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DPP – 2 (Kinematics)

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Q 1. A particle moving rectilinearly with a uniform acceleration 2m/s^2, and initial velocity 4 m/s. Find displacement from t = 4 sec to t = 6 sec

(a) 8 m (b) 20 m (c) 28 m (d) 32 m

Q 2. A car starts from rest and moves with constant acceleration. The ratio of the distance covered in the n^{th} second to distance covered in n seconds is:

(a) $\frac{2}{n^2}-\frac{1}{n}$ (b) $\frac{2}{n^2}+\frac{1}{n}$ (c) $\frac{2}{n}-\frac{1}{n^2}$ (d) $\frac{1}{n}+\frac{1}{n^2}$

Q 3. For a particle undergoing rectilinear motion with uniform acceleration, the magnitude of displacement is one third the distance covered in some time interval. The magnitude of final velocity is less than magnitude of initial velocity for this time interval. Then the ratio of initial speed to the final speed for this time interval is :

(a) $\sqrt{2}$ (b) 2 (c) $\sqrt{3}$ (d) 3

Q 4. A particle starts its motion from rest and moves with constant acceleration for time t_1 and then it retards with constant rate for time t_2 until it comes to rest. Then the ratio of maximum speed and average speed during the complete motion will be

(a) 2 : 1 (b) 1 : 2 (c) $t_1 : t_2$ (d) $t_2 : t_1$

Q 5. A point mass starts moving in straight line with constant acceleration a from rest at t =0. At time t = 2s, the acceleration changes the sign, remaining the same in magnitude. The mass returns to the initial position at time t =t_0 after start of motion. Here t_0 is :

(a) 4s (b) $(4 + 2\sqrt{2})$s
(c) $(2 + 2\sqrt{2})$s (d) $(4 + 4\sqrt{2})$s

Q 6. A body starts from rest with uniform acceleration a, its velocity after n seconds is v. The displacement of the body in last 3 seconds is :

(a) $\frac{v(6n-9)}{2n}$ (b) $-\frac{2v(6n-9)}{2n}$
(c) $\frac{2v(2n+1)}{n}$ (d) $\frac{2v(2n-1)}{n}$

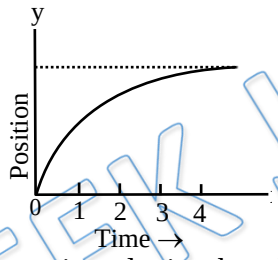
Q 7. A particle moving along a straight line with a constant acceleration of – 4 m/s^2 passes through a point A on the line with a velocity of + 8 m/s at some moment. Find the distance travelled by the particle in 5 seconds after that moment.

(a) 26 m (b) 8 m (c) 18 m (d) 10 m

Q 8. Average velocity of a particle moving in a straight line, with constant acceleration a and initial velocity u in first t seconds is

(a) u + $\frac{1}{2}$at (b) u + at (c) $\frac{u+at}{2}$ (d) $\frac{u}{2}$

Q 9. The displacement of a particle as a function of time is shown in figure. The figure indicates that



(a) the particle starts with a certain velocity, but the motion is retarded an finally the particle stops
(b) the velocity of particle is constant throughout
(c) the acceleration of the particle is constant throughout
(d) the particle starts with a constant velocity, the motion is accelerated and finally the particle moves with another constant velocity

Q 10. A steamer takes 12 days to reach from port A to B. Every day only one steamer sets out from both the ports. How many steamers does each boat meet in the open sea ?

(a) 12 (b) 13 (c) 23 (d) 24

Q 11. In a car race car A takes t_0 time less to finish than car B and passes the finishing point with a velocity v_0 more than car B. The cars start from rest and travel with constant accelerations a_1 and a_2. Then the ratio $\frac{v_0}{t_0}$ is equal to: (a) 0.1 m/s^2 at 37^0 North of West

(a) $\frac{a_1^2}{a_2}$ (b) $\frac{a_1+a_2}{2}$ (c) $\sqrt{a_1 a_2}$ (d) $\frac{a_2^2}{a_1}$

Q 12. Velocity of a particle moving on a straight line with constant acceleration is V at given time t_0. Find average velocity of particle from t = $(t_0 - 5)\ s$ to t = $(t_0 + 5)\ s$?

(a) $\frac{3V}{2}$ (b) $\frac{2V}{3}$ (c) V (d) $\frac{5V}{3}$

Q 13. A body moving with a uniform acceleration has velocities of u and v when passing through points A and B in its path. The velocity of the body midway between A and B is

(a) $\frac{u+v}{2}$ (b) $\sqrt{\frac{u^2+v^2}{2}}$ (c) $\sqrt{uv}$ (d) none of these

Q 14. Three particles start moving simultaneously from a point on a horizontal smooth plane. First particle moves with speed v_1 towards east, second particle moves towards north with speed v_2 and third one moves towards north east. The velocity of the third particle, so that the three always lie on a straight line, is

(a) $\frac{v_1+v_2}{2}$ (b) $\sqrt{v_1 v_2}$ (c) $\frac{v_1 v_2}{v_1+v_2}$ (d) $\sqrt{2}\frac{v_1 v_2}{v_1+v_2}$

Q 15. A body moving with a constant retardation in straight line travels 5.7 m and 3.9 m in the 6^{th} and 9^{th} second respectively. When will the body come momentarily to rest?

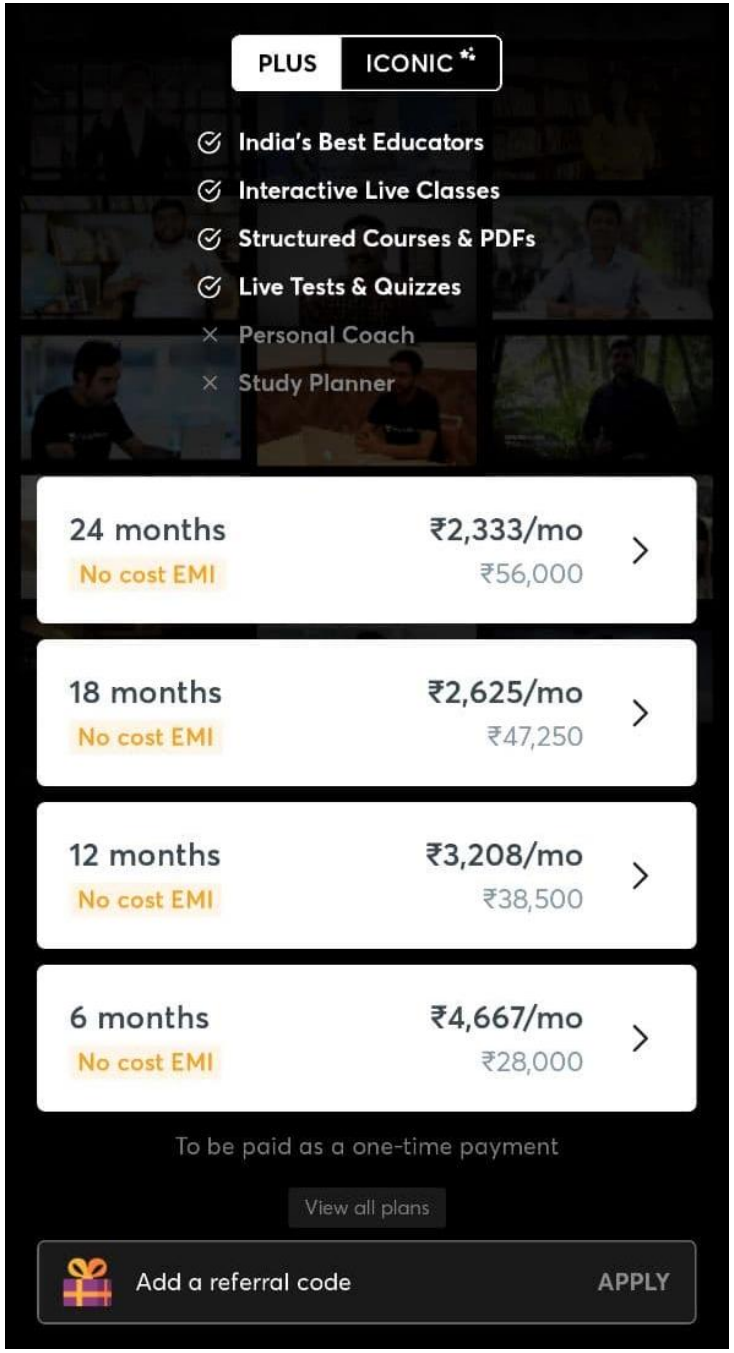
(a) 12 s (b) 25 s (c) 15 s (d) 17 s

Q 16. A particles of mass m moves horizontally in medium where the magnitude of retardation given as kv (where k is a constant and v is the velocity at time t) with the initial velocity u. What is the maximum distance of the particle from the starting point?

(a) $\frac{u}{k}$ (b) $\frac{2u}{k}$ (c) $\frac{uk}{2}$ (d) $2uk$

Answer Key

Q.1 c	**Q.2 c**	**Q.3 a**	**Q.4 a**	**Q.5 b**
Q.6 a	**Q.7 a**	**Q.8 a**	**Q.9 a**	**Q.10 c**
Q.11 c	**Q.12 c**	**Q.13 b**	**Q.14 d**	**Q.15 c**
Q.16 a				



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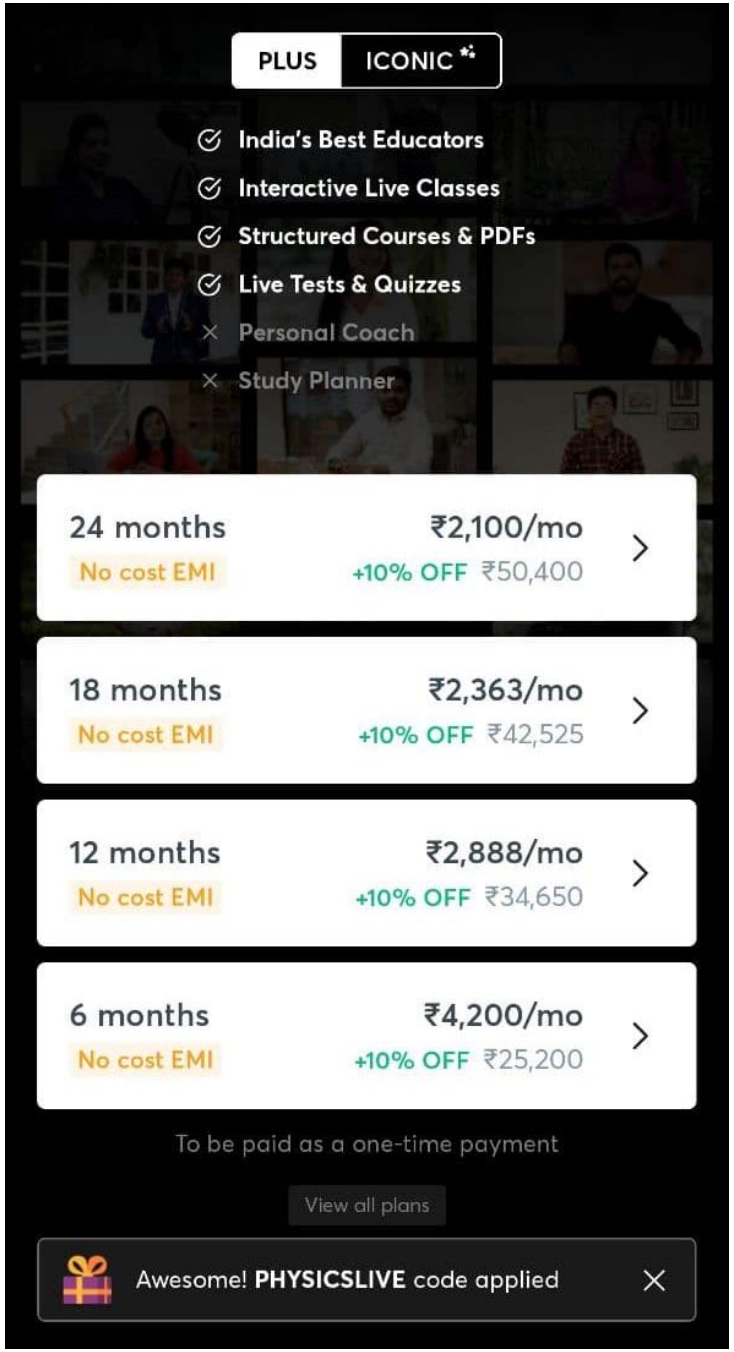
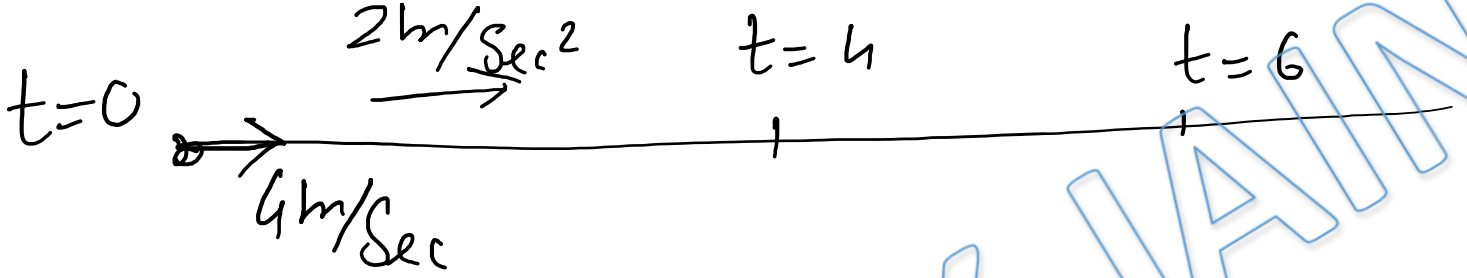


Written Solution

DPP-2 Equation of kinematics

By Physicsaholics Team

Solution: 1



Displacement in 6 Sec $= ut + \frac{1}{2}at^2$

$= 4 \times 6 + \frac{1}{2} \times 2 \times 36$

$= 60\ m$

Displacement in 4 Sec $= ut + \frac{1}{2}at^2$

$= 4 \times 4 + \frac{1}{2} \times 2 \times 16$

$= 32\ m$

Displacement from $t = 4$ Sec to $t = 6$ Sec

$= 60 - 32 = 28\ m$

ANS : b

Solution: 2

Distance covered in n^{th} second $= u + \frac{1}{2}a(2n-1)$

$= \frac{1}{2}a(2n-1)$

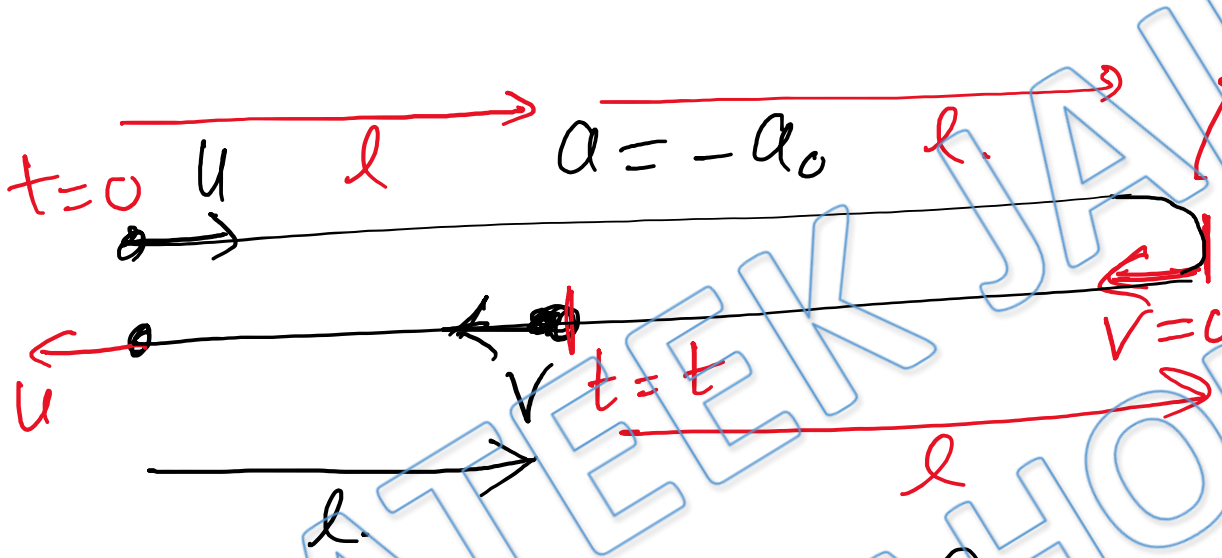
Distance covered in n second $= ut + \frac{1}{2}at^2$

$= \frac{1}{2}an^2$

$$\text{Ratio} = \frac{\frac{1}{2}a(2n-1)}{\frac{1}{2}an^2} = \frac{2}{n} - \frac{1}{n^2}$$

ANS : c

Solution: 3



If displacement is l & Distance is $3l$.
$\Rightarrow$ total distance when Particle returns back $= 4l$

Distance of forward motion = Distance of returning $= 2l$

$\Rightarrow$ Distance from extreme to $t = t$ is l.

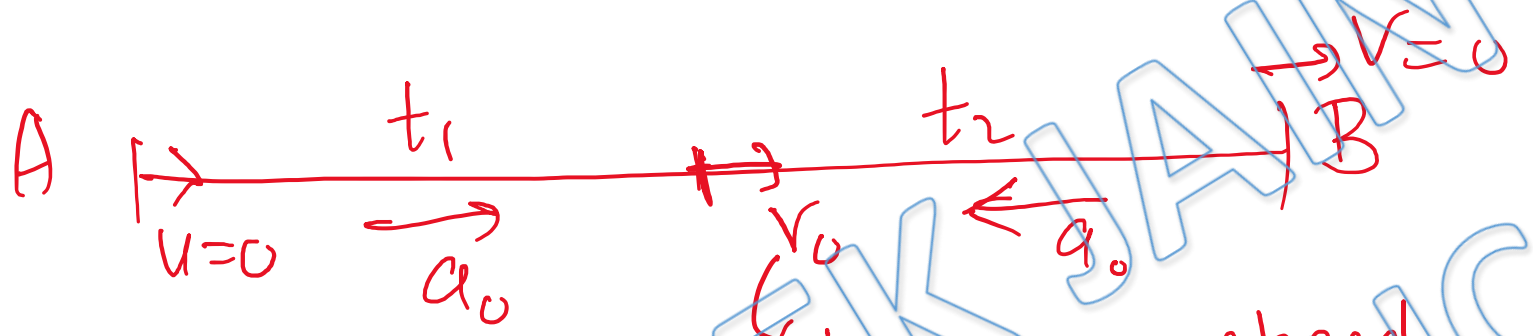
$\Rightarrow v^2 = u^2 + 2ax \Rightarrow v^2 = 0 + 2al$ — (1)

from extreme to initial point

$u^2 = 0 + 4al$ — (ii) $\Rightarrow \frac{v^2}{u^2} = \frac{1}{2} \Rightarrow v = u/\sqrt{2}$

ANS : a

Solution: 4



av. velocity of first half $= \frac{u+v}{2} = \frac{V_0}{2}$

" " " Second " $= \frac{u+v}{2} = V_0/2$

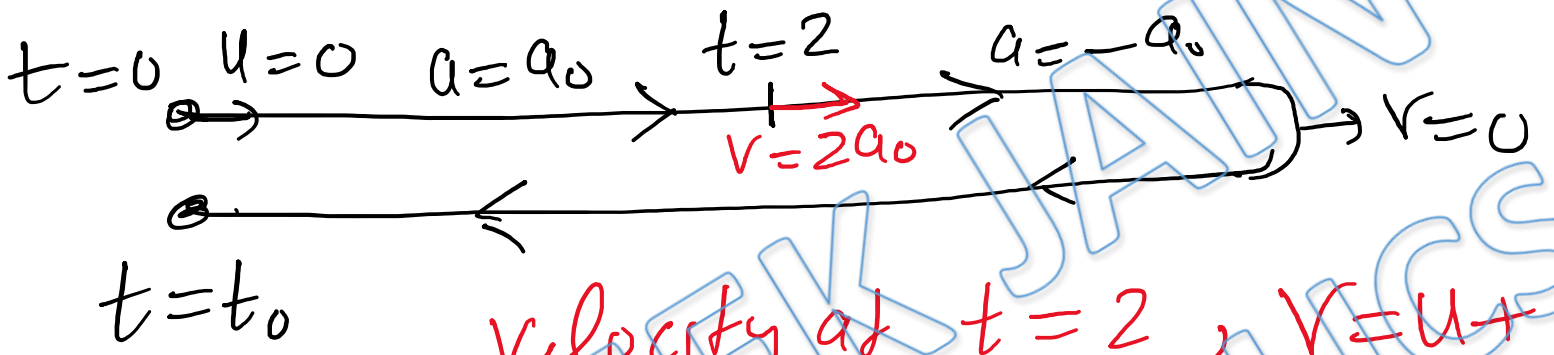
av. " " Complete motion $= V_0/2$

$$V_{av} = V_0/2$$

$$\frac{V_0}{V_{av}} = 2$$

ANS : a

Solution: 5



velocity at $t=2$, $v=u+at=2a_0$

Displacement at $t=2$, $x=\frac{1}{2}a_0\times 2^2=2a_0$

from $t=2$ to $t=t_0$

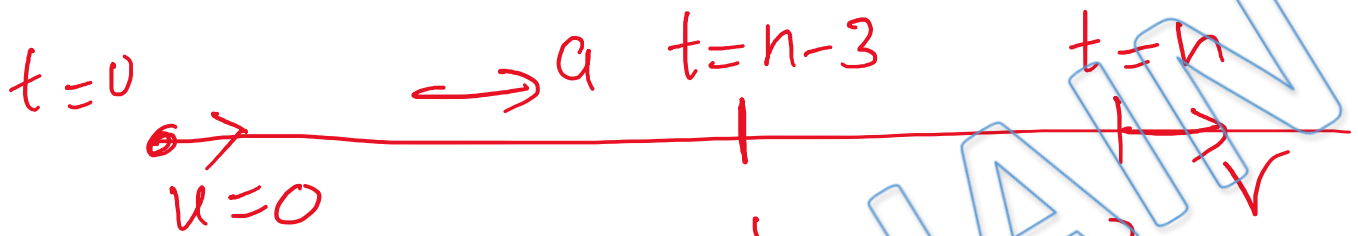
$$x=ut+\frac{1}{2}at^2 \Rightarrow -2a_0=2a_0(t_0-2)+\frac{1}{2}(-a_0)(t_0-2)^2$$

$$\Rightarrow (t_0-2)^2-4(t_0-2)-4=0 \Rightarrow t_0-2=\frac{4+\sqrt{16+16}}{2}$$

$$\Rightarrow t_0-2=2+2\sqrt{2} \Rightarrow t_0=4+2\sqrt{2}$$

ANS : b

Solution: 6



$x = ?$

Using $v = u + at$ from $t=0$ to $t=n$

$v = 0 + a \times n \Rightarrow a = v/n$

Velocity at $t = n-3$ is $v - 3a$ (using $v = u + at$)

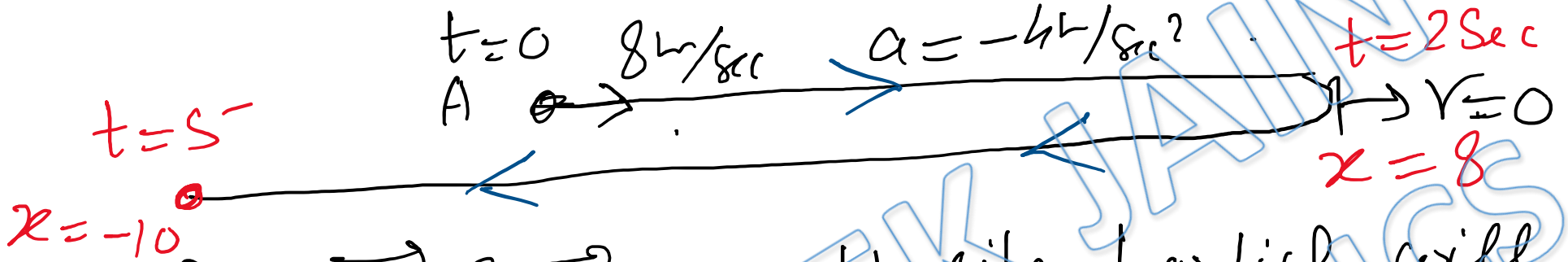
Displacement in last 3 sec

$$x = \frac{u+v}{2} \times t = \frac{v - 3a + v}{2} \times 3 = \frac{3}{2}(2v - 3a)$$

$$= \frac{3}{2}\left(2v - \frac{3v}{n}\right) = \frac{3v}{2}\left(2 - \frac{3}{n}\right) = \frac{3v}{2n}(2n-3)$$

ANS : a

Solution: 7



Since $\vec{u}$ & $\vec{a}$ are opposite, particle will change its direction of motion.

At extreme position $v=0$, $v=u+at \Rightarrow 0=8-4t$

$\Rightarrow t=2\,Sec \Rightarrow x=8\times2-\frac{1}{2}\times4\times2^2$

$=8$

Displacement in first 5 sec

$=8\times5-\frac{1}{2}\times4\times25=-10$

Distance travelled in 5 Sec $=8+8+10=26\,m$

ANS : a

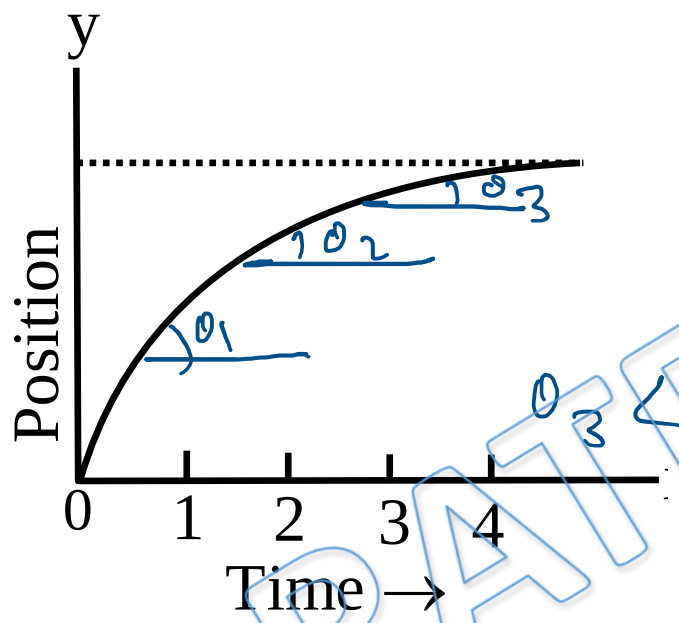
Solution: 8

$$v_{av} = \frac{\Delta x}{\Delta t} = \frac{ut + \frac{1}{2}at^2}{t}$$

$$= u + \frac{at}{2}$$

ANS : a

Solution: 9



Initial slope is +ve

⇒ initial velocity is nonzero.

$\theta_3 < \theta_2 < \theta_1$ ⇒ Slope is decreasing in magnitude

⇒ speed is decreasing.

✱ In displacement time graph |slope| = speed

ANS : a

Solution: 10

If steamer starts at 0th Day all steamers starting from -11th day to +11th day meet it in open sea.

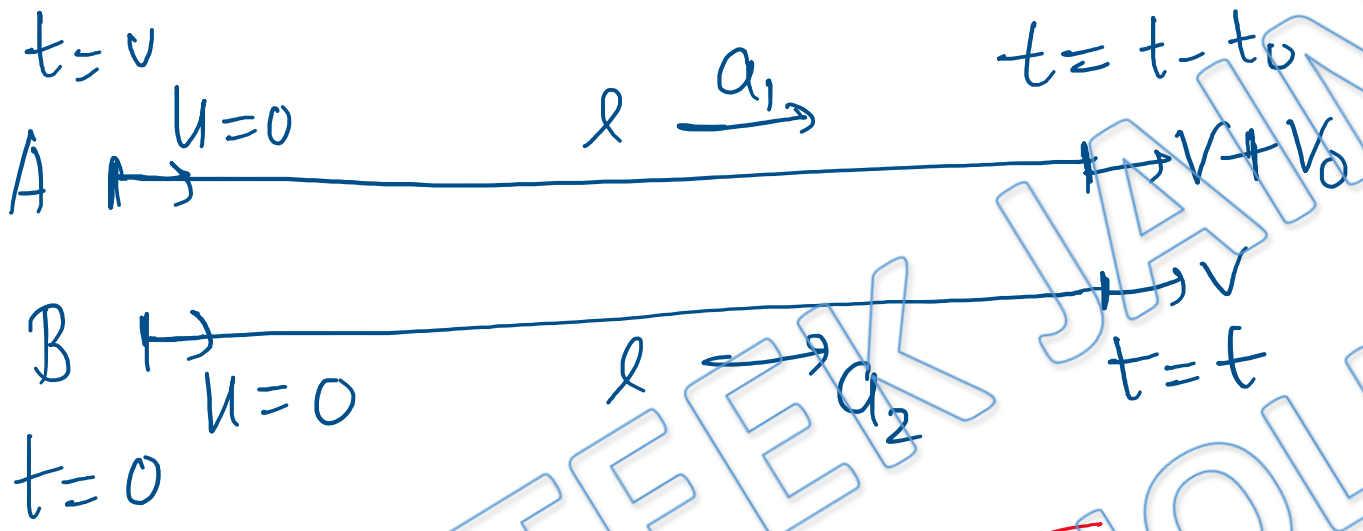
→ for steamer starting 0th day.

total no of steamers = 11 + 1 + 11

= 23

ANS : c

Solution: 11



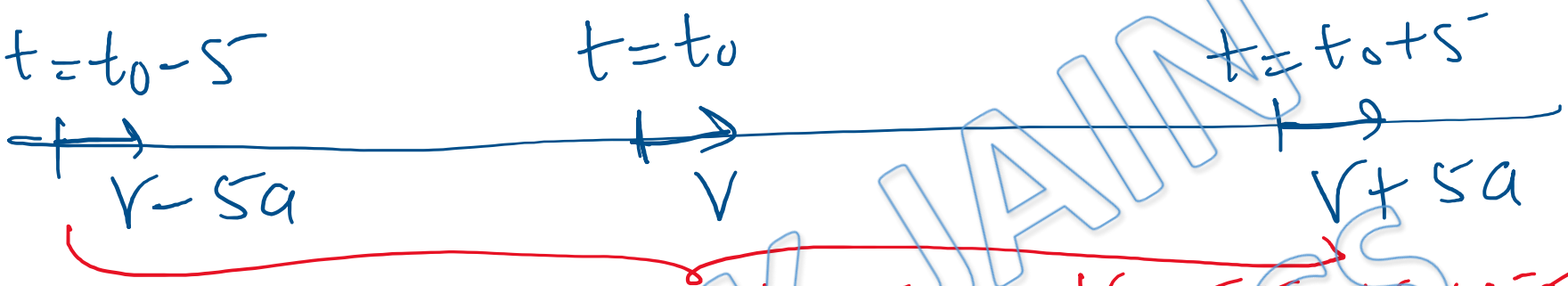
$V = \sqrt{2a_2\ell}$, $V + V_0 = \sqrt{2a_1\ell} \Rightarrow V_0 = \sqrt{2a_1\ell} - \sqrt{2a_2\ell}$

$t = \sqrt{\frac{2\ell}{a_2}}$, $t - t_0 = \sqrt{\frac{2\ell}{a_1}} \Rightarrow t_0 = \sqrt{\frac{2\ell}{a_2}} - \sqrt{\frac{2\ell}{a_1}}$

$$\Rightarrow \frac{V_0}{t_0} = \frac{\sqrt{a_1} - \sqrt{a_2}}{\frac{1}{\sqrt{a_2}} - \frac{1}{\sqrt{a_1}}} = \sqrt{a_1 a_2}$$

ANS : c

Solution: 12



$$v_{av} = \frac{u+v}{2} = \frac{v_0 - 5a + v_0 + 5a}{2} = v_0$$

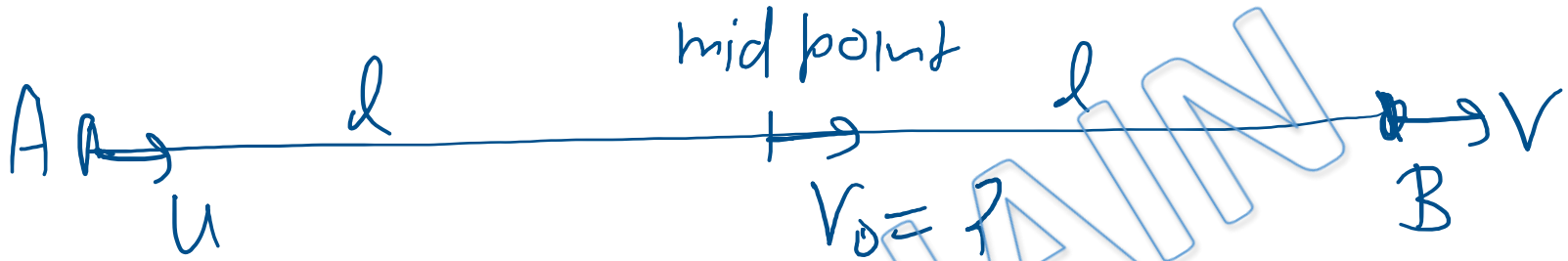
In motion with constant acc each second velocity increases by a.

$\Rightarrow$ at $t = t_0 + 5^-$, $v = v + 5a$

$\Rightarrow$ at $t = t_0 - 5^-$, $v = v - 5a$

ANS : c

Solution: 13



Using $v^2 = u^2 + 2ax$

$V_0^2 = u^2 + 2a\cancel{l}$ — for first half motion

$\cancel{V^2} = \cancel{V_0^2} + 2al$ " Second " "

$V_0^2 - V^2 = u^2 - V_0^2 \Rightarrow 2V_0^2 = u^2 + V^2$

$\Rightarrow V_0 = \sqrt{\frac{u^2+V^2}{2}}$

ANS : b

Solution: 14

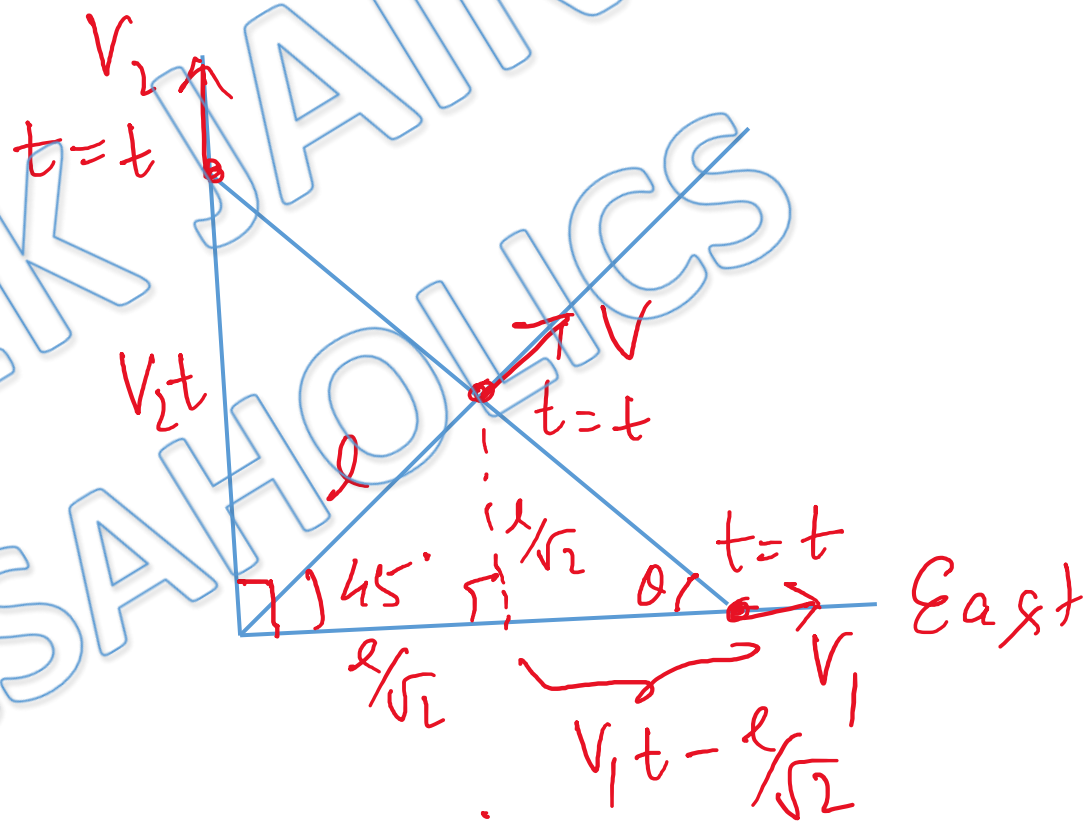
$$\tan\theta = \frac{\ell/\sqrt{2}}{v_1 t - \ell/\sqrt{2}} = \frac{v_2 t}{v_1 t}$$

$$\frac{v_1}{v_2}\frac{\ell}{\sqrt{2}} = v_1 t - \frac{\ell}{\sqrt{2}}$$

$$\frac{\ell}{\sqrt{2}}\left(\frac{v_1}{v_2}+1\right) = v_1 t$$

$$\ell = \frac{v_2 v_1 \sqrt{2}\, t}{v_1 + v_2}$$

$$v = \frac{d\ell}{dt} = \frac{v_1 v_2 \sqrt{2}}{v_1 + v_2}$$



ANS : d

Solution: 15

$$x_t = u + \frac{1}{2}a(2t-1) \longrightarrow \text{Displacement in } t^{th} \text{ Second}$$

$$\Rightarrow \quad 5.7 = u + \frac{a}{2}(12-1)$$

$$\Rightarrow \quad 3.9 = u + \frac{a}{2}(18-1)$$

$$1.8 = 0 - 3a \Rightarrow a = -.6$$

$$\Rightarrow \quad 5.7 = u + \frac{(-.6)}{2} \times 11 = u - 3.3 \Rightarrow u = 9$$

how : $v = u + at \Rightarrow 0 = 9 - .6t$

$$\Rightarrow t = \frac{9}{.6} = 15 \text{ sec}$$

ANS : c

Solution: 16

Retardation $\propto$ KV

Retardation means, velocity is in just opposite direction of velocity.

$\Rightarrow$ acceleration; $a \propto -kV$

$$a = v\frac{dv}{dx} = -kv$$

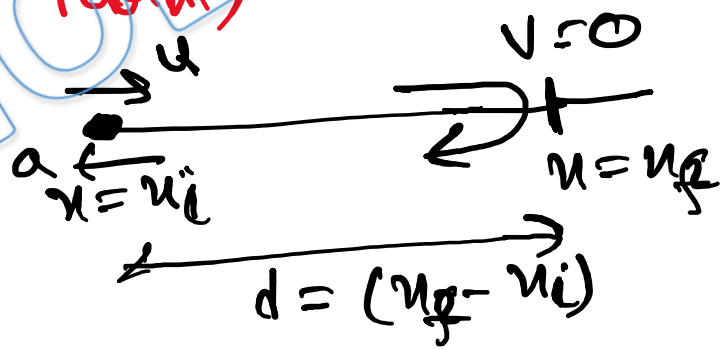
$$\Rightarrow \int_u^0 dv = -\int_{x_i}^{x_f} k\,dx \quad \text{(at max displacement, } v = 0 \text{ & particle will turn)}$$

$$[v]_u^0 = -k[x]_{x_i}^{x_f}$$

$$0 - u = -k(x_f - x_i)$$

$$-u = -kd$$

$$\boxed{d = \frac{u}{k}}$$



ANS : a

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