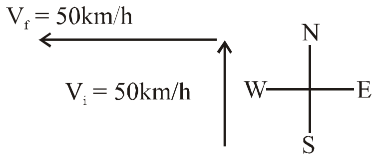
OBJECTIVE - I

1. At motor car is going due north at a speed of 50 km/h. It makes a 90o left turn without changing the speed. The change in the velocity of the car is about

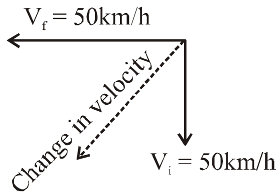
(A) 50 km/h towards west (B*) 70 km/h towards south-west

(C) 70 km/h towards north-west (D) zero

Sol. B



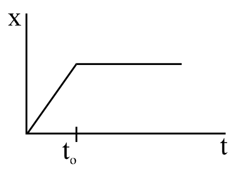
Change in velocity of the car = Vf – Vi



= $\sqrt{(50)^2 + (50)^2}$ towards south-west = $50\sqrt{2}$ km/h

= 70 km/h towards south-west

2. Fig. shows the displacement time graph of a particle moving on the X-axis.



(A) the particle is continuously going in positive x direction

(B) the particle is at rest

(C) the velocity increases up to a time t_o, and then becomes constant.

(D*) the particle moves at a constant velocity up to a time t_o, and then stops.

Sol. D

Slope of "x-t" graph gives velocity

Here ($t = 0$ to $t = t_0$) slope is constant so we can say that velocity is constant. Than aftrer to, slope is zero. So velocity is zero. So velocity is zero.

Þ velocity zero means particle stops.

3. A particle has a velocity u towards east at t = 0. Its acceleration is towards west and is constant, Let x_A and x_B be the magnitude of displacements in the first 10 seconds and the next 10 seconds.

(A) $x_A < x_B$ (B) $x_A = x_B$ (C) $x_A > x_B$

(D*) the information is insufficient to decide the relation of x_A with x_B.

Sol. D

W ¬ ® E

¬ ®

a= constant u

V= u + at

Some time after velocity is zero

O = u – at

t = u/a

then after particle is return back for this information, we not decided that particle is turn back before 10 sec or after 10 sec.

4. A person travelling on a straight line moves with a uniform velocity u_1 for some time and with uniform velocity u_2 for the next equal time. The average velocity u is given by

(A*) $\upsilon = \frac{\upsilon_1+\upsilon_2}{2}$ (B) $u = \sqrt{\upsilon_1 \upsilon_2}$ (C) $\frac{2}{\upsilon} = \frac{1}{\upsilon_2} + \frac{1}{\upsilon_2}$ (D) $\frac{1}{\upsilon} = \frac{1}{\upsilon_2} + \frac{1}{\upsilon_2}$

Sol. A

$S_1 = u_1 t$
$S_2 = u_2 t$
Total displacement = S Þ $S_1 + S_2$
$S = u_1 t + u_2 t$
$= (u_1 + u_2)\, t$
Total time = t + t = 2t

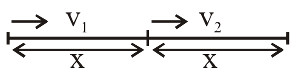
average velocity = $\frac{\text{Total displacement}}{\text{Total time taken}} = \frac{(u_1 + u_2)t}{2t} = \frac{u_1 + u_2}{2}$

5. A person travelling on a straight line moves with a uniform velocity u_1 for a distance x and with a uniform velocity u_2 for the next equal distance. The average velocity u is given by

(A) $\upsilon = \frac{\upsilon_1+\upsilon_2}{2}$ (B) $u = \sqrt{\upsilon_1 \upsilon_2}$ (C*) $\frac{2}{\upsilon} = \frac{1}{\upsilon_2} + \frac{1}{\upsilon_2}$ (D) $\frac{1}{\upsilon} = \frac{1}{\upsilon_2} + \frac{1}{\upsilon_2}$

Sol. Total displacement = 2x
Total time taken = $t_1 + t_2$

$= \frac{x}{v_1} + \frac{x}{v_2}$



average velocity = $\frac{\text{Total displacement}}{\text{Total time taken}} = \frac{2x}{\frac{x}{v_1} + \frac{x}{v_2}}$

$v = \frac{2}{\frac{1}{v_1} + \frac{1}{v_2}}$ Þ $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

6. A stone is released from an elevator going up with an acceleration a. The acceleration of the stone after the release is

(A) a upward (B) (g-a) upward (C) (g-a) downward (D*) g downward

Sol. D

Stone is released from an elevator
The acceleration of the stone after the release is
$a_{Se} = -g = g$ downward

7. A person standing neat the edge of the top of a building throws two balls A and B. The ball A is thrown vertically downward with the same speed. The ball A hits the ground with a speed u_A and the ball B hits the ground with a speed u_B. We have :

(A) $u_A > u_B$ (B) $u_A < u_B$ (*C) $u_A = u_B$
(D) the relation between A and B depends on height of the building above the ground.

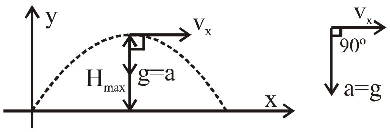
Sol. C

After come back at level 1 velocity of the ball 'A' is same and equal to ball 'B'.
$v^2 = u^2 + 2as$
Ball A + Ball B travels the same height so we can say that

$u_B = u_A$

8. In a projectile motion the velocity
(A) is always perpendicular to the acceleration
(B) is never perpendicular to the acceleration
(C*) is perpendicular to the acceleration for one instant only
(D) is perpendicular to the acceleration for two instants.

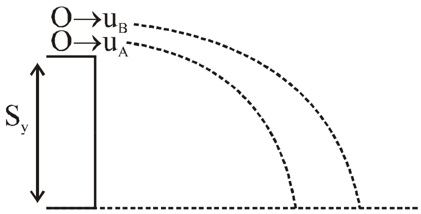
Sol. C



In a projectile motion
at maximum height, y component of the velocity is zero. Only instant velocity is perpendicular to the acceleration.

9. Two bullets are fired simultaneously, horizontally and with different speed from the same place. Which bullet will hit the ground first?
(A) the faster one (B) the slower one
(C*) both will reach simultaneously (D) depend on the masses.

Sol. C



Both bullet will hit the ground simultaneously because downward acceleration of the both bullet is same & equal to g. t fired at same place.

$S = ut + 1/2\ at^2$

$S_y = uy + 1/2\ a_y + t^2$

$S_y = O + 1/2\ gt^2$

$t = \sqrt{\frac{2S_y}{g}}$.

10. The range of a projectile fired at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45°, its range will be
(A) 25 m (B) 37 m (C) 50 m (D*) 100 m

Sol. D

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$50 = \frac{u^2 \sin 30°}{g} \quad .... (1)$$

$$\frac{u^2}{g} = 100 \quad .... (2)$$

Given Þ fired with the same speed atom angle of 45°

$$R' = \frac{u^2 \sin 2\times 45°}{g} = \frac{u^2}{g}\sin 90° \quad \{Q \sin 90° = 1\}$$

$$R' = \frac{u^2}{g} = 10\,m$$

11. Two projectiles A and B are projected with angle of projection 15° for the projectile A and 45° for the projection B. If R_A and R_B be the horizontal range for the two projectiles, then

(A) $R_A < R_B$ (B) $R_A = R_B$ (C) $R_A > R_B$

(D*) the information is insufficient to decide the relation of R_A with R_B.

Sol. D

$$R = \frac{u^2 \sin 2\theta}{g}$$

angle's are given but not given the information about 'u'.

12. A river is flowing from west to east at a speed of 5 metres per minute. A man on the south bank of the river, capable of swimming at 10 metres per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction.

(A*) due north (B) 30° east of north (C) 30° north of west (D) 60° east of north

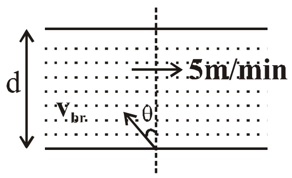
Sol. A

$$t = \frac{d}{V_{br\cos\theta}}$$

t_{min} Þ (cos q) max

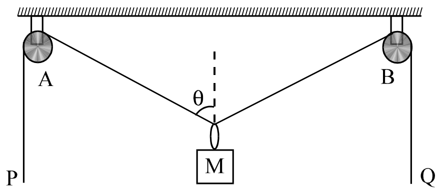
mean = q = 0°

$$t = \frac{d}{V_{br}}$$



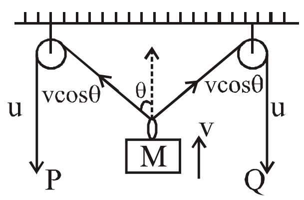
So he should swim in a north direction.

13. In the arrangement shown in fig. the ends P and Q of an inextensible string move downwards with uniform speed u. Pulleys A and B are fixed. The mass M moves upwards with a speed



(A) 2u cosq (B*) u/cosq (C) 2u/cosq (D) ucosq

Sol. B



Along the string velocity of block M is same the velocity of the each & every particle of the string.

So 2vcosq = 2u

v = u/cosq

always take the component of the resultant.

OBJECTIVE - II

1. Consider the motion of the trip of the minute hand of a clock. In one hour

(A*) the displacement is zero (B) the distance covered is zero

(C) the average speed is zero (D*) the average velocity is zero

Sol. AD

Minute hand complete one rotation in 1 hour.

So Displacement is zero.

Distance = 2pr ¹ 0

average speed = $\frac{\text{Distance}}{\text{Total time taken}}$ ¹ 0

average velocity = $\frac{\text{Displacement}}{\text{Total time taken}} = 0$

2. A particle moves along the X-axis as

$x = ut(t-2s) + a(t-2s)^2$

(A) the initial velocity of the particle is u (B) the acceleration of the particle is a

(C) the acceleration of the particle is 2a (D*) at t =2s particle is at the origin.

Sol. at t = 2 second

x = 0 i.e. particle is at origin.

3. Pick the correct statements:

(A) Average speed of a particle in a given time is never less than the magnitude of the average velocity.

(B) It is possible to have a situation in which $\left|\frac{d\vec{\upsilon}}{dt}\right| \neq 0$ but $\frac{d}{dt}|\vec{\upsilon}| = 0$.

(C) The average velocity of a particle is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval.

(D) The average velocity of a particle moving on a straight line is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval. (Infinite acceleration are not allowed)

Sol. ABC

(a) Average speed = $\frac{\text{Distance}}{\text{Total time taken}}$

average velocity = $\frac{\text{Displacement}}{\text{Total time taken}}$

\ Displacement $\leq$ Distance

Average speed $\geq$ average velocity

(b) Let $\vec{v} = \cos t\hat{i} + \sin t\hat{j}$

$\frac{d\vec{v}}{dt} = -\sin t\hat{i} + \cos t\hat{j}$

SO $\left|\frac{d\vec{v}}{dt}\right|$ ¹ 0

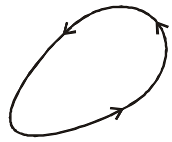
$$|\vec{v}| = \sqrt{\cos^2 t + \sin^2 t} = 1 \qquad \frac{d|\vec{v}|}{dt} = 0$$

(c) Let the path of the particle is

Displacement = 0

Average velocity = 0

But instantaneous velocity is never zero in the interval.



(d) In the straight line motion

Displacement = 0

Average velocity = 0

But in this motion at one point instantaneous velocity is zero.

4. An object may have

(A) varying speed without having varying velocity

(B*) varying velocity without having varying speed

(C) nonzero acceleration without having varying velocity

(D*) nonzero acceleration without having varying speed.

Sol. BD

(a) Speed increase, that causes magnitude of velocity increases.

(b) Magnitude of velocity is constant but direction is continuous changes.

(c) Acceleration = rate of change of velocity

(d) May be possible that acceleration change the direction of the particle but not change the magnitude of the velocity.

5. Mark the correct statements for a particle going on a straight line:

(A) If the velocity and acceleration have opposite sign, the object is slowing down.

(B) If the position and velocity have opposite sign, the particle is moving towards the origin.

(C) If the velocity is zero at an instant, the acceleration should also be zero at that instant.

(D) If the velocity is zero for a time interval, the acceleration is zero at any instant within the time interval.

Sol. (A), (B), (D)

During retardation, acceleration opposes velocity.

Velocity implies the direction of motion of a body.

6. The velocity of a particle is zero at t = 0

(A) The acceleration at t = 0 must be zero

(B*) The acceleration at t = 0 may be zero.

(C*) If the acceleration is zero from t = 0 to t = 10 s, the speed is also zero in this interval.

(D*) If the speed is zero from t = 0 to t = 10 s the acceleration is also in the interval.

Sol. BCD

(a) Free falling body $t = 0$ Þ $v = 0$ & $a = g$¯

(b) Body at rest

(c) From t = 0 to t = 10s, the speed is also zero in this interval. Because (v = u + at)

(d) If body is rest in the interval of t = 0 to t = 10s.

7. Mark the correct statements:

(A*) The magnitude of the velocity of a particle is equal to its speed.

(B) The magnitude of average velocity in an interval is equal to its average speed in that interval.

(C) It is possible to have a situation in which the speed of a particle is always zero but the average speed is not zero

(D) It is possible to have a situation in which the speed of the particle is never zero but the average speed in an interval is zero.

Sol. A

(a) Speed = $|\vec{v}|$

(b) Average velocity = $\frac{\text{Total Displacement}}{\text{Total time taken}}$

Average speed $= \dfrac{\text{Distance}}{\text{Total time taken}}$

|Average velocity| $\neq$ |Average speed|

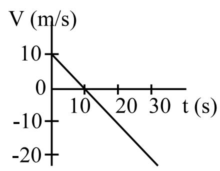
\ |Displacement| $\leq$ |Distance|

(c) Speed of a particle is always zero means particle at rest. Distance travelled by the particle is zero. So average speed = 0

(d) Speed of a particle is never zero means, particle travelled some distance.

So average speed $= \dfrac{\text{Distane}}{\text{time}} \neq 0$

8. The velocity-time plot for a particle moving on a straight line is shown in fig.



(A) The particle has constant acceleration

(B) The particle has never turned around.

(C) The particle has zero displacement

(D) The average speed in the interval 0 to 10s is the same as the average speed in the interval 10s to 20s.

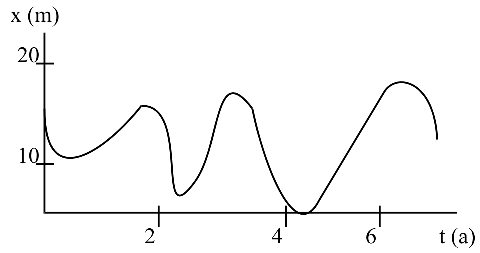
Sol. (A), (D)

Slope of given v-t graph (i.e. acceleration) is constant.

- From 0 to 10 seconds, velocity is in positive and then negative. That means the particle trans around at t = 10 sec.
- The positive and negative areas are not equal, So displacement is not zero.
- Area of v-t graph from t = 0 to t = 10 sec is same as that from t = 10 to 20 sec.

Hence average speed is same.

9. Fig. shows the position of a particle moving on X-axis as funcation of time.



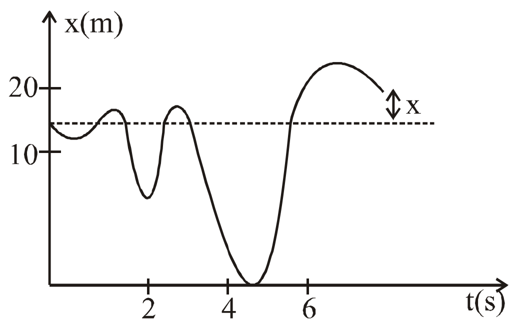
(A*) The particle has come to rest 6 times

(B) The maximum speed is at t = 6 s

(C) The velocity remains positive for t = 0 to t = 6 s

(D) The average velocity for the total period shows is negative.

Sol. A



(a) Slope of x-t graph gives the velocity.

Here 6 times slope is zero. So we can say that the particle has come to rest 6 times.

(b) Just after t = 6 sec slope of x-t graph is zero. Then –ve. So we easily can say that speed is not maximum at t = 6s.

(c) Slope of x-t graph some time +ve & some time –ve¯ or zero. So we can say that in interval of t = 0 to t = 6s some time velocity is +ve, –ve or zero.

(d) Average velocity = $\frac{\text{Total Displacement}}{\text{Total time taken}} = \frac{x_f - x_i}{t} = \frac{x}{t}$ = +ve

10. The accelerations of a particle as seen from two frames S_1 and S_2 have equal magnitude 4 m/s^2.

(A) The frames must be at the rest with respect to each other.

(B) The frames may be moving with respect to each other but neither should be accelerated with respect to the other.

(C) The acceleration of S_2 with respect to S_1 may either be zero or 8 m/s^2.

(D*) The acceleration of S_2 with respect to S_1 may be anything between zero and 8 m/s^2.

Sol. $\vec{a}_{s_2s_1} = \vec{a}_{s_2p} + \vec{a}_{ps_1}$

$\vec{a}_{s_2s_1} = \sqrt{4^2 + 4^2 + 2.4.4.\cos\theta}$

Hence $a_{s_2s_1}$ may lie between 0 & 8 depending upon value of q.