Physicsaholics

DPP – 1 (Kinematics)

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Q 1. A ball is thrown vertically up with a certain velocity. It attains a height of 40 m and comes back to the thrower. Then choose the correct option :(g = 10m/s^2)

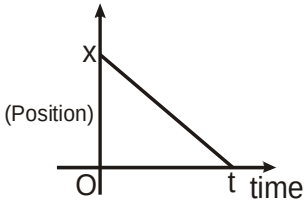
(a) the average speed of the ball for the round trip is zero.
(b) total displacement is 80 m
(c) total displacement is zero
(d) the average velocity for round trip is non zero

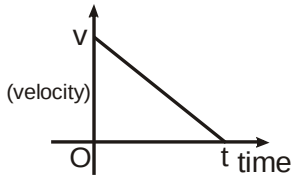
Q 2. The magnitude of the displacement is equal to the distance covered in a given interval of time if the particle.
(a) moves with constant acceleration along any path
(b) moves with constant speed
(c) moves in same direction with constant velocity or with variable velocity
(d) have acceleration and velocity in opposite direction.

Q 3. A point moves in a straight line in such a manner that its retardation is proportional to its speed. Then

(a) Distance is proportional to the increase in speed
(b) Distance is proportional to the speed destroyed
(c) Average velocity of the particle is constant
(d) None of these

Q 4. For which of the following graphs the average velocity of a particle moving along a straight line for time interval (0, t) must be negative -

(a) 

(b) 

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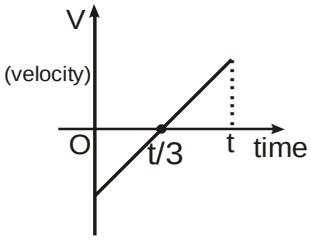

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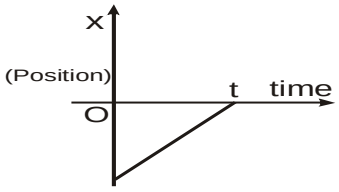
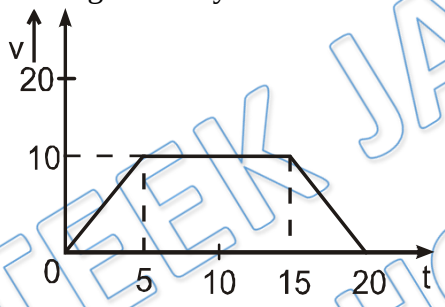
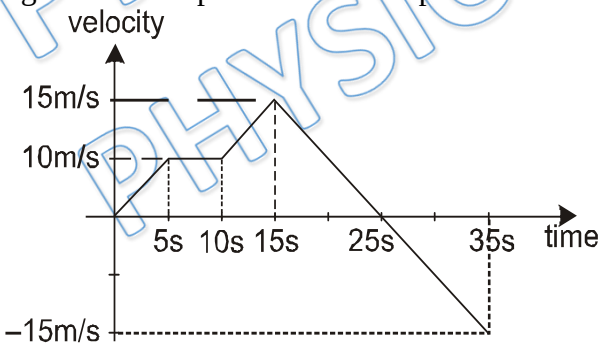


Q 5. Figure shows the velocity time graph of a particle moving along straight line (v is m/s and t is in seconds). Its average velocity in 20 seconds will be:



(a) 10 m/s (b) zero
(c) 3.75 m/s (d) 7.5 m/s

Q 6. A person starts from origin and for his linear motion velocity is given as shown in figure. Find displacement of the person from t = 15 sec to t = 35 sec.



(a) 75 m (b) 0
(c) –75 m (d) 150 m

Q 7. The displacement of a particle is given by $x = (t-2)^2$ where x is in metres and t in seconds. The distance covered by the particles in first 4 seconds is:

(a) 12 m (b) 8 m (c) 9 m (d) 18 m

Q 8. A car covers half of the distance with speed 60 km/hr and rest of the half with speed 30 km/hr. The average speed of the car is –

(a) 45 km/hr (b) 40 km/hr
(c) 20.0 km/hr (d) 50 km/hr

Q 9. A body travelling along a straight line traversed one third of the total distance with a velocity 4 m/s. The remaining part of the distance was covered with a velocity 2 m/s for half the time and with velocity 6 m/s for the other half of time. The mean velocity averaged over the whole time of motion is:

(a) 5 m/s (b) 4 m/s (c) 4.5 m/s (d) 3.5 m/s

Q 10. The displacement of a particle moving in a straight line is described by the relation, $s = 6 + 12t - 2t^2$. Here s is in metres and t in seconds. The distance covered by particle in first 5 s is:

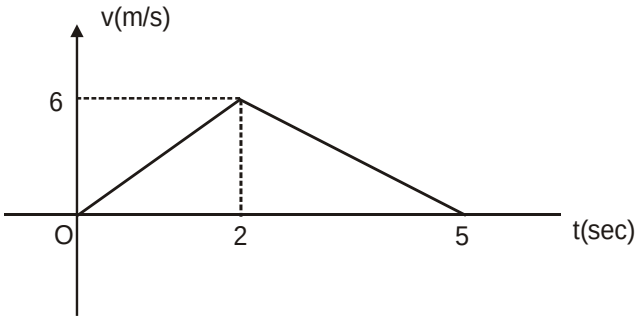
(a) 20 m (b) 32 m (c) 24 m (d) 26 m

Q 11. A body moving in a curved path possesses a velocity 3 m/s towards north at any instant of its motion. After 10s, the velocity of the body was found to be 4 m/s towards west. Calculate the average acceleration during this interval.
(a) 0.1 m/s^2 at 37^0 North of West
(b) 0.5 m/s^2 at 37^0 South of West
(c) 0.1 m/s^2 at 37^0 South of West
(d) 0.5 m/s^2 at 37^0 North of West

Q 12. A particle moves with constant speed v along a regular hexagon ABCDEF in same order (i.e. A to B , B to C, C to D, D to E, E to F, F to A...). Then magnitude of average velocity for its motion from A to C is –
(a) v (b) v/2
(c) $\sqrt{3}v/2$ (d) none of these

Q 13. A particle moves with a velocity v in a horizontal circular path. The change in its velocity for covering 60° will be –
(a) $v\sqrt{2}$ (b) $v/\sqrt{2}$
(c) $v\sqrt{3}$ (d) v

Q 14. From the velocity-time graph of a particle determine the acceleration of particle at t = 1 sec :

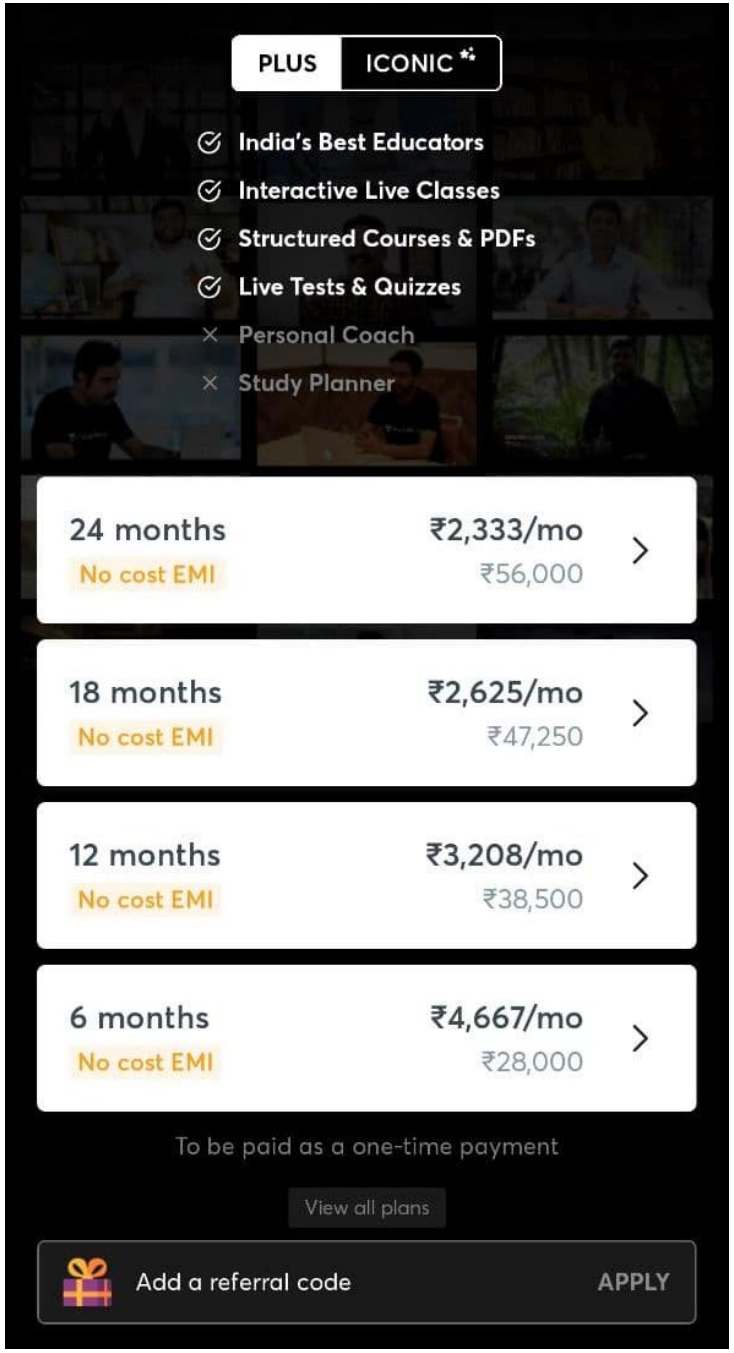


(a) $3m/s^2$ (b) $6m/s^2$
(c) $2m/s^2$ (d) 5m/s

Q 15. A particle moves along the positive branch of the curve $y = \frac{x^2}{2}$ where $x = \frac{t^2}{2}$, x an y are measured in metres and t in seconds. At t = 2 s, the velocity of the particle is
(a) $2\hat{\imath} - 4\hat{\jmath}$ m/s (b) $4\hat{\imath} + 2\hat{\jmath}$ m/s
(c) $2\hat{\imath} + 4\hat{\jmath}$ m/s (d) $4\hat{\imath} - 2\hat{\jmath}$ m/s

Answer Key

Q.1 c	**Q.2 c**	**Q.3 b**	**Q.4 a**	**Q.5 d**
Q.6 b	**Q.7 b**	**Q.8 b**	**Q.9 b**	**Q.10 d**
Q.11 b	**Q.12 c**	**Q.13 d**	**Q.14 a**	**Q.15 c**



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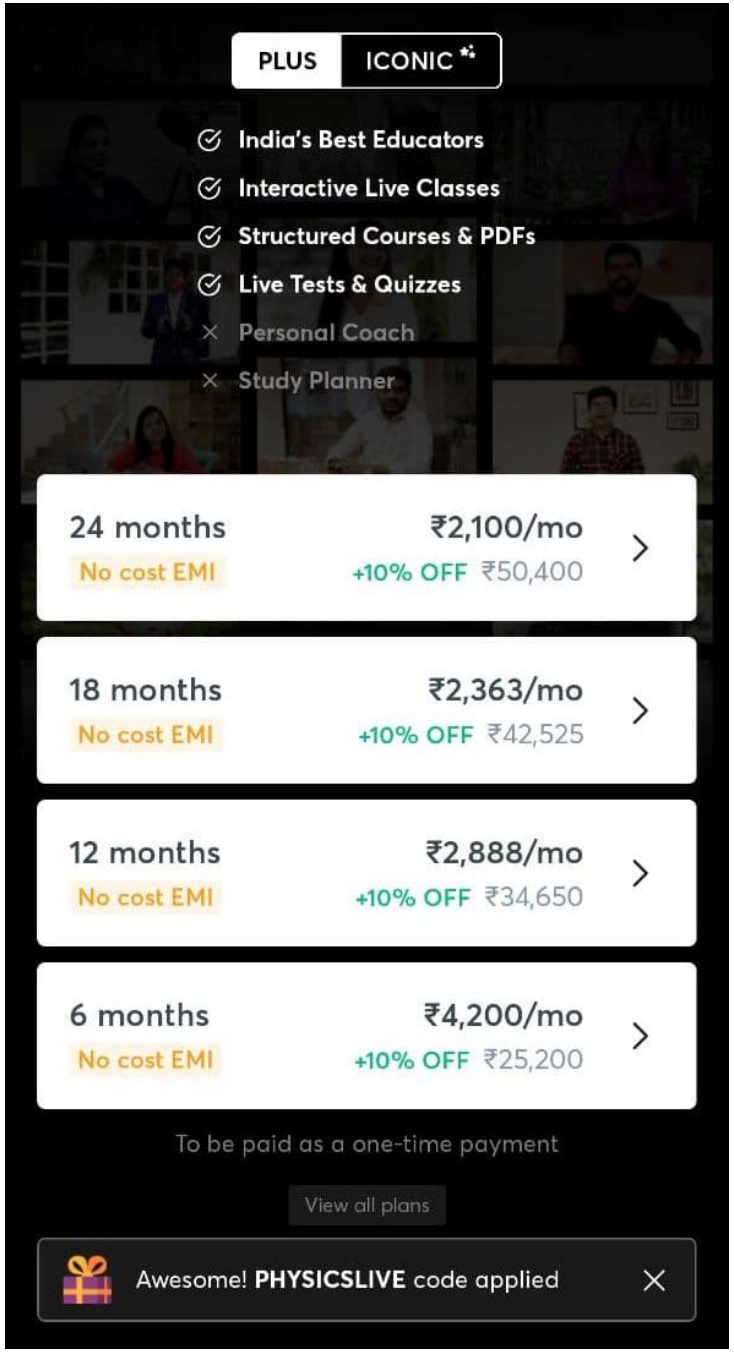


Written Solution

DPP-1 Kinematics: Speed, Velocity, Distance and Displacement

By Physicsaholics Team

Solution: 1

Sol^{n}: since initial & final position is same. so net displacement is zero.

ANS : C

Solution: 2

$|disp| =$ distance

and $\Delta t =$ same

then $|\vec{v}| = \frac{|disp|}{time}$

and $speed = \frac{dist}{time}$

$|\vec{v}| =$ speed.

this is possible if particle is moving along a straight line in one direction. and also not taking u-turn.

because if particle takes u-turn, then Disp. < Dist.

and if particle is not taking any u-turn the $\vec{a}$ & $\vec{v}$ are in same direction.

ANS : c

Solution: 3

Sol^n $\quad a = -kv$; where k is a +ve constant

$$\frac{dv}{dt} = -kv$$

$$\int_{v}^{v} \frac{dv}{v} = -\int_{0}^{t} k\,dt$$

$$\ln v = -kt$$

$$v = e^{-kt}$$

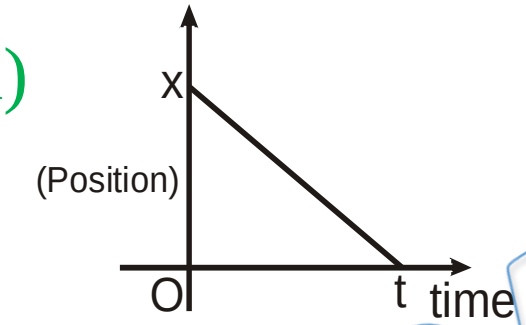
$\Rightarrow$ since v is decreasing with time

so, distance is proportional to $\downarrow$ in speed

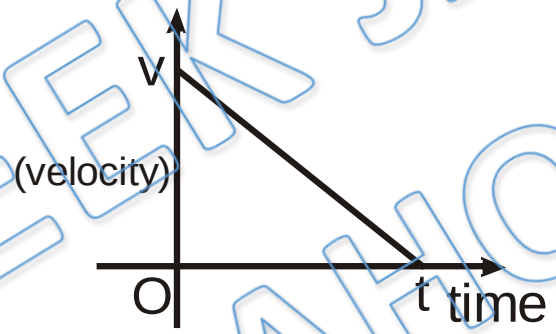
ANS : b (B)

Solution: 4

(a)



(b)



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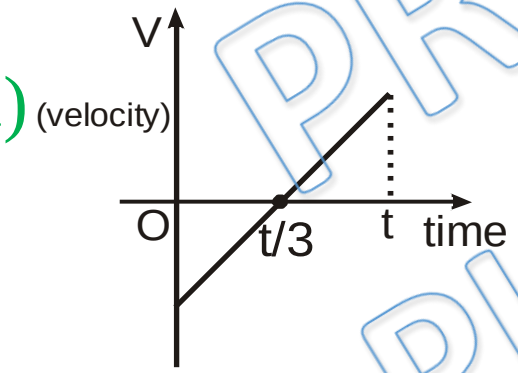
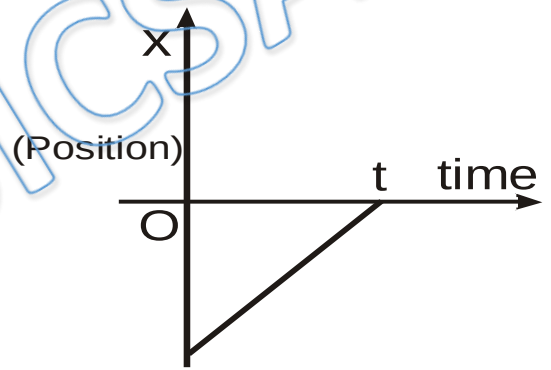


(d)

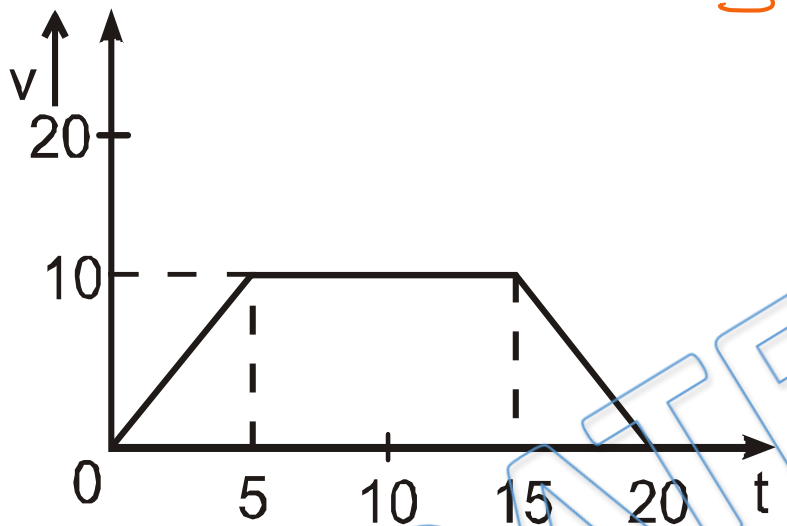


Sol 4. $\langle v \rangle = \frac{x_f - x_i}{\Delta t}$

Since in option (b) x is ↓ with time. so $\langle v \rangle$ will be -ve.

ANS : a

Solution: 5



Soln: $\langle v \rangle = \frac{\text{total displacement}}{\text{total time}}$

$= \frac{\text{Area under v vs t curve}}{\text{time}}$

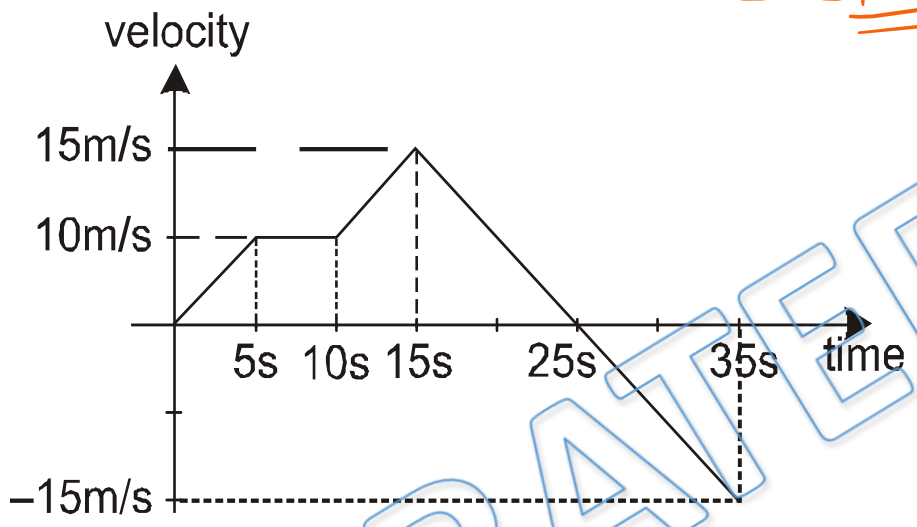
$= \frac{1}{2} \times \frac{30 \times 10}{20}$

$= 7.5$ m/s (d)

Ans.

ANS : d

Solution: 6



Soln: Area of velocity v/s time gives us displacement

$\Rightarrow$ from $t = 15$ to $t = 25$ sec

$s_1 = \frac{1}{2} \times 15 \times \frac{5}{10} = 75$ m (+ve)

from $t = 25$ sec to $t = 35$ sec

$s_2 = \frac{1}{2} \times 15 \times \frac{5}{10} = 75$ m (−ve)

so, net displacement = 0

ANS : b

Solution: 7

$x = (t-2)^2$

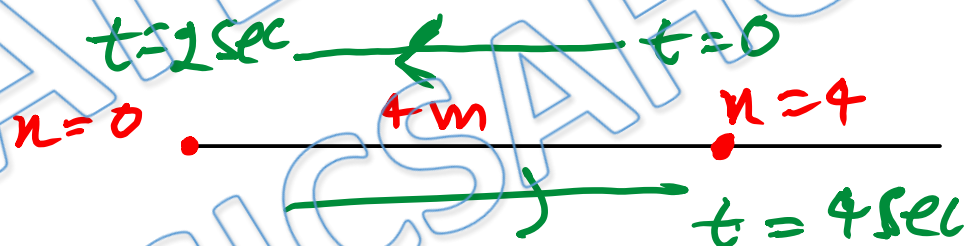
$v = 2(t-2) = 2t - 4$

$v = 2t - 4 = 0$

$\boxed{t = 2 \text{ sec}}$

at; $t = 0$, at; $t = 2$ sec , at; $t = 4$ sec

$x_1 = 4$ m , $x_2 = 0$ m , $x_3 = 4$ m.



$d = 4 + 4$

$\boxed{d = 8 \text{ m}}$ Ans

ANS : b

Solution: 8

time elapsed in first half motion $= \frac{x/2}{60}$

time " " second " " $= \frac{x/2}{30}$

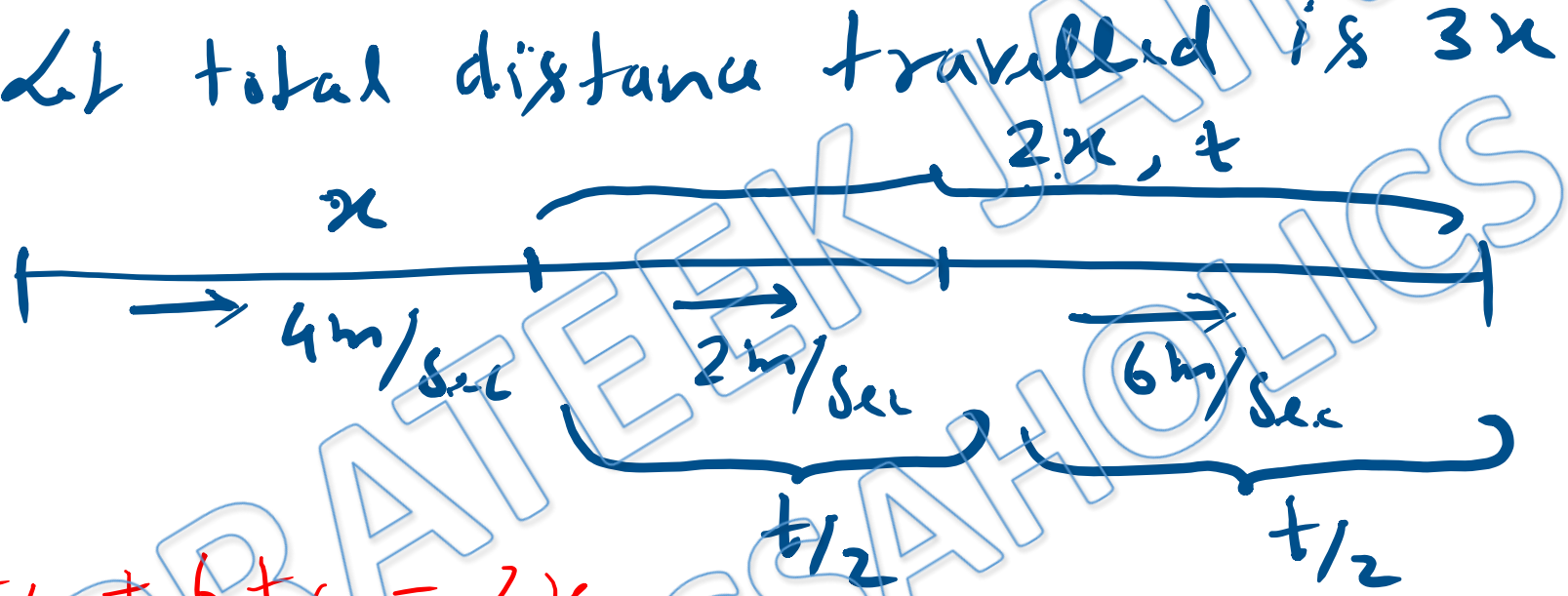
total time $= \frac{x}{120} + \frac{x}{60} = \frac{x}{40}$

$v_{av} = \frac{\Delta s}{\Delta t} = \frac{x}{x/40} = 40\ \text{km/hr}$

ANS : b

Solution: 9

Let total distance travelled is $3x$



$$2t/2 + 6t/2 = 2x$$

$$\Rightarrow 4t = 2x$$

$$t = x/2$$

$$V_{av} = \frac{\Delta s}{\Delta t} = \frac{3x}{\frac{x}{4} + x/2}$$

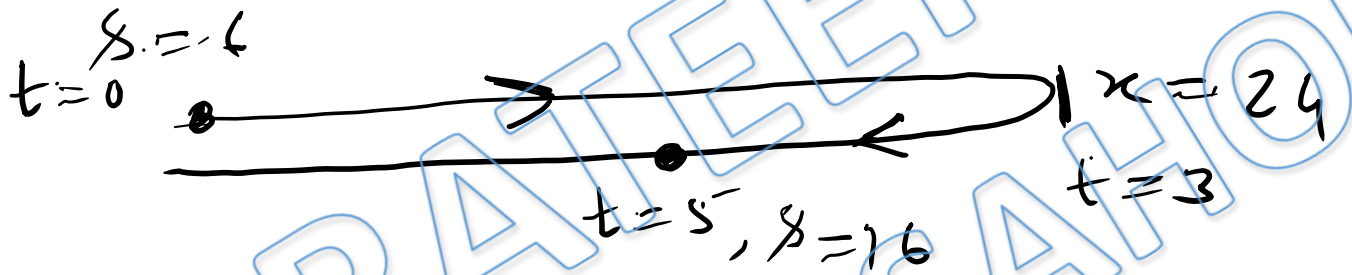
$$= \frac{3x}{3x/4} = 4 \text{ m/sec}$$

ANS : b

Solution: 10

$$s = 6 + 12t - 2t^2 \Rightarrow v = \frac{ds}{dt} = 12 - 4t$$

$v = 0 \Rightarrow t = 3\,Sec \Rightarrow$ particle has changed its direction of motion at $t = 3$ Sec.



at $t = 0$, $s = 6$

at $t = 3$, $s = 6 + 36 - 18 = 24$

at $t = 5$, $s = 6 + 60 - 50 = 16$

total distance travelled

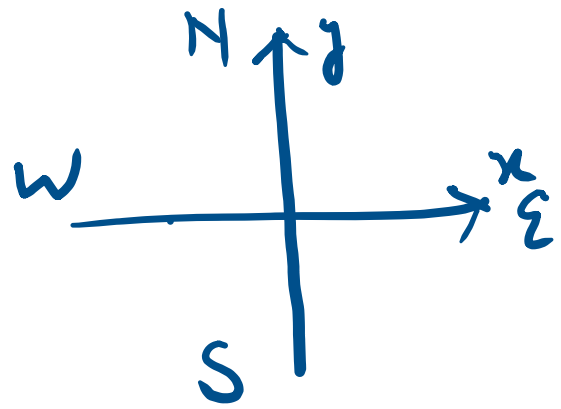
$= (24 - 6) + (24 - 16)$

$= 18 + 8$

$= 26$ m

ANS : d

Solution: 11

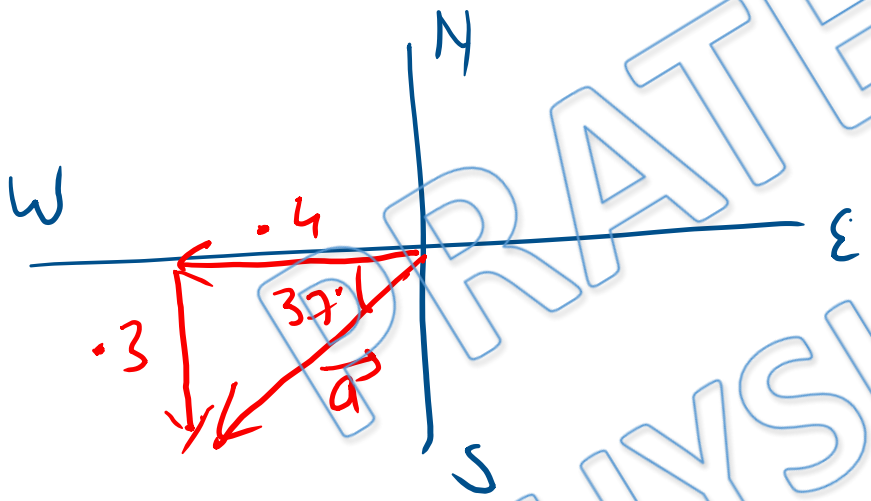


$$\vec{V_i} = 3\hat{j} \qquad \vec{V_f} = -4\hat{i}$$

$$\vec{\Delta V} = \vec{V_f} - \vec{V_i} = -4\hat{i} - 3\hat{j}$$

$$\vec{a_{av}} = \frac{\vec{\Delta V}}{\Delta t} = \frac{-4\hat{i} - 3\hat{j}}{10}$$

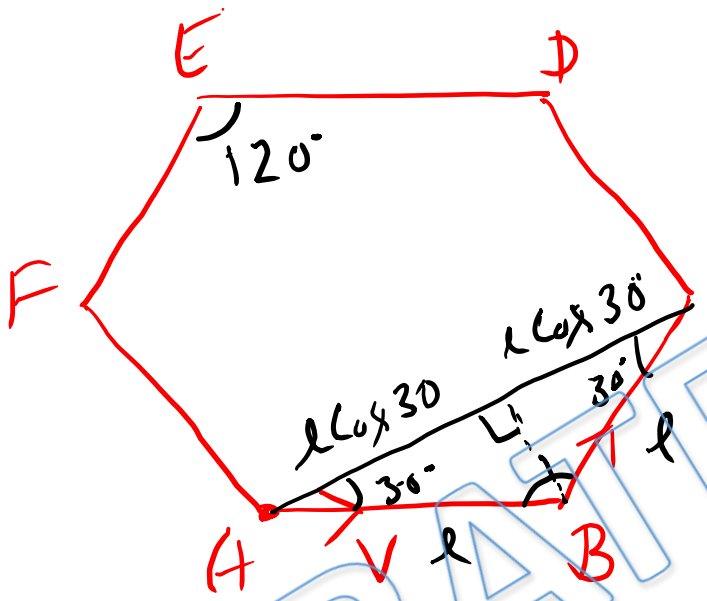
$$= -0.4\hat{i} - 0.3\hat{j}$$



$a_{av} = 0.5\ m/sec^2$ at angle 37° S of West.

ANS : b

Solution: 12



Displacement from A to C

$= 2\ell \cos 30 = \ell\sqrt{3}$

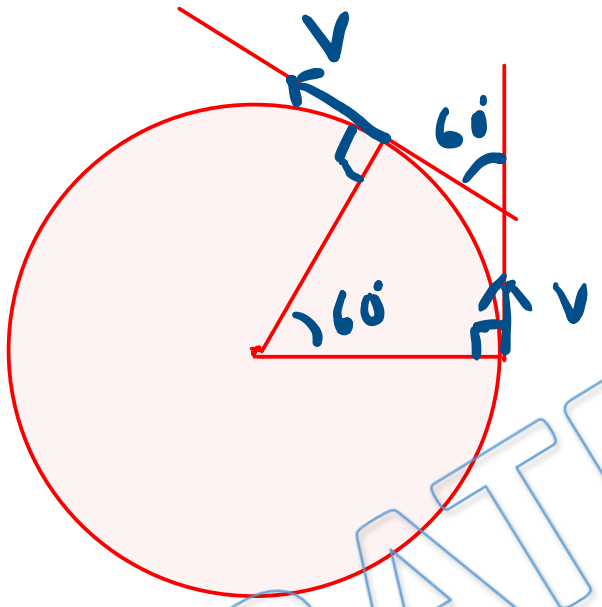
total time taken $= \frac{2\ell}{V}$

$V_{av} = \frac{\ell\sqrt{3} \times V}{2\ell}$

$= \frac{V\sqrt{3}}{2}$

ANS : c

Solution: 13



angle b/w initial velocity & final velocity = 60°

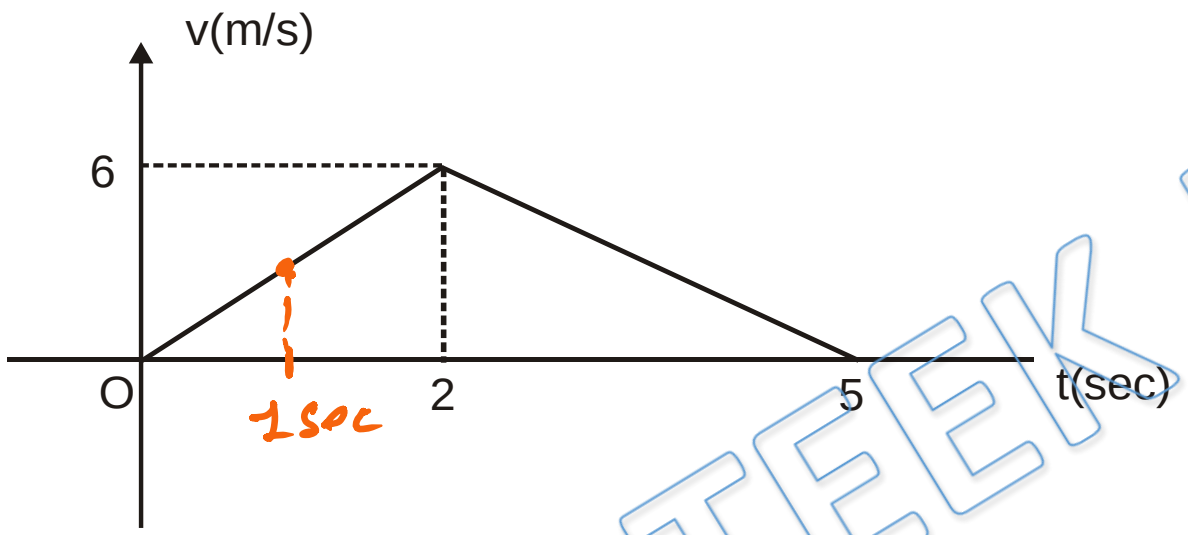
change in velocity vector

$= 2V \sin 60°$

$= 2V \times \frac{\sqrt{3}}{2} = V\sqrt{3}$

ANS : d

Solution: 14



$a = 3\ m/s^2$ is constant for time interval $t=0$ to $t=2$ sec.

so, at $t=1$ sec also

$$\boxed{a = 3\ m/s^2}$$ Ans

in $t=0$ to $t=2$ sec

v-t curve is straight line

means, $\frac{dv}{dt} = a =$ constant

$$a = \frac{\Delta v}{\Delta t} = \frac{6-0}{2-0} = \frac{6}{2} = 3\ m/s^2$$

$$\boxed{a = 3\ m/s^2}$$

ANS : a

Solution: 15

$$y = \frac{x^2}{2} \quad \text{—①}$$

$$x = \frac{t^2}{2} \quad \text{—②}$$

Put Value of 'x' in eqⁿ ①

$$y = \frac{(t^2/2)^2}{2} = \frac{t^4/4}{2} = t^4/8$$

So; $x = \frac{t^2}{2}$ & $y = \frac{t^4}{8}$

$$\frac{dx}{dt} = 2\frac{t}{2} \quad \& \quad \frac{dy}{dt} = 4\frac{t^3}{8}$$

$$v_x = t \quad \& \quad v_y = \frac{t^3}{2}$$

$$\vec{v} = v_x\hat{i} + v_y\hat{j}$$

$$\vec{v} = t\,\hat{i} + \frac{t^3}{2}\,\hat{j}$$

at $t = 2$ sec

$$\vec{v} = 2\,\hat{i} + \frac{2^3}{2}\,\hat{j}$$

$$\boxed{\vec{v} = 2\,\hat{i} + 4\,\hat{j}}$$ Ans

ANS : c

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