ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

- **Subject- Physics** **Study Material -4** **Class IX**
- **Date : 8.05.2020**
- **Chapter: Motion (Numericals)**

Question 1: Calculate the force needed to speed up a car with a rate of $5ms^{-2}$, if the mass of the car is 1000 kg.

Solution: According to question:

Acceleration (a) $=5m/s2=5m/s2$ and Mass (m) = 1000 kg, therefore, Force (F) =?
We know that, $F=m\times aF=m\times a$
$=1000kg\times5m/s2=1000kg\times5m/s2$
$=5000kg\ m/s2=5000kg\ m/s2$
Therefore, required Force $=5000m/s2=5000m/s2$ or 5000 N

Question 2: If the mass of a moving object is 50 kg, what force will be required to speed up the object at a rate of $2ms^{-2}$?

Solution: According to the question;

Acceleration (a) $=2ms-2=2ms-2$ and Mass (m) = 50 kg, therefore, Force (F) =?
We know that, $F=m\times aF=m\times a$
$=50kg\times2m/s2=50kg\times2m/s2$
$=100kg\ m/s2=100kg\ m/s2$
Therefore, required Force $=100m/s2=100m/s2$ or 100 N

Question 3: To accelerate a vehicle to $3m/s^2$what force will be needed if the mass of the vehicle is equal to 100 kg?

Solution: According to the question:

Acceleration (a) $=3m/s2=3m/s2$ and Mass (m) = 100 kg, therefore, Force (F) =?
We know that, $F=m\times aF=m\times a$
$=100kg\times3m/s2=100kg\times3m/s2$
$=300kg\ m/s2=300kg\ m/s2$
Therefore, required Force $=300m/s2=300m/s2$ or 300 N

Question 4.
A particle of 10 kg is moving in a constant acceleration 2m/s^2 starting from rest. What is its momentum and velocity per the table given below

S.No	time	Momentum	Velocity
1	1sec		
2	1.5 sec		
3	2 sec		
4	2.5 sec		

Solution
Velocity can find using
$v=u+at$
For u=0
$v=at$
Momentum
$P=mv$

S.No	time	Momentum	Velocity
1	1sec	20 Kg m/s	2 m/
2	1.5 sec	30 kg m/s	3 m/s
3	2 sec	40 kg m/s	4 m/s
4	2.5 sec	50 kg m/s	5 m/s

Question 5
If a net force of 7 N was constantly applied on 400 g object at rest, how long will it take to raise its velocity to 80 m/s?
a. 0 s
b. 2.23 s
c. 3.47 s
d. 4.57 s

Solution

Given F=7 N,m=400g= .4 kg Acceleration is given by $a=Fm$
a=17.5 m/s^2

Now u=0,v=80 m/s $v=u+at$v=u+at

$t=\frac{v-u}{a}$t=v−ua

t=4.57 sec

Question 6

A sedan car of mass 200kg is moving with a certain velocity . It is brought to rest by the application of brakes, within a distance of 20m when the average resistance being offered to it is 500N.What was the velocity of the motor car?

Solution

$F=ma$F=ma

or

$a=\frac{F}{m}$a=Fm

or

a= -500/200=-2.5 m/s^2

Now

$v^2=u^2+2as$v2=u2+2as

Now v=0,s=20 m,a=-2.5 m/s^2

So, u=10 m/s

Question 7

A driver accelerates his car first at the rate of 4 $m/s^2$and then at the rate of 8 m/s^2 .Calculate the ration of the forces exerted by the engines?

Solution

$F_1=ma_1$F1=ma1

and

$F_2=ma_2$F2=ma2

So,Ratio of force exerted is given by

$=\frac{F_1}{F_2}=\frac{ma_1}{ma_2}=\frac{a_1}{a_2}=1:2$=F1F2=ma1ma2=a1a2=1:2

Question 8

An object of mass 10 g is sliding with a constant velocity of 2 m/ s on a frictionless horizontal table. The force required to keep the object moving with the same velocity is

(a) 0 N

(b) 5 N

(c) 10 N

(d)20 N

Solution

As m=0, F=0

Hence (a) is correct

Question 9
A cricket ball of mass 0.20 kg is moving with a velocity of 1.2m/s . Find the impulse on the ball and average force applied by the player if he is able to stop the ball in 0.10s?

Solution
Impulse= Change in momentum
$I=\Delta p=m\Delta v=.20\times 1.2=.12$ Kgm/s
Now
Impulse is also defined as
$I=F\times t$
or
$F\times t=.12$
or
$F=\frac{.12}{.10}=1.2$ N

Question 10
A car start from rest and acquire a velocity of 54 km/h in 2 sec. Find
(i) the acceleration
(ii) distance travelled by car assume motion of car is uniform
(iii) If the mass of the car is 1000 Kg,what is the force acting on it?

Solution
Given u=0 ,v= 54 km/hr= 15 m/s , t=2 sec a. Acceleration is given by
$a=\frac{\Delta v}{t}$
So, a=7.5 m/s^2

b. Distance is given by
$s=ut+\frac{1}{2}at^2$
s= 15 m

c. Force is given by $F=ma=1000\times 7.5=7500$ N

Question 11
A hockey ball of mass .2 Kg travelling at 10 ms^{-1} is struck by a hockey stick so as to return it along its original path with a velocity at 2 m/s . Calculate the change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.

Solution
$\Delta P=m\times(v-u)=0.2\times(-2-10)=-2.4$ kg ms^{-1}
(The negative sign indicates a change in direction of hockey ball after it is struck by hockey stick.)

Question 12

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

Solution

Given $m_1=100gm=0.1kg$m1=100gm=0.1kg, $m_2=200gm=0.2kg$m2=200gm=0.2kg

$u_1=2$u1=2 ms^{-1}, $u_2=1$u2=1 ms^{-1}, $v_1=1.67$v1=1.67 ms^{-1}, $v_2=?$v2=?

By the law of conservation of momentum,

$m_1u_1+m_2u_2=m_1v_2+m_2v_2$m1u1+m2u2=m1v2+m2v2

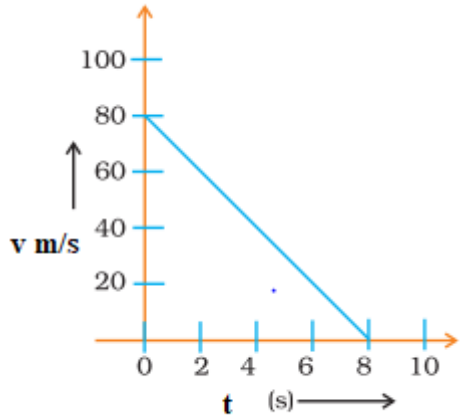
$0.1\times2+0.2\times1=0.1\times1.67+0.2v_2$0.1×2+0.2×1=0.1×1.67+0.2v2

$v_2=1.165$v2=1.165 ms^{-1}

It will move in the same direction after collision

Question 13

Velocity versus time graph of a ball of mass 100 g rolling on a concrete floor is shown below. Calculate the acceleration and the frictional force of the floor on the ball?



Solution

From the graph ,we can see that

$\Delta v=-80m/s$Δv=−80m/s, t=8 sec

Now

$a=\frac{\Delta v}{t}=-10m/s^2$a=Δvt=−10m/s2

Frictional force will be given as

$F=ma=.1\times-10=-1N$F=ma=.1×−10=−1N

Question 14
An object of mass 1kg acquires a speed of 10 m/s when pushed forward. What is the impulse given to the object?

Solution
Impulse=Change in Momentum= 10 Kgm/s

Question 15
A bullet of mass 10 gm is fired with an initial velocity of 20 m/s from a rifle of mass 4 kg. Calculate the initial recoil velocity of the rifle?

Solution
Let v be the initial recoil velocity of the rifle From law of conservation of Momentum

$0=.01\times20+4\times v0=.01\times20+4\times v$

Or $v=-.05\mathrm{m/s}v=-.05\mathrm{m/s}$

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