = $\frac{Total\ distance\ covered}{Total\ time\ taken}$

Whereas the average velocity = $\frac{Displacement}{}$

$Total\ time\ taken$

Therefore, for both the quantities to be equal, the numerator of the quantities should be equal. Thus the average speed of the object will be equal to its average velocity when that total distance travelled by the object is equal to its displacement.

5) What parameter is measured using the odometer in an automobile?

Answer:

In an automobile the Odometer is used to measure the total distance travelled by the vehicle.

6) When an object is in uniform motion, what type of path does it follows?

Answer:

An object in an uniform motion will have a straight line path because in a curved path there will be acceleration and deceleration which varies the average speed, thus deviating from the uniformity of speed.

7) From a rocket launch station, a signal sent from the recently launched vehicle reaches the station in 5 minutes. If the speed of the wave is 3 * 10^8 m/s, find the distance at which the rocket sent its signal from.!

Answer:

Total time taken by the signal from the spaceship to reach the ground station is, 300 sec

Speed of the signal = 3 * 10^8 m/s

By, definition; Speed = $\frac{Total\ distance}{Total\ time\ taken}$

Therefore, the total distance = speed * total time taken.

= (3 * 10^8) * (300)

= 900 * 10^8 metres

= 9 * 10^{10} metres

8) How will you determine whether the object is in

1. **Uniform acceleration?**
2. **Non – uniform acceleration?**

Answer:

1. When the velocity of the moving object changes uniformly, that is if it increases or decreases its speed at an uniform rate, it is said to be undergoing an uniform acceleration. This happens when the body is moving in a straight path without bends or curves because they tend to change the rate of acceleration.
2. When the velocity of the moving object changes non uniformly, that is if the rate of change of its velocity is not uniform, then it is said to be undergoing a non uniform acceleration. Objects moving in a circular path or in the curved area tend to move in a non uniform acceleration.

9) While driving, the man observes a cloud of vehicles ahead and reduces his speed. Find the acceleration of the vehicle if the speed changes from 80 km h^{-1} to 60 km h^{-1}.

Answer:

The primary step is to convert the given speed in km h^{-1} to m/s for easier calculation.

Initial speed of the vehicle = u = 80 * (5/18) = 22.22 m/s

Final speed of the vehicle = v = 60 * 5/18) = 16.66 m/s

Total time = 5 sec

Acceleration = a = $\frac{v-u}{t}$

= $\frac{16.66 - 22.22}{5}$

= -1.112 m/s^2

The negative sign indicates that the acceleration is negative. It is decelerating at the rate of 1.112 m/s^2.

10) A car in a national highways starts after a pit stop and attains a speed of 40 km h^{-1} in 10 minutes. Find its rate of acceleration.

Answer:

Initial velocity = u = 0 (since the car is starting from rest)

Final velocity (given) = v = 40 km h^{-1} = 11.11 m/s (convert into m/s)

Total time taken = t = 10 min = 600 sec

W.k.t a = $\frac{v-u}{t}$

= $\frac{11.11-0}{600}$

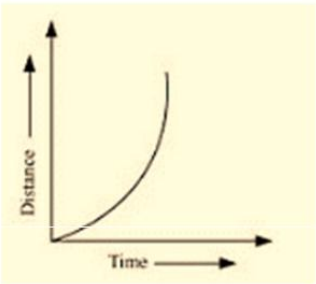
= 0.0185 m/s^2

Hence, the acceleration of the car is 0.0185 m/s^2

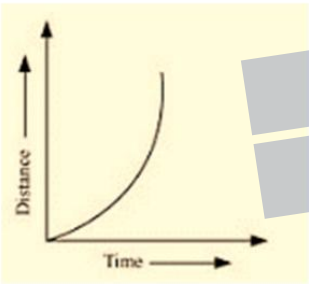
11) Draw the distance time graphs for uniform and non uniform motion of an object. Explain their existence.

Answer:

For an uniform motion the distance time graph is a straight line, as the acceleration in zero and the distance travelled at a particular time is the same)



The distance – time graph for non uniform motion of an object is a curved line since it undergoes an acceleration.



12) Comment on the motion of object whose distance – time graph is a straight line parallel to the time axis.

Answer:

When the distance time graph is parallel to the time axis, it means that the object covers no distance with the progression of time. Hence it is observed that the object is at rest.

13) Comment on the motion of object whose speed time graph is a straight line parallel to the time axis.

Answer:

When the speed time graph is parallel to the time axis, it means that the object does not vary its speed with the change in time. Hence, it is said to be in an uniform motion.

14) What does the area under the velocity time graph represent?

Answer:

W.k.t

Velocity = $\frac{distance}{time}$

Hence, velocity * time gives you the distance covered by the object distance travelled

15) A car starts from the rest with an uniform acceleration of 0.1 m/s^2. In two minutes, find (a) the speed it reaches (b) the distance travelled

Answer:

(a) Given:

u = 0

v = ?

a = 0.1 m/s^2

t = 120 sec

a = $\frac{v-u}{t}$

0.1 = $\frac{v-0}{120}$

= 12 m/s

(b) Given:

u = 0

v = 12 m/s

t = 120 sec

a = 0.1 m/s^2

According to the third equation of motion

$v^2 + u^2 = 2as$

$(12)^2 + (0)^2 = 2\ (0.1)s$

On solving the above equation,

s = 720 metres

16) A car is moving with a speed of 90 km h^{-1}. The driver sees a road sign stating that there is a block in the road in 1 km. He applies brake to produce an uniform acceleration of -0.5 m s^{-2}. Find how far before the block the car stops.

Answer:

Initial speed of the car: u = 90 km h^{-1} = 25 m s^{-1}

Final speed of the car: v = 0 m s^{-1} (since it comes to rest)

Acceleration: -0.5 m s^{-2}

Using the third equation of motion

$v^2 = u^2 + 2as$

$(0)^2 = (25)^2 + 2(-0.5)s$

On solving the above equation,

S = 625 m

Therefore, the car stops (1000 – 625) = 375 m before the block.

17) In a supermarket a lady leaves her trolley on an inclined plane and didn't notice. The trolley started moving down with an acceleration of 2 cm s^2 . With what velocity will the trolley be moving at the 3rd second after it started moving?

Answer:

Initial velocity = 0 m/s (since the trolley was at rest)

Acceleration = a = 2 cm s^{-2} = 0.02 m s^{-2}

Time = t = 3 sec

Using the first equation of motion,

v = u + at

$v = 0 + (0.02 * 3)$

$v = 0.06 \text{ m s}^{-2}$

18) A horse accelerates at a rate of 4 m s^{-2}. What is the distance it covers after running for 10 sec from the start?

Answer:

Initial velocity = $u = 0 \text{ m s}^{-1}$

Acceleration = $a = 4 \text{ m s}^{-2}$

Time = t = 10 sec

Using the second equation of motion,

$S = ut + 0.5 at^2$

$S = 0 = (0.5 * 4 * 10^2)$

S = 200 m

Hence the horse covers 200 metres in the first 10 seconds.

19) A stone is thrown in a vertically upward direction with a velocity of 5 m s^{-1}. If the acceleration of the stone during its motion is 10 m s^{-2} in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

Answer:

Initial velocity of stone = $u = 5 \text{ m s}^{-1}$

Final velocity of stone = $v = 0 \text{ m s}^{-1}$ (since at the maximum height, the stone comes to rest)

Acceleration = $a = 10 \text{ m s.}^{-2}$

Using the first equation of motion,

$v = u + at$

$0 = 5 + (-10)t$ (because the acceleration is in the opposite direction to the motion)

t = 0.5 sec

Using this answer in the second equation of motion,

$s = ut + 0.5at^2$

$s = (5 * 0.5) + (0.5 * (-10) * 0.5^2)$

$s = (2.5) – (1.25)$

s = 1.25 metres

Thus, the stone attains 1.25 m at the maximum accelerating point.

20) A satellite is made to revolve around the earth's orbit of radius 42250 km. With what speed should it be initiated for it to go around the whole orbit in 24 hours?

Answer:

Given radius of earth = r = 42250 m

Time taken = 24 hours

Speed of object in circular motion = $v = \frac{2\prod r}{t}$

$= \frac{2*3.14*42250}{24}$

$= 1.105 * 10^4 \text{ km h}^{-1}$

$= 3.069 \text{ km s}^{-1}$

Hence, the speed of the satellite is 3.069 km s^{-1}

21) A man is chased by a dog who runs around a circular park of diameter 200 m. He runs at a speed with which he covers the perimeter in 40 sec. At the end of

21) A man is chased by a dog. He runs around a circular park of diameter 200 m. He runs at a speed with which he covers the perimeter in 40 sec. At the end of 2 min 20 sec what will be the distance covered by him. Also find the displacement at the end of the given period.

Answer:

Given:

Diameter of circular park = d = 200 m

Radius = r = 100 m

Circumference = 2∏ r = 2 * 3.14 * 100

= 628 metre

Total time the is running = 2 min 20 sec = 140 sec

Hence, the distance covered in 140 sec = (628/40) * 140 = 2200 metres

He he is running in a circular path and he takes 40 sec for each round, his displacement after each 40 sec will be zero since he is coming to the same place where he started. Thus, he completes three whole rounds in 120 sec and in the next 20 sec covers half the distance.

At the end of 140 sec, he will be in exact opposite spot from where he started. Since the diameter of the circular park is 200 metre, his displacement after 140 sec is 200 metres.

22) Akash jogs from one end A to the other end B of a 400 metre road in 2 min 45 sec and then turns around and jogs 200 metres back to point C in another 1 min 30 sec. What are Akash's average speed and velocities in jogging (a) from A to B and (b) from A to C?

Answer:

(a) From A to B

Distance travelled by akash = 400 m

Time taken to cover the distance = 165 sec

Avg spd = $\frac{Total\ distance}{Total\ time\ taken}$

Speed = $\frac{400}{165}$

= 2.424 m s^{-1}

Velocity = $\frac{Total\ displacement}{Timetaken}$

= 2.424 m s^{-1} (since the shortest distance between A and B is total distance travelled to reach B from A)

(b) Distance travelled = 400 + 200 = 600

Time taken = 4 minutes 15 seconds = 255 seconds

Average speed = $\frac{Total\ distance}{Total\ time\ taken}$

= $\frac{600}{255}$

= 2.253 $m\ s^{-1}$

Velocity= $\frac{Total\ displacement}{Timetaken}$

Total displacement = 300 – 100 = 200 m

Time taken = 255 s

∴ Velocity = $\frac{200}{255}$

= 0.7843 $m\ s^{-1}$

23) Seetha rides her bicycle to school. In morning while going to school she averages a speed of 15 km/h. On her return from school at evening along the same route, she averages a speed of 12 km/h. Calculate the average speed of Seetha's trip.

Answer:

Average speed= $\frac{Total\ distance}{Total\ time\ taken}$

Let s be the total distance travelled and t be the time taken

Let t_1 and t_2 be the time taken to ride from home to school and from school to home respectively.

15 = $\frac{s}{}$

15 = $\frac{s}{t_1}$

t_1= $\frac{s}{15}$

12 = $\frac{s}{t_2}$

t_2 = $\frac{s}{12}$

∴ The average speed of her round trip = $\frac{Total\ distance}{Total\ time\ taken}$

Here total distance travelled is s + s = 2s

Total time taken = Time taken to ride to school + Time taken to return from school

= t_1 + t_2

Average speed = $\frac{2s}{t_1+t_2}$

= $\frac{2s}{\frac{s}{15}+\frac{s}{12}}$

= $\frac{120}{9}$ = 13.33 km h^{-1}

Therefore, the average speed of Seetha in the round trip is 13.33 km h^{-1}

24) A car ,which is at rest, starts to accelerate at a steady rate of 4 m s^{-2}

in a straight line and it continues to do so for 5 seconds. Calculate the distance travelled by car during this time.

Answer:

Here the initial velocity of the car is zero

Therefore, u = 0

Travelling time = t = 5 seconds

Acceleration of the car = a = 4 m s^{-2}

Distance travelled is given by the second equation of motion :

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

S = 0 + $\frac{1}{2} * 4 * (5)^2$

S = 50 m

Therefore, the distance travelled by the car during the time of 5 seconds is 50 meters.

25) A car moving at a speed of 55 km/h, when applied brake comes to a stop in 6 s. Another car which is moving at a speed of 6 km/h come to a stop in 11s, when applied a brake.Plot the speed vs time graphs for both the cars on the same scale. Which among the two cars will travel farther after the braking?

Answer:

Let the two cars be A and B

Initial speed of the car A, u_1 = 55 km/h = 15.277 m/s

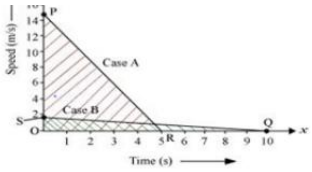
Time duration between the application of brakes and stopping of car A = t_1= 6 s

That is the speed of the car reaches zero 5 s after the application of brakes.

Initial speed of the car B, u_2= 6 km/h = 1.666 m/s

Time duration between the application of brakes and stopping of car B = t_2=11 s

That is the speed of the car reaches zero after 11 s of application of brakes.



Graph is to be edited based on the values above

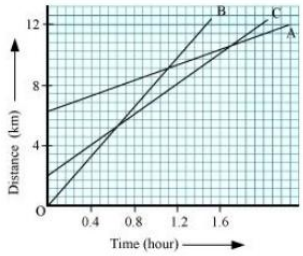
Distance travelled by each car after the application of brakes is given by the area under their respective speed-time graph

For car A, ½ * 6 * 15.27 = 45.81 m

For car B, ½ * 11 * 1.666 = 9.163 m

Thus the car A has travelled farther than the car B after the application of brakes.

26) Observe the following graph, which shows the distance-time graphs of three objects 1, 2, 3 and answer the questions.



**** names of the lines to be edited (A,B,C as 1,2,3)****

i) Which among the three is faster?

ii) Did all three ever happen to be at the same point?

iii) What is the distance travelled by the 3, when 2 crosses 1.

iv) What is the distance travelled by the 2, when it crosses 3.

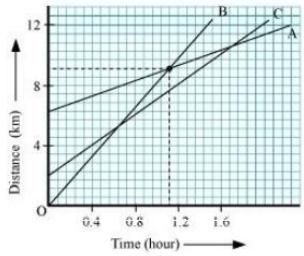
Answer:

i).∵ Speed = Slope of the graph

Since the slope of object 2 is greater than objects 1 and 3, it is the fastest among them.

ii) All three object's distance-time graph never get to meet at the same point. Therefore, they never could have been at the same point at a time.

iii) In the graph, each box represents a distance of $\frac{4}{7}$ km



As we can see initially, when time is zero, object 3 is four boxes away from the origin.

Therefore, at the start object 3 is $\left(4 * \frac{4}{7}\right) = \frac{16}{7}$ km away from the origin.

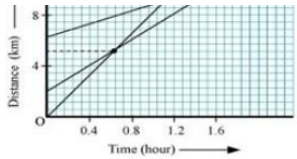
Distance between object 3 and origin, when 2 crosses 1 = 8 km

Therefore, the total distance travelled by object 3, when object number 2 crosses 1

= 8 – $\frac{16}{7}$ = $\frac{40}{7}$

= 5.71 km

iv) Boxes covered by object 2, when it crosses 3 = 9 boxes



$\therefore 9 * \frac{4}{7} = \frac{36}{7} = 5.143$ km

27) A stone is dropped from a building of height of 30m. It accelerates at a rate of 8 m s^{-2}. What will be the velocity of the stone when it hits the ground? How long will it take to reach the ground?

Answer:

Distance travelled by the stone before it reaches the ground = s = 30m

Acceleration = 8 m s^{-2}

Initial velocity = 0 m s^{-1}

Final velocity when it reaches the ground, v, is given by third equation of motion

$v^2 = u^2 + 2as$ Misplaced & $v^2 = 320$

v = 17.889 m s^{-1}

Time taken to reach the ground can be found out using first equation of motion

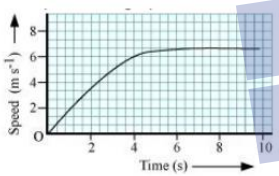
v = u + at

17.899 = 0 + 8 * t

T = $\frac{17.889}{8}$ = 2.236

Hence the stone reaches the ground with a velocity of 17.889 m/s in 2.236 seconds after it is dropped from the building

28) The velocity- time graph of a bike is given below



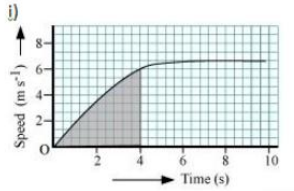
i) Calculate the distance travelled by the bike in first four hour of its travel. Show the area in the graph that stands for the distance travelled by the bike in that first four hours.

ii) Mention the region of the graph that represents uniform motion of the bike

Solution:

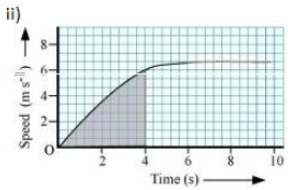
i) The greyed out region of the graph that is equal to 0.5 * 4 * 6 = 12m, stands for the distance travelled by the bike in first four kilometers.

i)



ii) The region of the graph between 6s and 10s of the time scale represents the uniform motion of the bike.

ii)



29) State if the following conditions are possible and if possible give an example.

i) To have a constant acceleration with zero velocity

i) To have a constant acceleration with zero velocity

ii) To have an acceleration in one direction and move in a perpendicular direction.

Answer:

i) Possible condition

Example: Consider a ball thrown up and when it reaches its maximum height attains zero velocity, but it experiences a constant acceleration due to gravity , that is 9.8 m/ s^2 .

ii) Possible condition

Example: A car moving in a circular track accelerates in the perpendicular direction.

30) A man- made satellite is orbiting around the earth in a circular path of radius 52350 km. Find the velocity of the satellite if it takes 20 hrs to finish one revolution around the earth.

Answer:

Speed = $\frac{Distance}{Time}$

Distance = $2 * \pi * r$ = 2 * 3.14 * 52350 = 328758 km

Time = 20 hours

Speed = Distance/time

Speed = 328758 / 20 = 16437.6 km/h