Physicsaholics

DPP – 9 (Basic Maths)

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Q 1. Find the velocity of particle if the position of particle is given as $x = (3t^2 - 2)$ m?
(a) $v = (3t - 1)$ m/s
(b) $v = (6t - 1)$ m/s
(c) $v = (6t)$m/s
(d) None of these

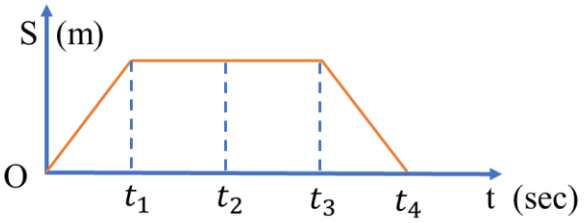
Q 2. Find the acceleration of particle if the position of particle is given as $x = (3t^2 - 2)$ m?
(a) $a = 6\ m/s^2$
(b) $a = 3\ m/s^2$
(c) $a = 6t\ m/s^2$
(d) None of these

Q 3. Find the acceleration of particle if the velocity of particle is given as $V = (16t^2 - 2t + 3)$ m/s?
(a) $a = (32t - 2) m/s^2$
(b) $a = (16t^2 - 2t) m/s^2$
(c) $a = 32t\ m/s^2$
(d) None of these

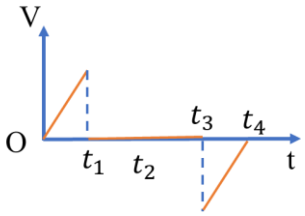
Q 4. Find the acceleration of particle at $t = 2sec$ if the position of particle is given as $x = (t^2 - 2t + 1)$ m?
(a) $a = 4\ m/s^2$
(b) $a = 2\ m/s^2$
(c) $a = 3\ m/s^2$
(d) None of these

Q 5. Find the acceleration of particle at $t = 2sec$ if the velocity of particle is given as $v = (t^2 - 2t + 1)$ m/s?
(a) $a = 4\ m/s^2$
(b) $a = 2\ m/s^2$
(c) $a = 3\ m/s^2$
(d) None of these

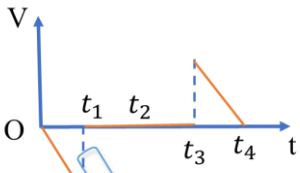
Q 6. The displacement-time graph of a body is shown in figure below. The velocity-time graph of the motion of the body will be:



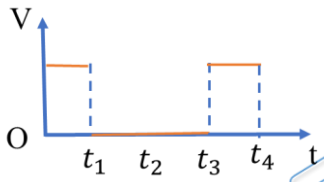
(a)



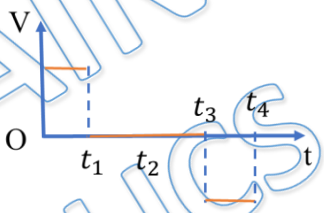
(b)



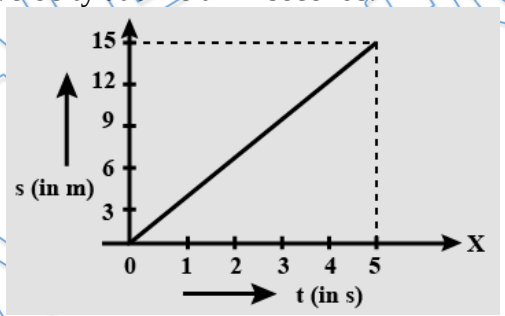
(c)



(d)

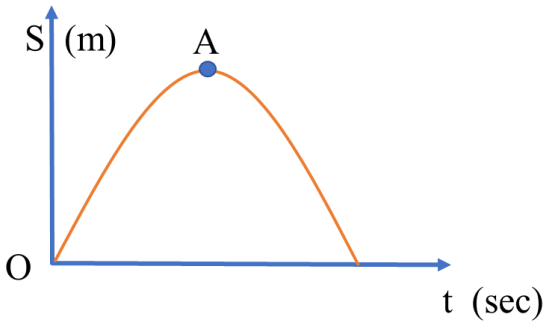


Q 7. A displacement-time graph of a body moving with uniform velocity is shown in the figure. Find out its velocity at time t = 4 seconds:



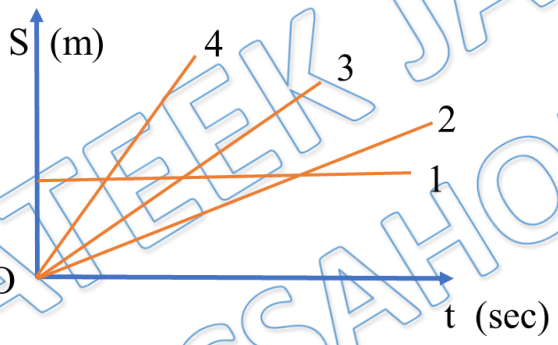
(a) $v = 4\,m/s$
(b) $v = 2\,m/s$
(c) $v = 3\,m/s$
(d) None of these

Q 8. In Figure as shown below the velocity of the body at topmost point A is:



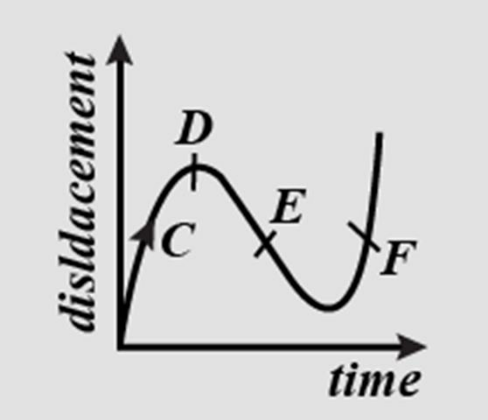
(a) zero
(b) 1 m/s
(c) Infinite
(d) Maximum

Q 9. The position-time graphs below represent the motions of cars 1 to 4. How do they rank, according to their speeds (greatest first)?



(a) 1, 2, 3, 4
(b) 2, 1, 4, 3
(c) 4, 3, 2, 1
(d) None of these

Q 10. The displacement-time graph of a moving particle is shown. The instantaneous velocity of the particle is negative at the point :-



(a) D (b) F
(c) C (d) E

Q 11. A particle moves along a straight line OX. At a time t(in seconds) the distance x(in meters)of the particle is given by $x = 40 + 12t - t^3$. How much distance will the particle travel before coming to rest?
(a) 24m (b) 56 m
(c) 40m (d) 16m

Q 12. A particle moves in a straight line with an acceleration a ms^{-2} at time 't' seconds where $a = -\frac{1}{t^2}$. At time t = 1s the particle has a velocity of $3ms^{-1}$ then find the velocity when t = 4s
(a) 1.25 m/s (b) 3.5 m/s
(c) 2.25 m/s (d) 0.5. m/s

Q 13. Velocity of a particle as function of displacement x is given by $v = b\,x^{\frac{1}{2}}$. Then the displacement as function of time is
(a) bt (b) $\frac{b^2t^2}{4}$
(c) $\frac{bt}{4}$ (d) $\frac{b^2t^3}{4}$

Q 14. The acceleration of a particle as a function of time t is given as $a = k\,t^{\frac{5}{2}}$. If initial speed of the particle (at t = 0) is u then its velocity v as a function of time t is given as:
(a) $V = u + \frac{2}{5}kt^{\frac{5}{2}}$ (b) $V = u + \frac{2}{7}kt^{\frac{7}{2}}$
(c) $V = u + kt^{\frac{5}{2}}$ (d) $V = u + kt^{\frac{7}{2}}$

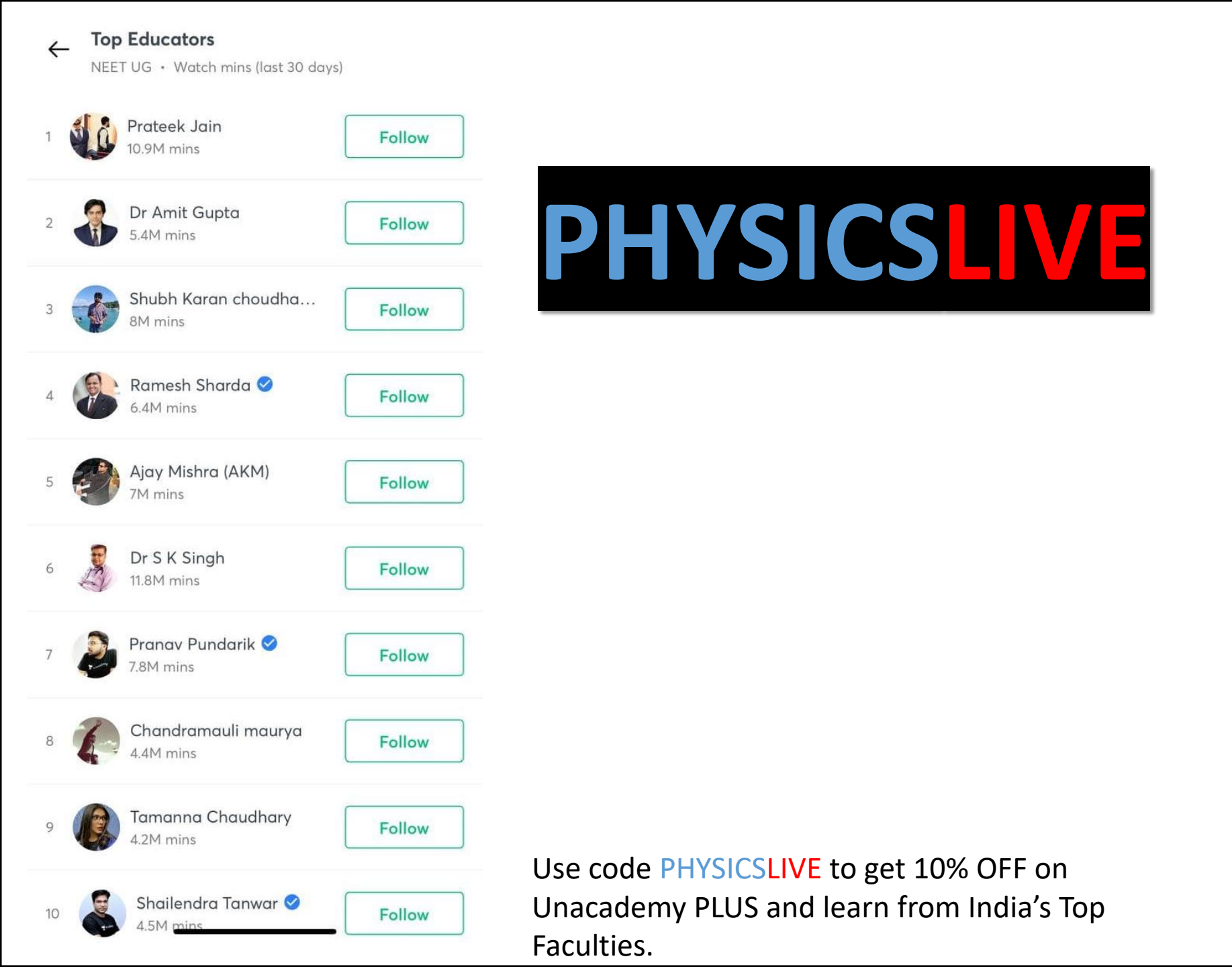
Q 15. For a particle moving along x-axis, acceleration is given as a = v. Find the position as a function of time? Given that at t = 0, x = 0, v = 1 m/s
(a) $e^t - 1$ (b) $e^{2t} - 1$
(c) $\frac{e^t}{2}$ (d) $e^t + 1$

Q 16. The acceleration of particle is a function of position is given by a(x) = 4 - 2x m/s^2. Then velocity v(x) is equal to [given that v(0) = 0]
(a) $\sqrt{4x - x^2}$ (b) $\sqrt{2(4x - x^2)}$

(c) $(4x - x^2)$ (d) $2(4x - x^2)$

Answer Key

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



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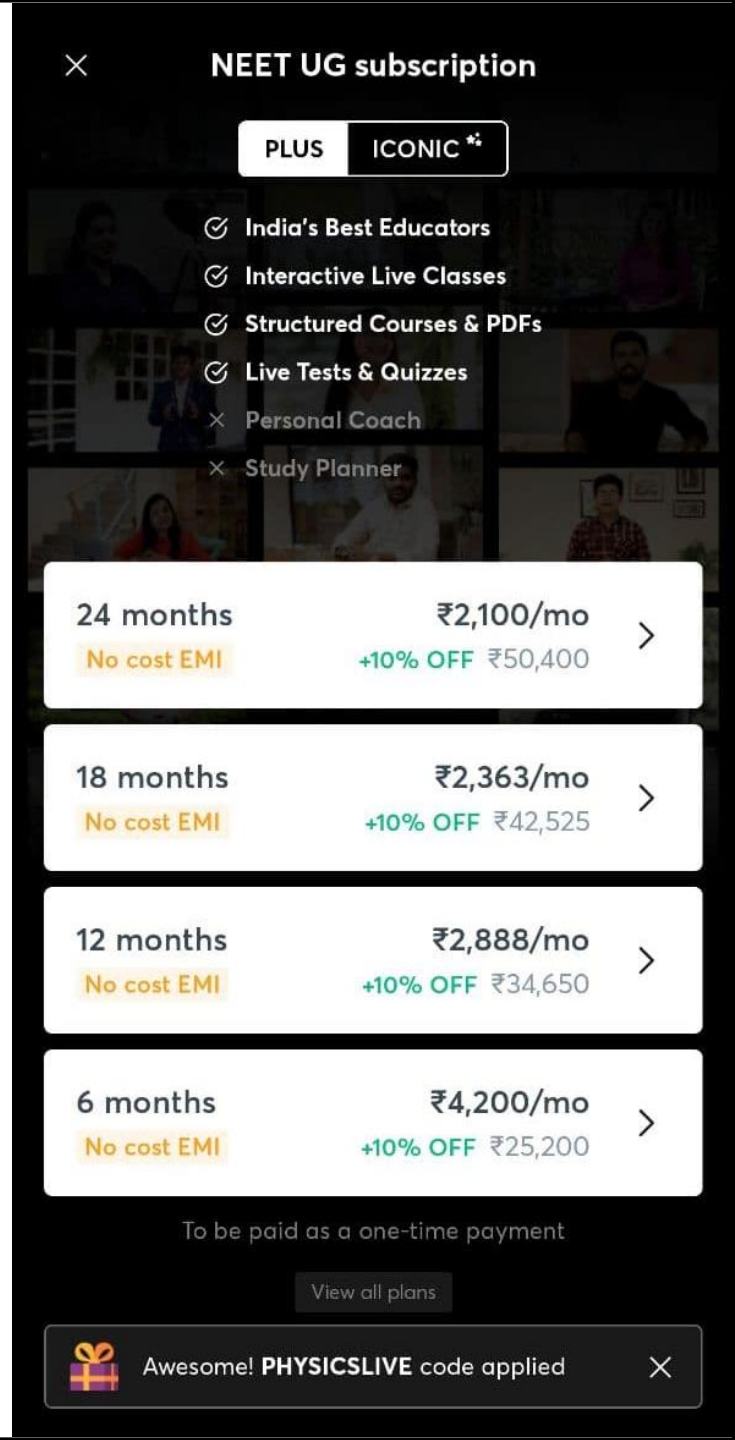

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Written Solution

DPP 9 Basic Maths- Use of Differentiation in Physics

By Physicsaholics Team

Solution: 1

$$x = (3t^2 - 2)\ m$$

$$v = \frac{dx}{dt} = 6t\ m/s$$

$$\boxed{v = (6t)\ m/s}$$

Ans. c

Solution: 2

$$x = 3t^2 - 2$$

$$v = \frac{dx}{dt} = 6t$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = 6$$

$$\boxed{a = 6\ m/s^2}$$

Ans. a

Solution: 3

$$v = 16t^2 - 2t + 3$$

$$a = \frac{dv}{dt} = 32t - 2$$

$$\boxed{a = (32t - 2)\ m/s^2}$$

Ans. a

Solution: 4

$$x = t^2 - 2t + 1$$

$$v = \frac{dx}{dt} = 2t - 2$$

$$a = \frac{dv}{dt} = 2$$

$$a = 2\ m/s^2$$

acceleration is constant

So, at, $t = 2$ sec

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

Ans. b

Solution: 5

$$v = t^2 - 2t + 1$$

$$a = \frac{dv}{dt} = 2t - 2 \quad m/s^2$$

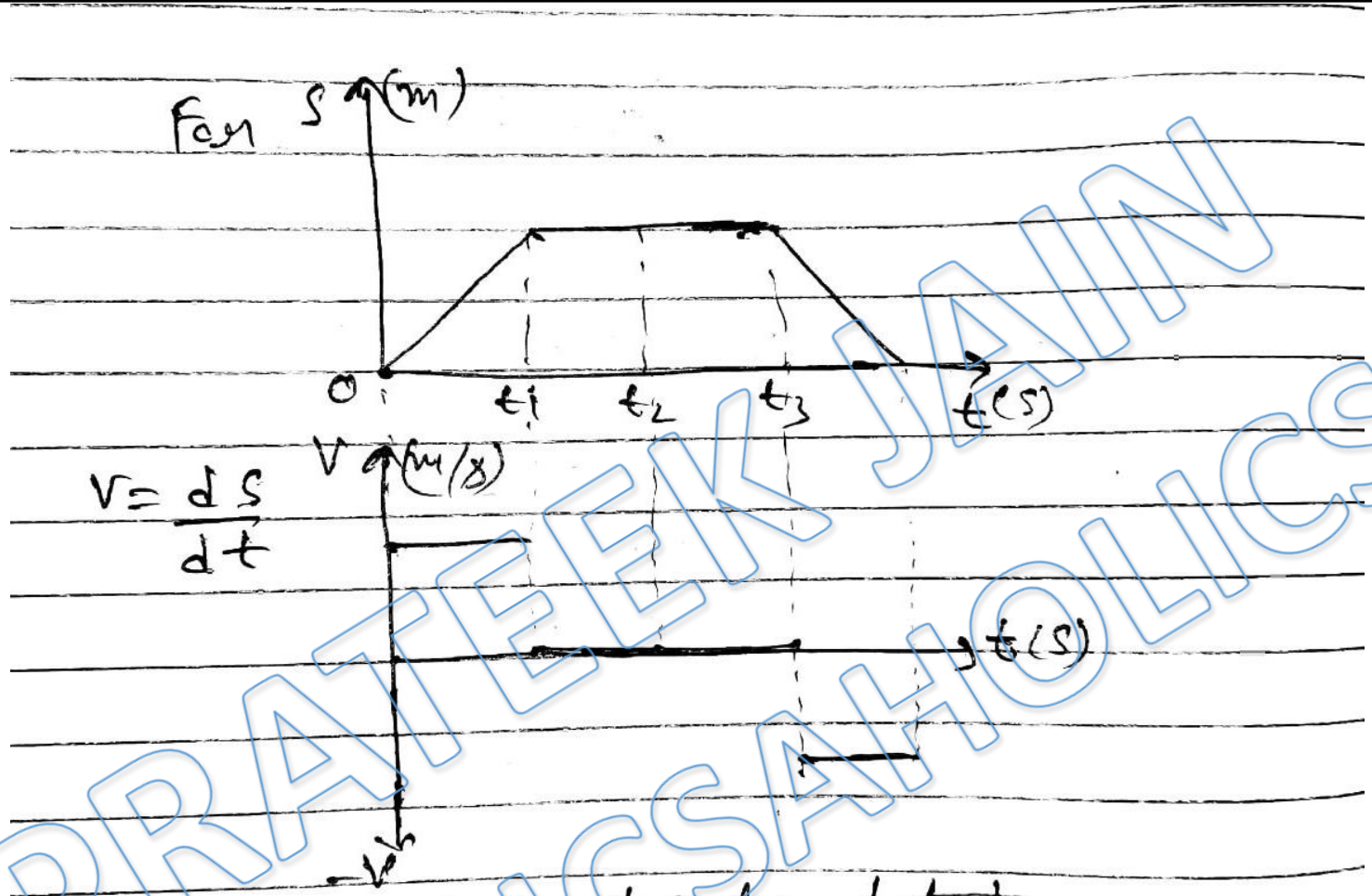
at, $t = 2$ sec

$$a = 2(2) - 2$$

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

Ans. b

Solution: 6



$V = \frac{dS}{dt}$

$\therefore$ For $t = 0$ to $t = t_1$ ~~d~~

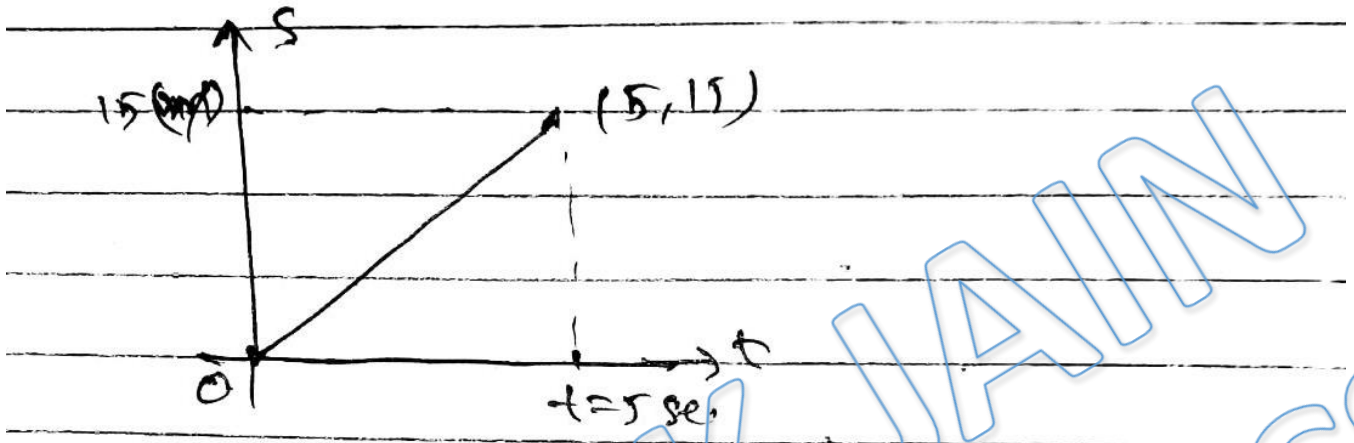
$V = \frac{dS}{dt}$ = slope = constant = +ve

in $t = t_1$ to $t = t_3 \Rightarrow V = \frac{dS}{dt} = 0$

and in $t = t_3$ to $t = t_4 \Rightarrow V = \frac{dS}{dt} = -ve$ But Constant

Ans. d

Solution: 7



S-t curve is straight line

so; velocity = $v = \frac{dS}{dt}$

v = slope of S-t curve

v = constant

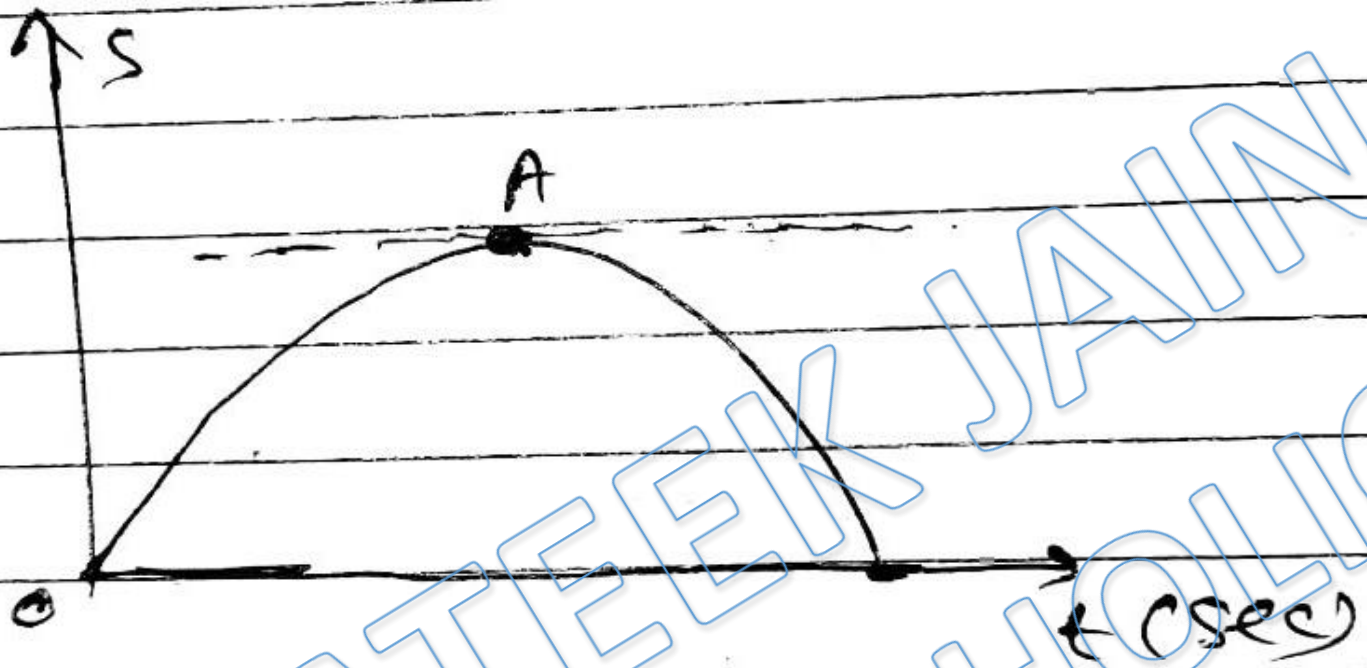
∴ slope of straight line = constant

$\therefore v = \frac{15 - 0}{5 - 0} = 3$

$\boxed{v = 3 \text{ m/s}}$

Ans. c

Solution: 8



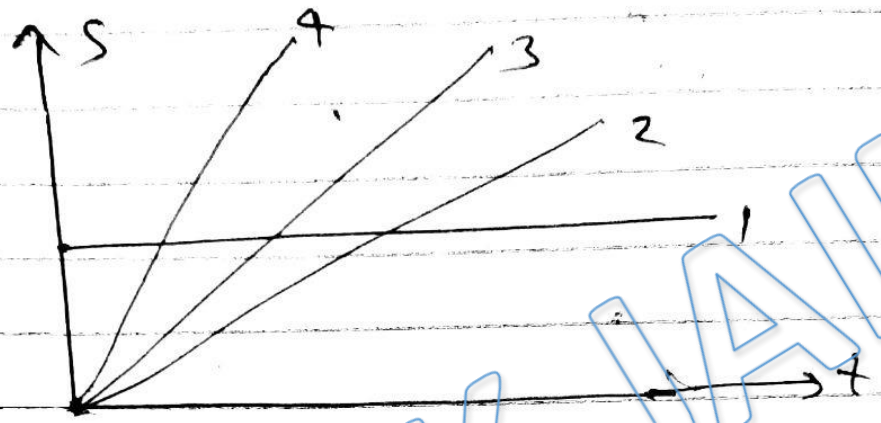
At point A (topmost point on curve)
Tangent will be parallel to time-axis

$\therefore \quad \frac{dS}{dt}$ at $A = 0$

$\Rightarrow \boxed{V_A = 0}$

Ans. a

Solution: 9



$$\text{speed} = \left|\frac{dS}{dt}\right|$$

for more value of $\frac{dS}{dt}$

means high slope

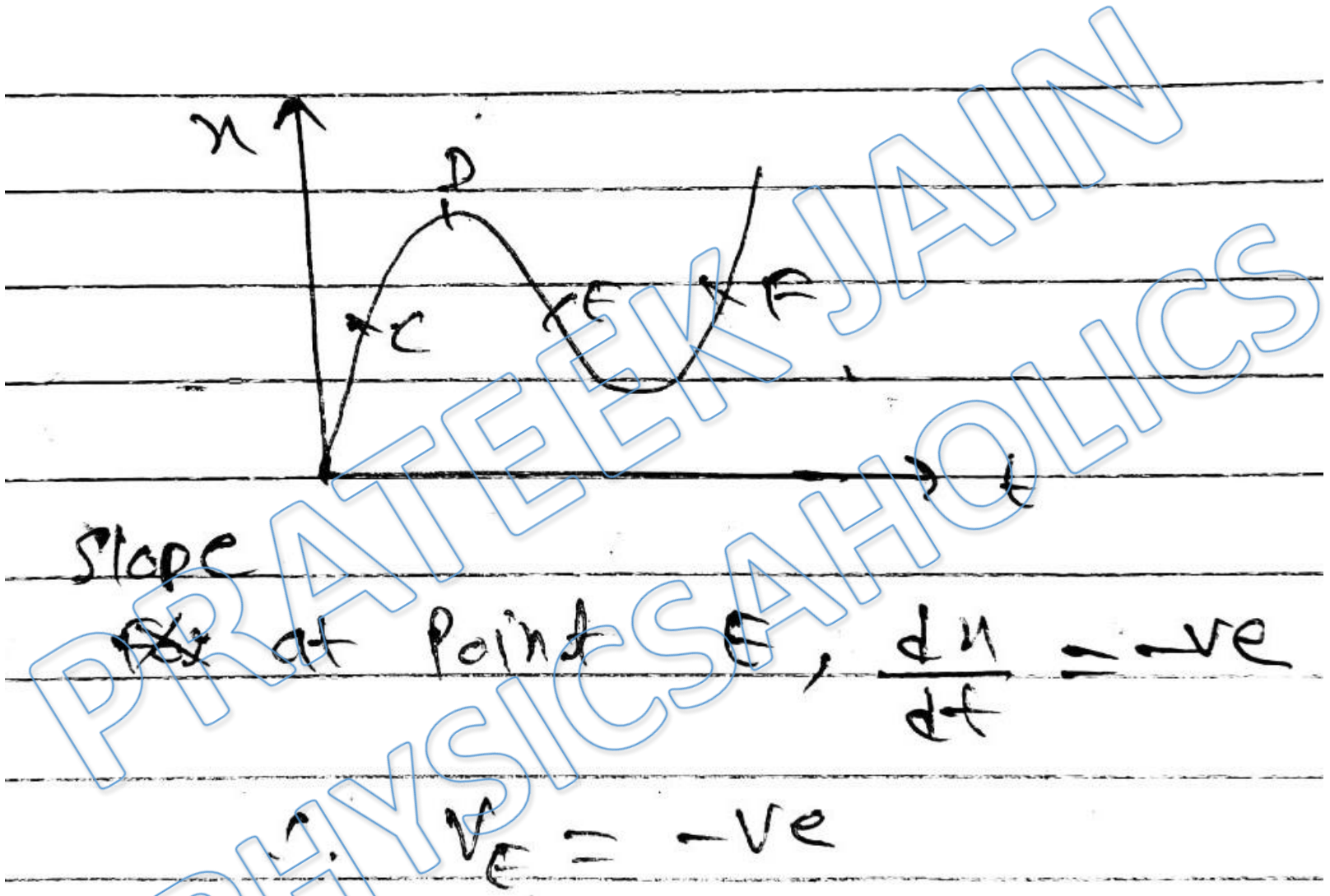
$$\therefore \left(\frac{dS}{dt}\right)_4 > \left(\frac{dS}{dt}\right)_3 > \left(\frac{dS}{dt}\right)_2 > \left(\frac{dS}{dt}\right)_1$$

$$\Rightarrow v_4 > v_3 > v_2 > v_1$$

$\therefore$ Ranking : 4, 3, 2, 1

Ans. c

Solution: 10



Ans. d

Solution: 11

$x = 40 + 12t - t^3$

$v = 12 - 3t^2$

for $v = 0$

$12 - 3t^2 = 0$

$3t^2 = 12$

$t^2 = 4$

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

at, $t = 0$

$\boxed{x_1 = 40 \text{ m}}$

at, $t = 2$ sec

$x_2 = 40 + 12(2) - (2)^3$

$= 40 + 24 - 8$

$\boxed{x_2 = 56 \text{ m}}$

$\therefore$ distance $= x_2 - x_1$

$= 56 - 40$

$\boxed{d = 16 \text{ m}}$

Ans. d

Solution: 12

$a = -\frac{1}{t^2}$

$t = 1$ sec ; $v = 3$ m/s.

then at $t = 4$ sec ; $v = ?$

$$\frac{dv}{dt} = -\frac{1}{t^2} \Rightarrow \int_3^v dv = -\int_1^4 \frac{1}{t^2}\,dt$$

$$[v]_3^v = -\left[\frac{t^{-1}}{-1}\right]_1^4 = +\left[\frac{1}{t}\right]_1^4 = \left[\frac{1}{t}\right]_1^4$$

$$\Rightarrow v - 3 = \frac{1}{4} - 1 = -\frac{3}{4} \Rightarrow v = 3 - \frac{3}{4}$$

$$v = \frac{9}{4} \Rightarrow \boxed{v = 2.25 \text{ m/s}}$$ Ans.

Ans. c

Solution: 13

$$v = b x^{1/2} \Rightarrow 2\sqrt{x} = bt$$

$$\frac{dx}{dt} = b x^{1/2} \qquad \sqrt{x} = \frac{bt}{2}$$

$$\frac{dx}{x^{1/2}} = b\,dt \qquad x = \frac{b^2 t^2}{4}$$

$$\int_0^x x^{-1/2}\,dx = \int_0^t b\,dt$$

$$\boxed{x = \frac{b^2 t^2}{4}} \quad \text{Ans}$$

$$\left[\frac{x^{-\frac{1}{2}+1}}{-\frac{1}{2}+1}\right]_0^x = bt$$

$$2\left[\sqrt{x}\right]_0^x = bt$$

Ans. b

Solution: 14

$a = kt^{5/2}$

$\frac{dv}{dt} = kt^{5/2}$

$\int dv = \int kt^{5/2}\, dt$

$\int_u^v dv = k\int_0^t t^{5/2}\, dt$

$[v]_u^v = k\left[\frac{t^{7/2}}{7/2}\right]_0^t = \frac{2k}{7}t^{7/2}$

$v - u = \frac{2}{7}kt^{7/2}$

at, $t = 0$

$v = u$

$\Rightarrow \boxed{v = u + \frac{2}{7}kt^{7/2}}$ Ans

Ans. b

Solution: 15

Sol :-

at $t=0$, $\begin{cases} x = 0 \\ v = 1\ m/s \end{cases}$

$a = v$

$a = \frac{dv}{dt} = v$

$\int_1^v \frac{dv}{v} = \int_0^t dt$

$[\ln v]_1^v = t$

$\ln v - \ln 1 = t$

$\ln v = t$

$v = e^t$

Now,

$v = e^t$

$v = \frac{dx}{dt} = e^t$

$\int_0^x dx = \int_0^t e^t\, dt$

$x = [e^t]_0^t$

$x = e^t - e^0$

$x = e^t - 1$

Ans. a

Solution: 16

Sol :=

$$a = 4 - 2x$$

$$a = v\frac{dv}{dx} = 4 - 2x$$

$$v\,dv = (4 - 2x)\,dx$$

at $x = 0$, $v = 0$

then at $x = x$, $v = ?$

$$\int_0^v v\,dv = \int_0^x (4 - 2x)\,dx$$

$$\frac{v^2}{2} = \left[4x - \frac{2x^2}{2}\right]_0^x$$

$$v^2 = 2(4x - x^2) \Rightarrow v = \sqrt{2(4x - x^2)}$$

Ans. b

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