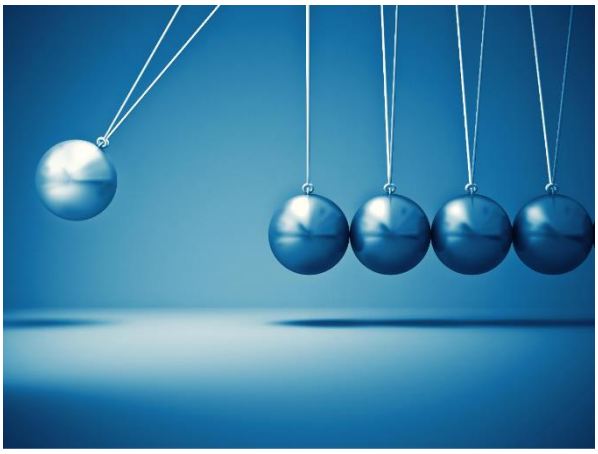
Easy Physics

For : 1st secondary

Chapter 3 : Force and Motion

Session one:- Momentum



by

Mr. Abdullah Abdelazeem

Tel :

01221517001 - 01154564212

Momentum

It is the product of the object mass and its velocity.

* Momentum (P) = mass(m) × velocity(V)

$$P = m \times V$$

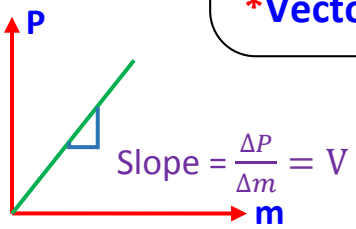
*measure in kg.m/s

*dimensions $M.L.T^{-1}$

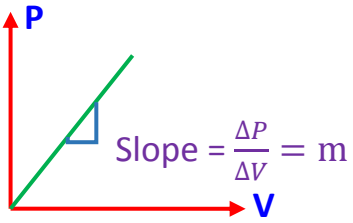
*Vector quantity

*** Factors that affect momentum**

1 – Mass → directly proportional at constant velocity.



2 – Velocity → directly proportional at constant mass.



G.R Momentum is a vector quantity.

Bec. it is a dot product of a vector quantity (velocity) and scalar quantity (mass).

❖ Direction of momentum is in the same direction of the velocity.

When does.....?

The momentum of a body equal zero.

ANSWER

When the velocity of the body equal zero (v = 0)

Solved example

An object of mass 0.5 kg is left to fall from the top of a tower where it reached the ground after 4 seconds. Calculate the momentum when it touches the ground.

Answer:

m= 0.5 Kg V_i= zero t= 4 S P= ?

∵ $V_f = V_i + at$ $V_f = 10 \times 4 = 40$ m/s

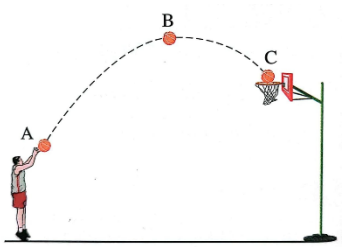
∵ P=mV

P=0.5 x 40 = 20 Kg.m/s

Examples

1- A ball of mass 0.7 kg begins a free fall motion, vertically from a height of 50 m, hence with neglecting the resistance of air, Find the momentum of the ball at the instant of hitting the ground

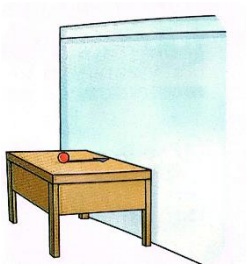
2- A player shoots the ball into the basket as shown in the opposite figure, at which of the following points the momentum of the ball is greater than the other points?



a) Point A b) Point B

c) Point C d) Neither, because momentum is the same at all points.

3- In the opposite figure, a ball of mass 200 g was placed on a horizontal table that is adjacent to a vertical wall. If the ball is pushed to move horizontally towards the wall to collide with it at a velocity of 0.7 m/s then rebound from it with a velocity of 0.4 m/s, the magnitude of change in the momentum of the ball due to the collision equals……



a) 0.22 Kg.m/s b) 0.14 Kg.m/s

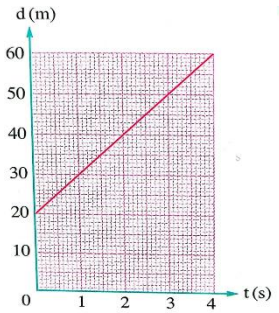
c) 0.08 Kg.m/s d) 0.06 Kg.m/s

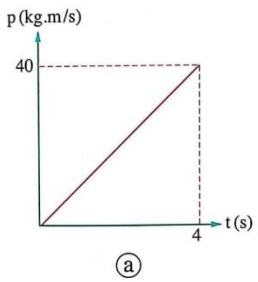
4- When an empty truck of mass m was moving at a constant velocity v, its momentum was p. If the truck is loaded with a load of mass 2 m and moves with a velocity of $\frac{1}{2}$v , its momentum becomes……

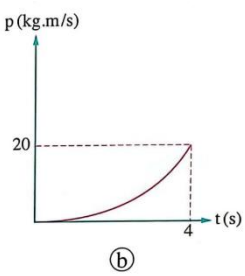
a) $\frac{1}{2}$p b) p

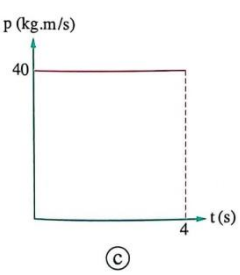
c) $\frac{3}{2}$p d) 2 p

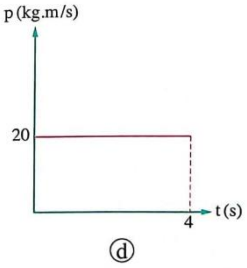
5- The opposite graph represents the variation of the displacement (d) versus time (t) for a body of mass 2 kg that is moving in a straight line, which of the following graphs represents the variation of the momentum of this body (p) versus tim e (t) through the same time interval?











Homework

1- The product of the mass of a body that is moving in a constant direction and the time rate of change in its displacement represents the…….

a) force b) momentum

c) acceleration d) weight

2- A firefighting airplane dropped its load into a firing forest when it was flying horizontally at a constant velocity and continued its motion by the same velocity, so the momentum of the airplane after dropping the load would……..

a) increase b) decrease

c) remain unchanged d) become zero

3- Two bodies have the same momentum, one of them has a mass of 5 kg and its velocity is 20 m/s, hence if the second one has a mass of 15 kg, its velocity equals.....

a) 0.15 m/s b) 5.55 m/s

c) 6.67 m/s d) 20 m/s

4- A bowling ball of mass 4.6 kg is moving at velocity v along a bowling alley, so at what velocity a gulf ball of mass 46 g has to move so that it has the same magnitude of momentum as that of the bowling ball?

a) 0.01 v b) 5 v

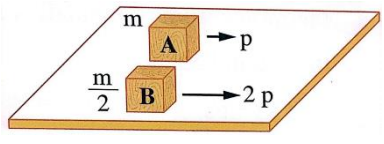
c) 10 v d) 100 v

5- An eagle of mass 10 kg flies at a velocity of 20 m/s, if it catches a prey of mass 1 kg and then flies with it at the same velocity, hence the ratio between the momentum of the eagle alone and its momentum with the prey respectively equals…….

a) $\frac{1}{1}$ b) $\frac{1}{10}$

c) $\frac{10}{11}$ d) $\frac{10}{1}$

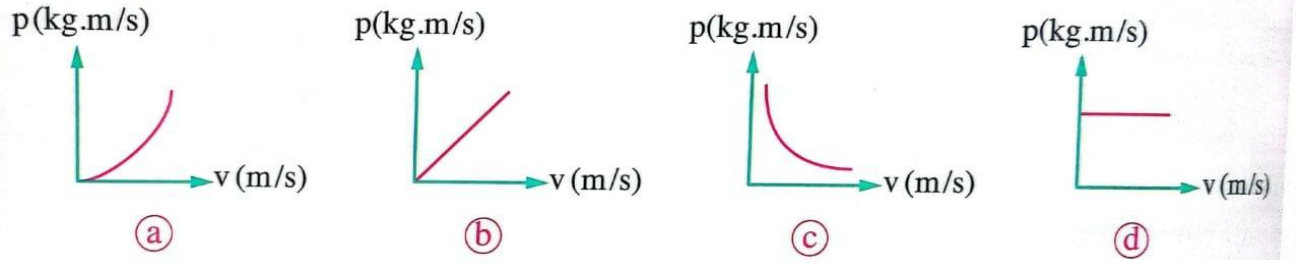
6- In the opposite figure, if body A has mass m, velocity v and momentum p while body B has mass $\frac{m}{2}$ and momentum 2 p, the velocity of body B is……..



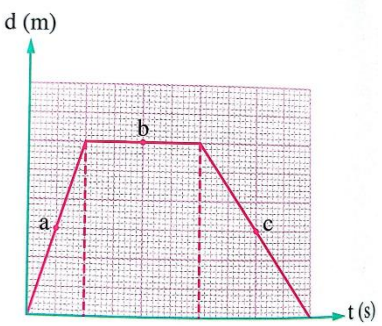
a) $\frac{v}{2}$ b) v

c) 2 v d) 4 v

7- The graph that represents the relation between the momentum of a body and its velocity is……



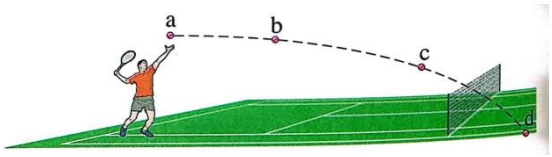
8- The opposite graph represents the variation of the displacement (d) of a body that is moving in a straight line versus time (t), so at which of the shown points in the graph the body has its maximum momentum?



a) a b) b

c) c d) All points have equal momenta.

9- At which of the shown points in the opposite figure the tennis ball has the largest momentum?



a) a b) b

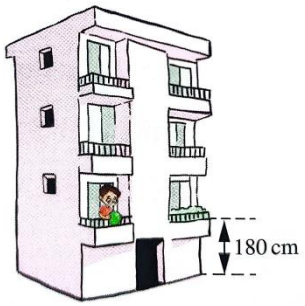
c) c d) d

10- An object of mass 0.5 kg begins a free fall motion from the top of a building so that it strikes the ground 4 s later, hence the momentum of the object at the moment of striking the ground equals..... (Take: g= 10 m/s²)

a) 10 kg.m/s b) 20 kg.m/s

c) 30 kg.m/s d) 40 kg.m/s

11- The opposite figure shows a ball of mass 0.5 kg that undergoes a free fall motion towards the ground, hence the momentum of the ball at the moment of reaching the ground equals……. (Take: g= 10 m/s²)



a) 3 kg.m/s b) 5 kg.m/s

c) 6 kg.m/s d) 9 kg.m/s