Physicsaholics

DPP – 4 (Kinematics)

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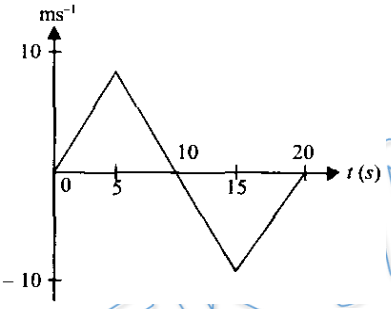
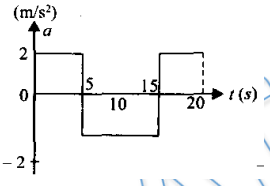
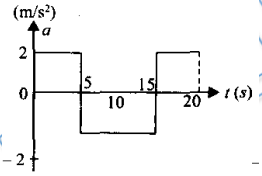
Q 1. Plot acceleration time graph of the figure shown



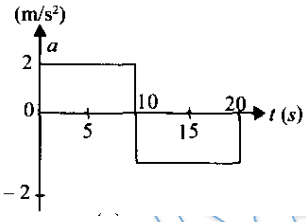
(a)



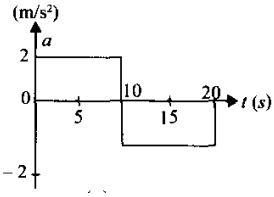
(b)



(c)

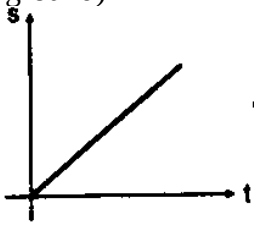


(d)

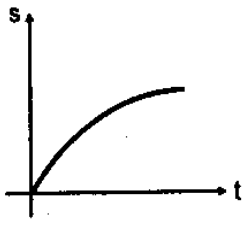


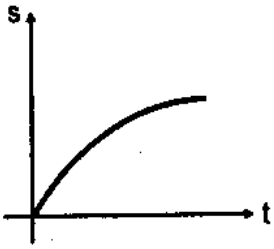
Q 2. One stone is dropped from a tower from rest and simultaneously another stone is projected vertically upwards from the tower with some initial velocity. The graph of the distance(s) between the two stones varies with time (t) as: (before either stone hits the ground)

(a)

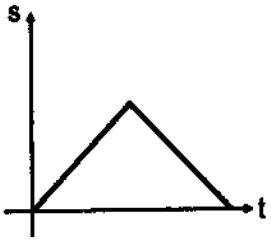


(b)



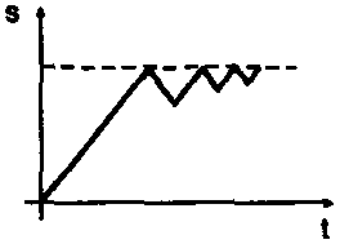


(c)

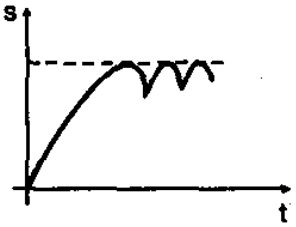


(d)

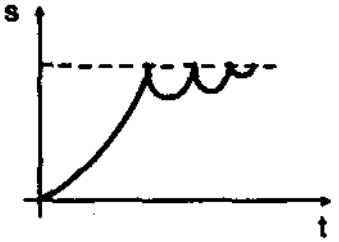
Q 3. A ball is dropped from a certain height on a horizontal floor. If speed reduced to half after each collision with ground. The displacement-time graph of the ball will be:



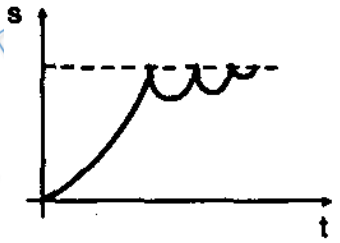
(a)



(b)

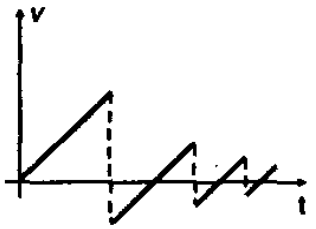


(c)

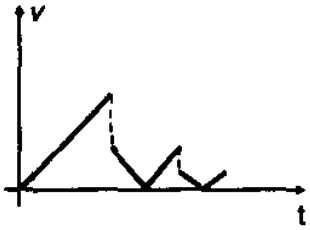


(d)

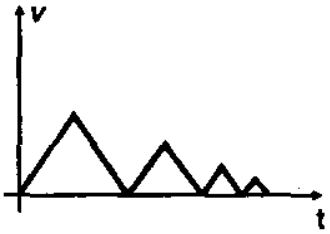
Q 4. A ball is dropped from a certain height on a horizontal floor. If speed reduced to half after each collision with ground. The speed-time graph of the ball in the above situation is:



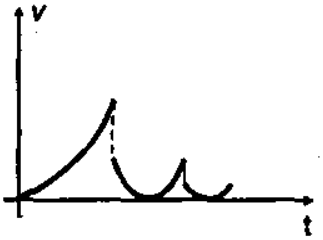
(a)



(b)

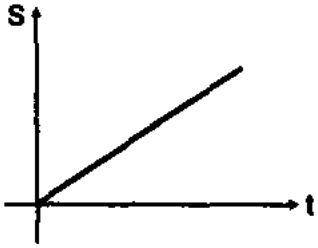


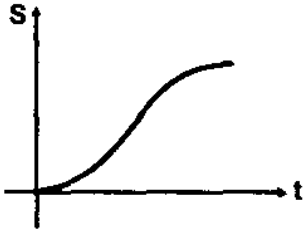
(c)

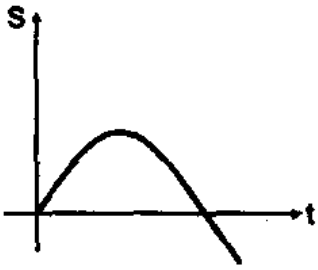


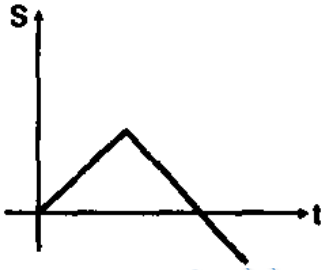
(d)

Q 5. A particle is moving in x-y plane with $y = \frac{x}{2}$ and $v_x = 4 - 2t$. The displacement versus time graph of the particle would be :

(a) 

(b) 

(c) 

(d) 

Q 6. Velocity-time equation of a particle moving in a straight line is $v = 2t-4$ for $t \leq 2$ s and $v = 4 - 2t$ for $t > 2$ s. The distance travelled by the particle in the time interval from t = 0 to t = 4 s is (Here, t is in second and v in m/s):

(a) 12 m (b) 16 m (c) 4 m (d) 8 m

Q 7. A car starts from rest, moves with an acceleration a and then decelerates at b for sometime to come to rest. If the total time taken is t, the maximum velocity is

(a) abt/(a + b) (b) $a^2t/(a + b)$
(c) at/(a + b) (d) $b^2t/(a + b)$

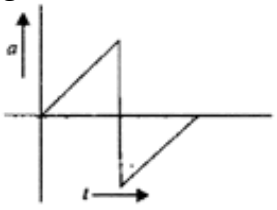
Q 8. A car starts moving rectilinearly from rest with $5ms^{-2}$ form sometime, then uniformly and finally decelerates at $5\ ms^{-2}$ and come to a stop. The total time of motion equal 25 s. How long does the car move uniformly? Given V_{av}= 72 km/h during motion.

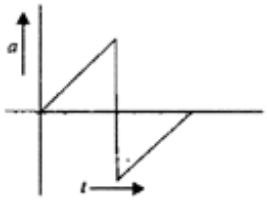
(a) 5s (b) 10 s (c) 15 s (d) 20 s

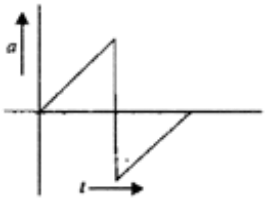
Q 9. A bird flies for 4 s with a velocity of $|t-2|$ m/s in a straight line, where t = time in seconds. It covers a distance of

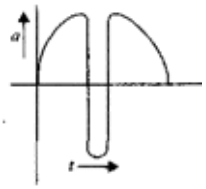
(a) 2 m (b) 4 m
(c) 6 m (d) none of these

Q 10. A football dropped from a height onto an elastic net, stretched horizontally much above the ground rebounds. The graph for the motion is

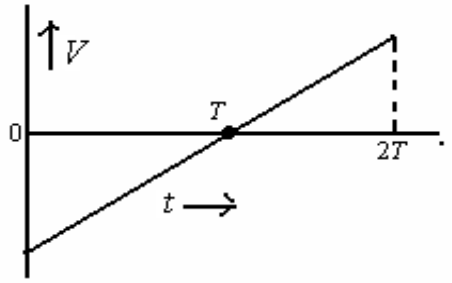
(a) 

(b) 

(c) 

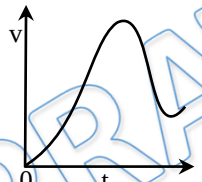
(d) 

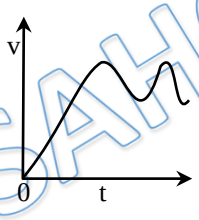
Q 11. The figure shows the velocity (v) of a particle plotted against time (t). Particle is retarding in time interval

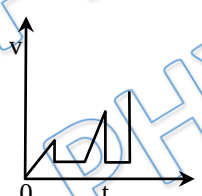


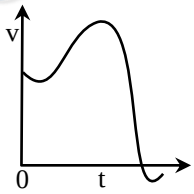
(a) 0 to T
(b) 0 to 2T
(c) T to 2T
(d) Never

Q 12. The following figures show some velocity v versus time t curves. Which of the following cannot be realized in practice

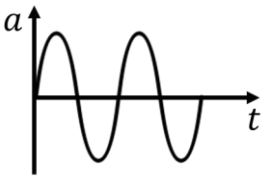
(a) 

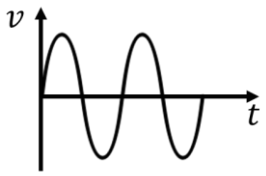
(b) 

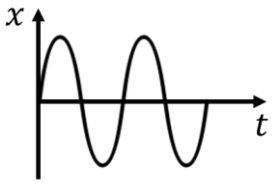
(c) 

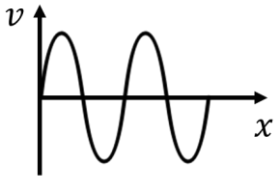
(d) 

Q 13. In the following figures shown, Which of the following cannot be realized in practice

(a) 

(b) 

(c) 

(d) 

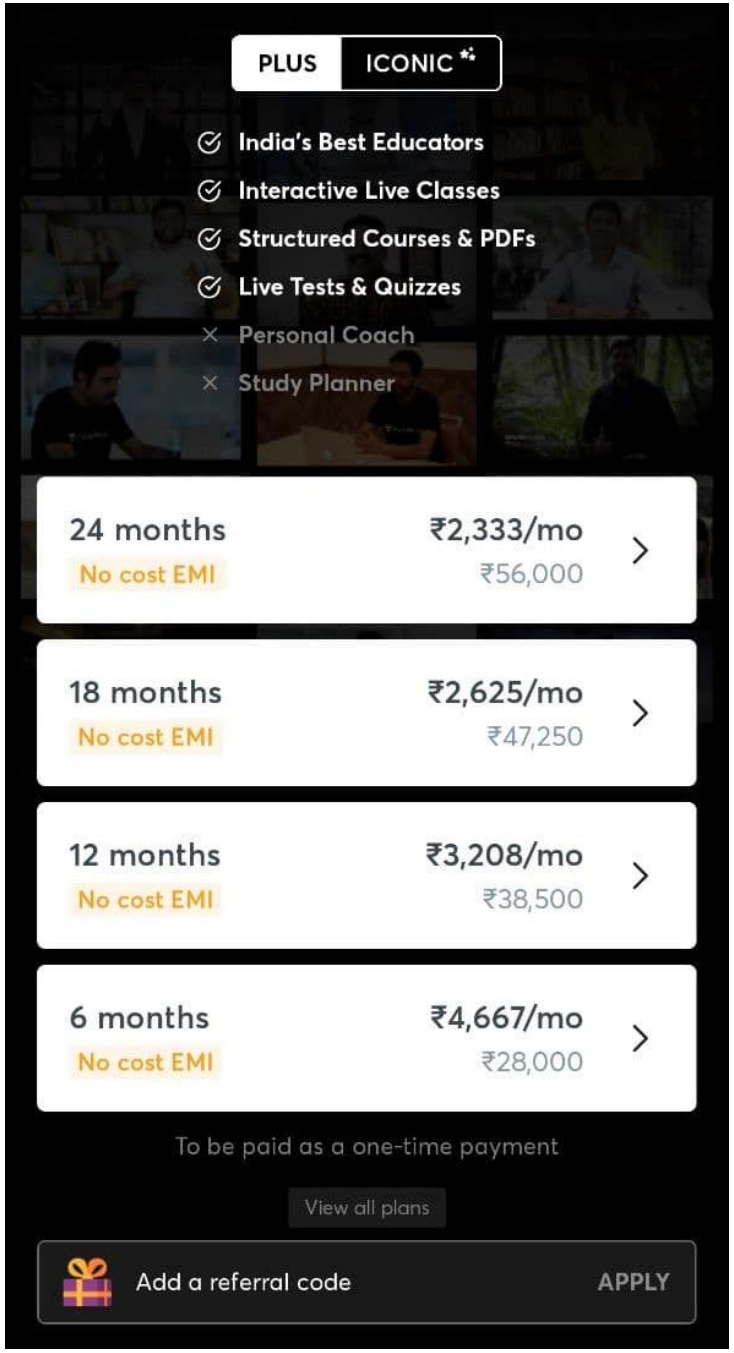
Q 14. A car starting from rest accelerates at the rate f through a distance s, then continues at constant speed for time t and then decelerates at rate f/2 to come to rest. If the total distance covered is 15 s, then

(a) $s = ft^2/72$ (b) $s = ft^2/4$

(c) $s = ft^2/6$ (d) $s = ft^2/2$

Answer Key

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



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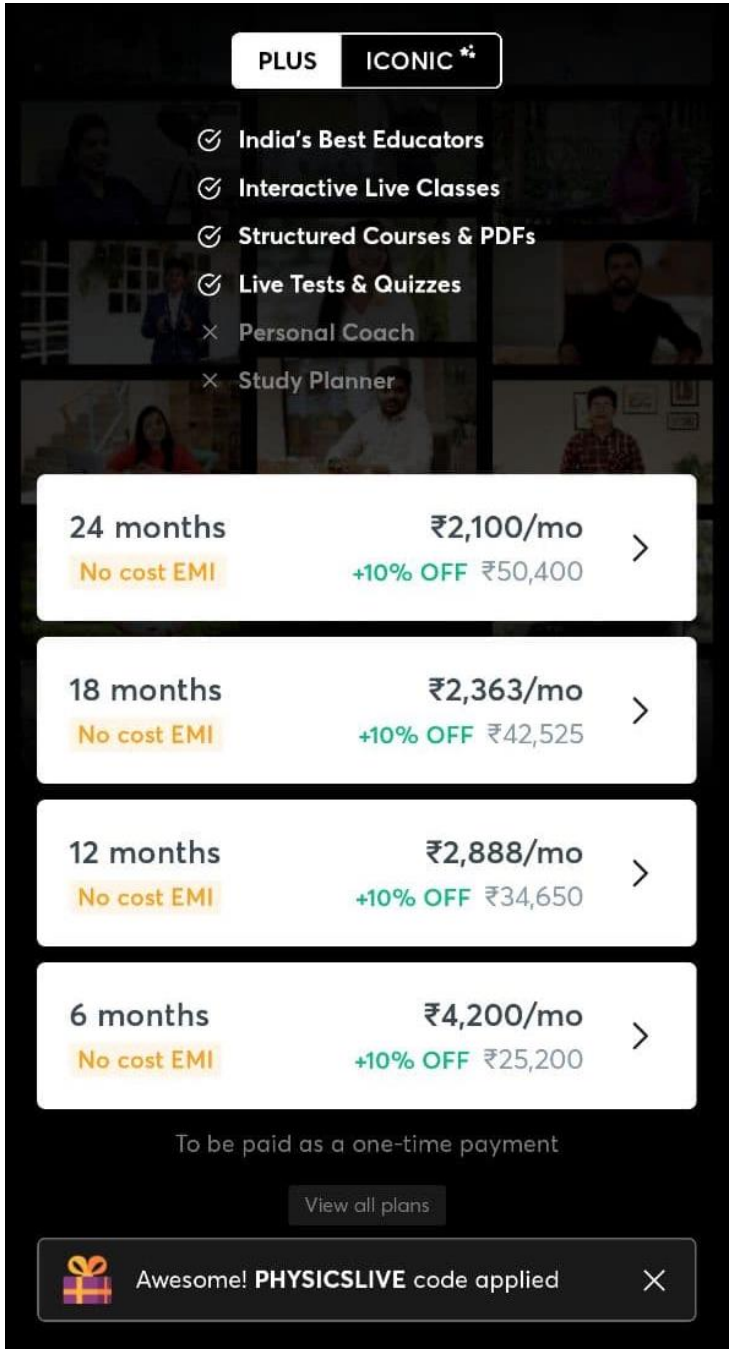
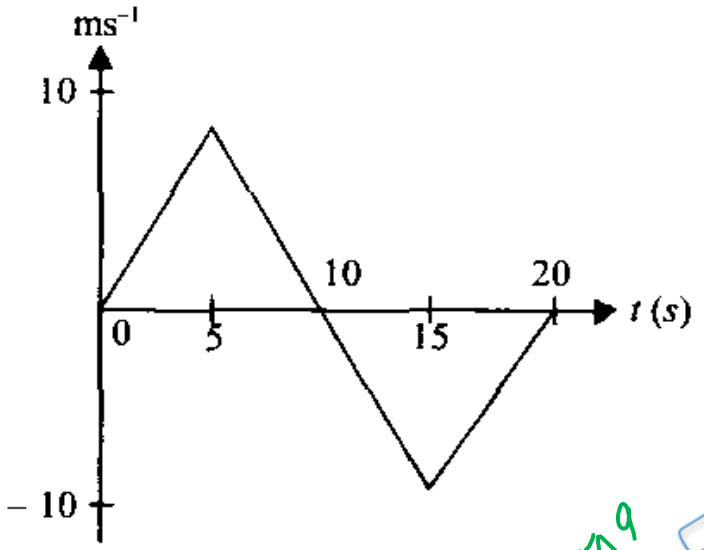


Written Solution

DPP-4 Position, Velocity and Acceleration Graph

By Physicsaholics Team

Solution: 1

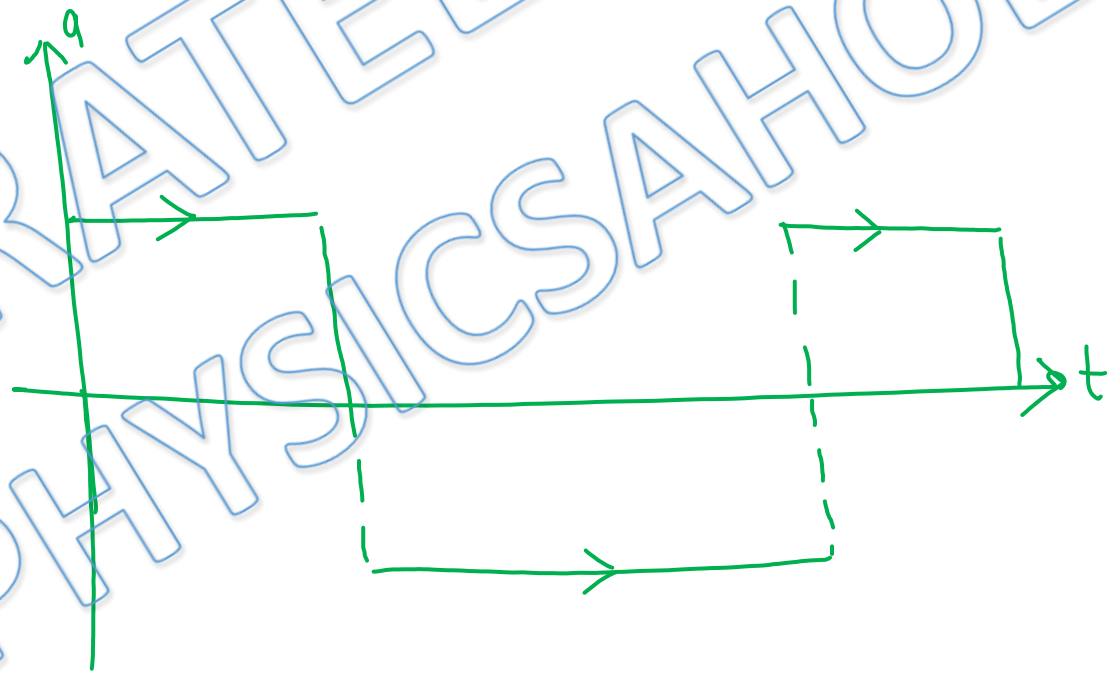


In V-t graph, a = Slope of graph

from t=0 to t=5, Slope i.e a is +ve Constant

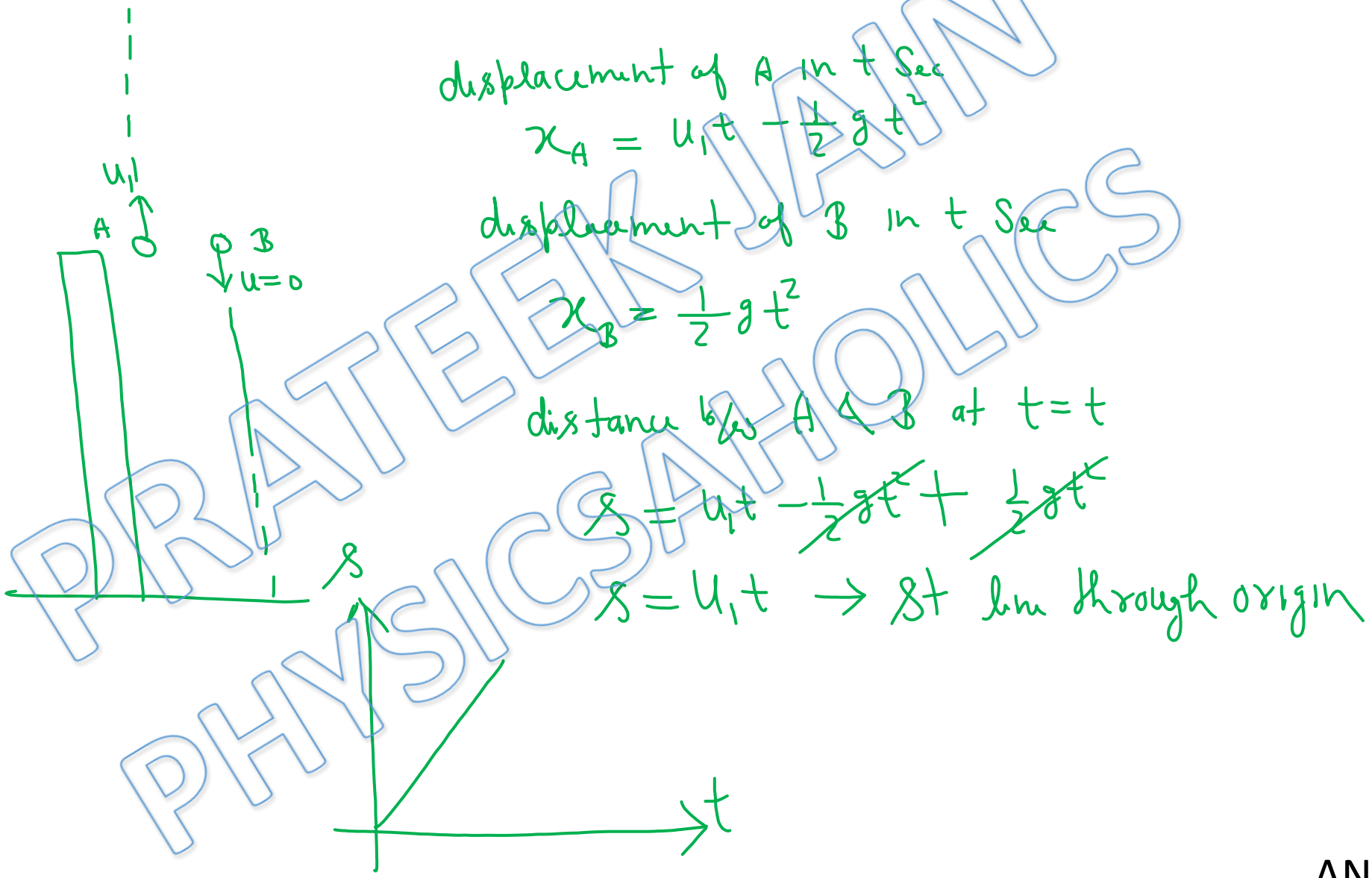
from t=5 to t=15, " " " " -ve "

from t=15 to t=20, " " " " +ve "



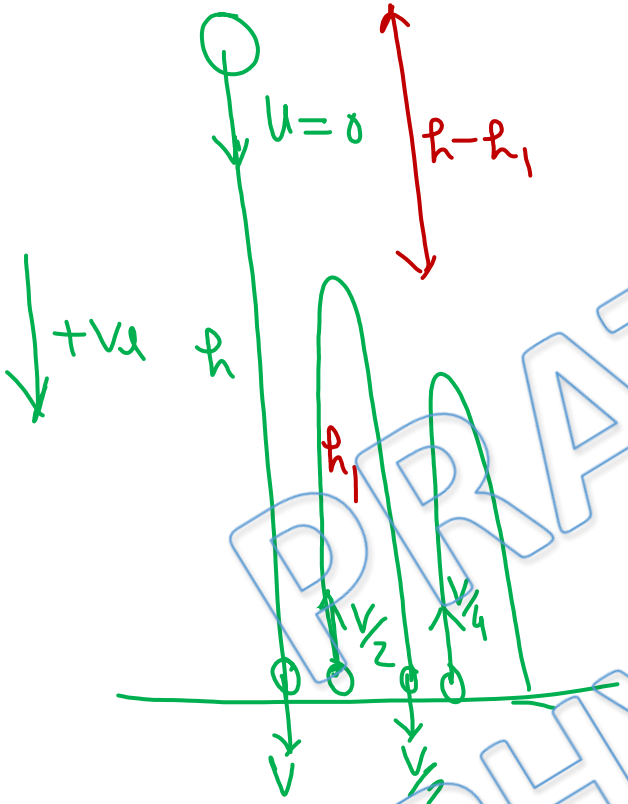
ANS : a

Solution: 2

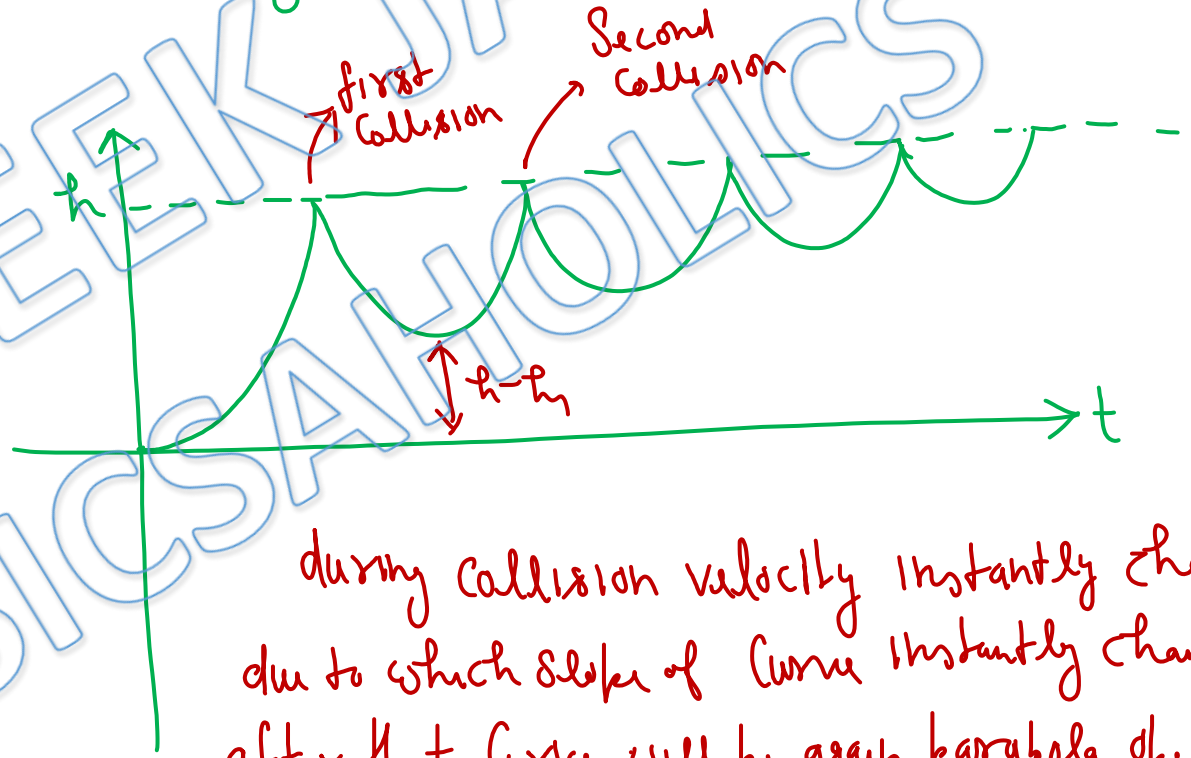


ANS : a

Solution: 3



x − t graph in Constant +ve acceleration is Parabola opening up

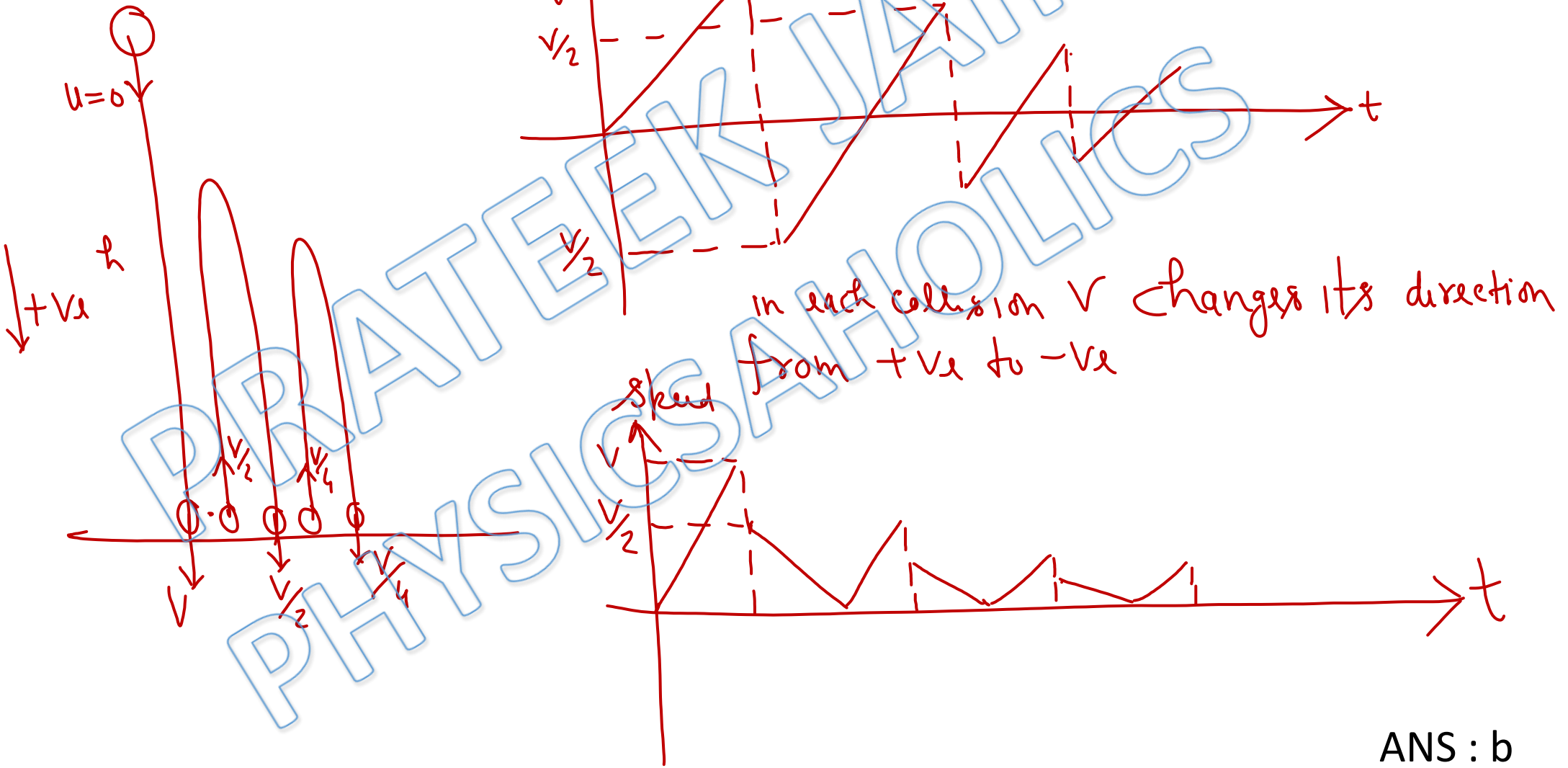


during collision velocity instantly changes due to which slope of curve instantly changes after that curve will be again parabola opening up

ANS : c

Solution: 4

a = Constant
⇒ V–t graph is st line



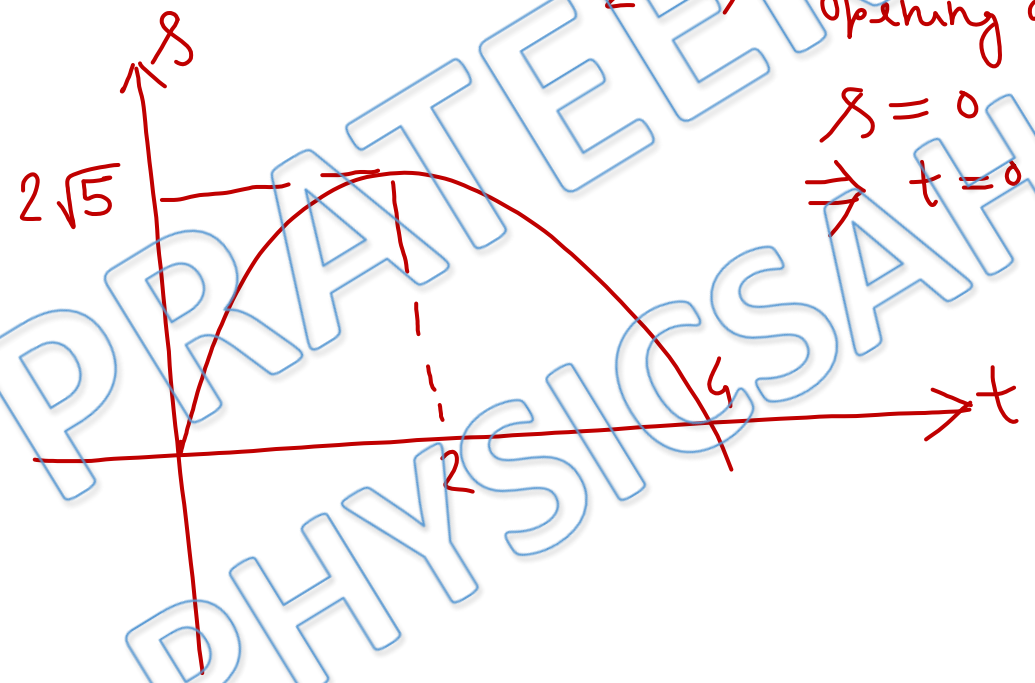
ANS : b

Solution: 5

$$V = 2\sqrt{5} - \sqrt{5}\,t$$

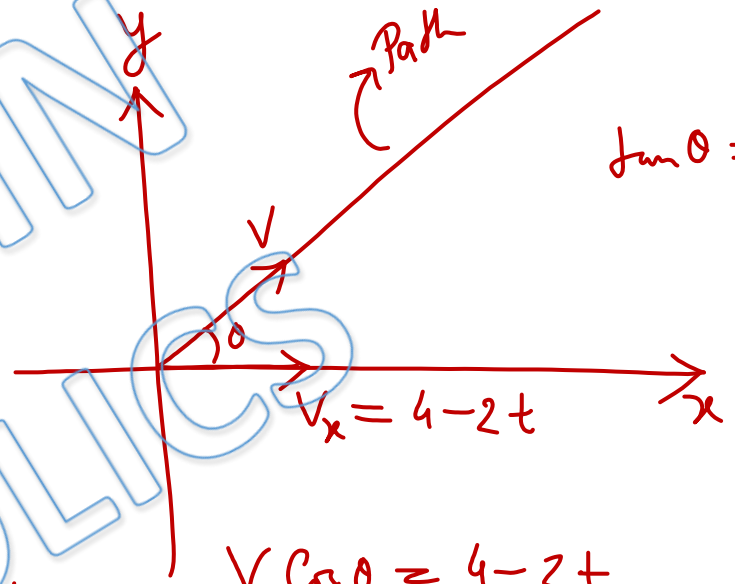
$$\Rightarrow \int_0^s ds = \int_0^t (2\sqrt{5} - \sqrt{5}\,t)\,dt$$

$$\Rightarrow s = 2\sqrt{5}\,t - \sqrt{5}\,\frac{t^2}{2} \Rightarrow \text{Parabola opening down}$$



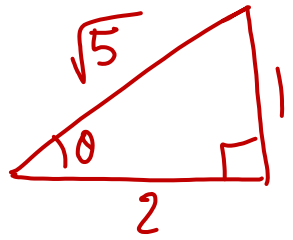
$s = 0$

$\Rightarrow t = 0, t = 4$



$\tan\theta = \frac{1}{2}$

$V\cos\theta = 4 - 2t$

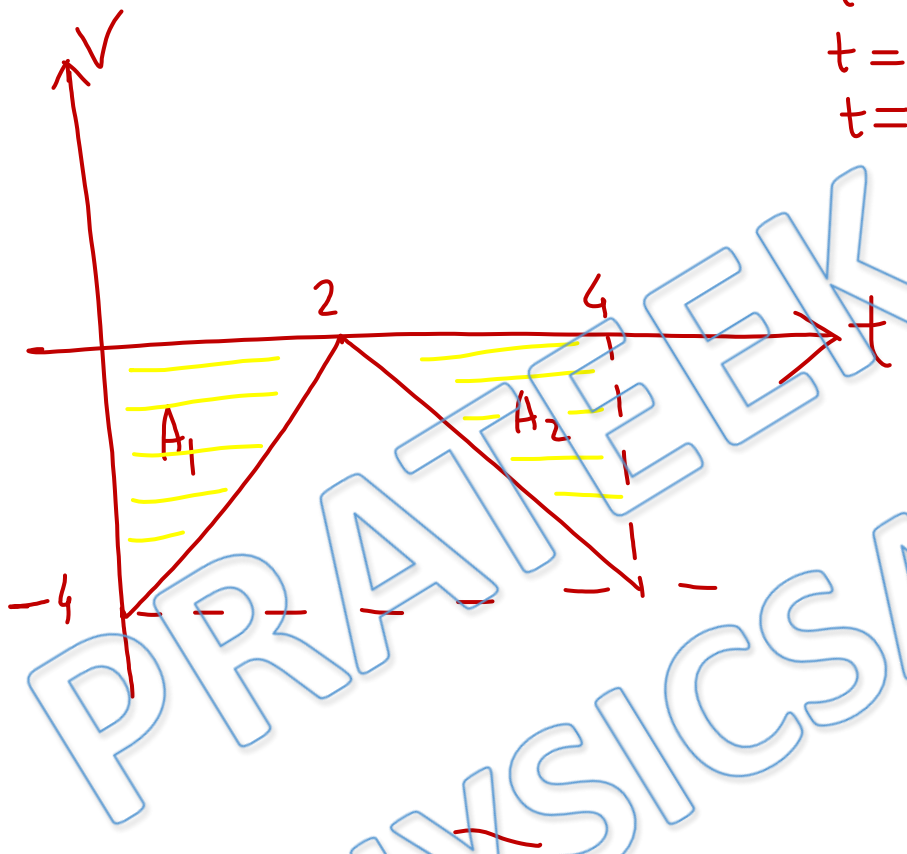


$$\frac{2}{\sqrt{5}}V = 4 - 2t$$

$$V = 2\sqrt{5} - \sqrt{5}\,t$$

ANS : c

Solution: 6



$t = 0 \Rightarrow V = -4$

$t = 2 \Rightarrow V = 0$

$t = 4 \Rightarrow V = -4$

In V–t graph

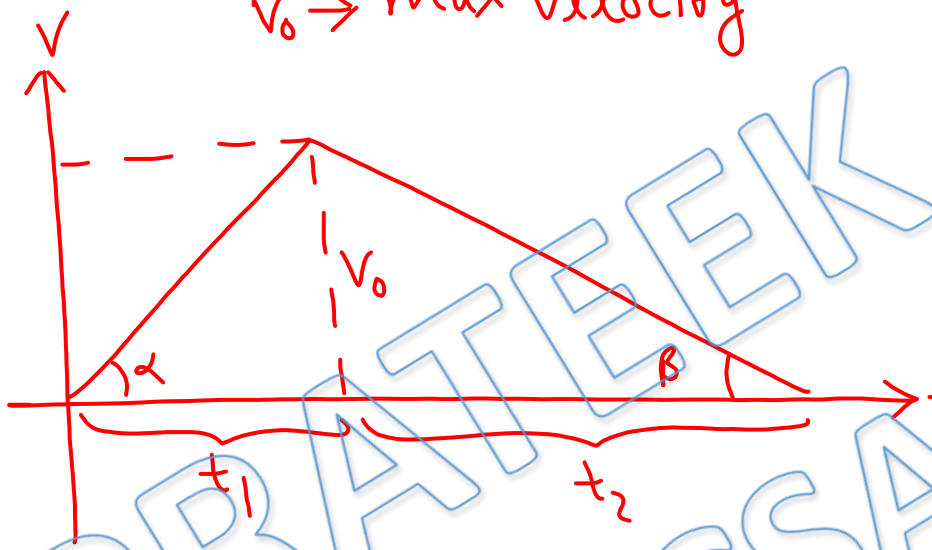
$S = |A_1| + |A_2|$

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

$= 8\ m$

ANS : d

Solution: 7



V–t graph of motion is

$v_0 \rightarrow$ max velocity

Since acceleration = Slope of V–t graph

$a = \tan\alpha = v_0/t_1 \Rightarrow t_1 = v_0/a$

$b = \tan\beta = \frac{v_0}{t_2} \Rightarrow t_2 = \frac{v_0}{b}$

total time of motion

$\Rightarrow t_1 + t_2 = T$

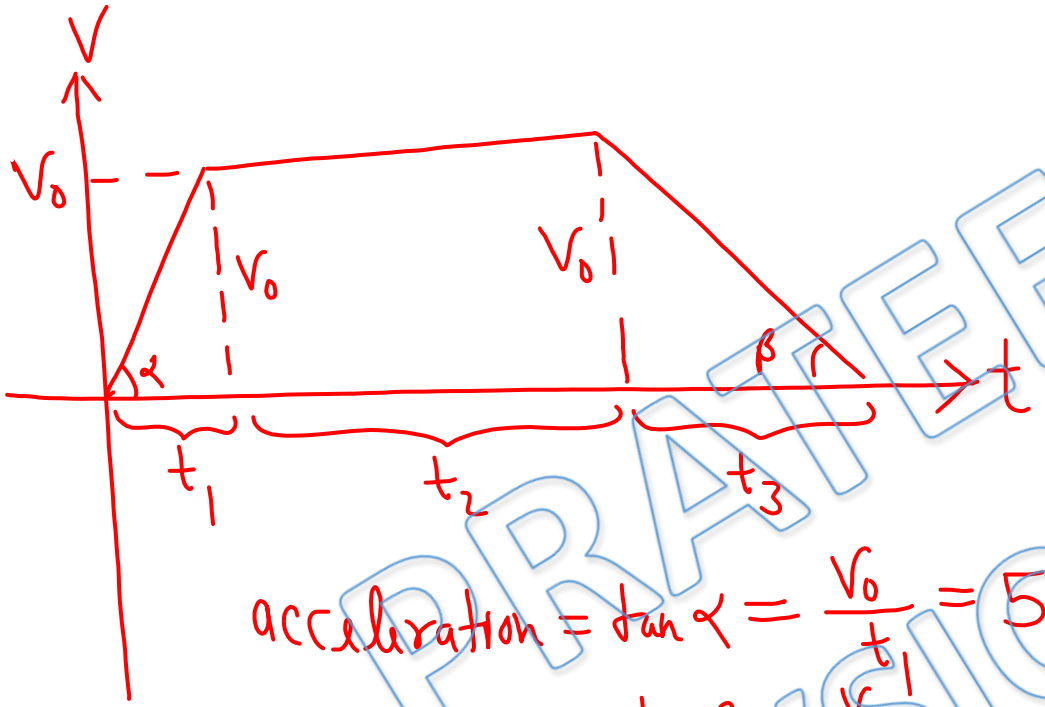
$\Rightarrow \frac{v_0}{a} + \frac{v_0}{b} = T$

$\Rightarrow v_0 = \frac{abt}{a+b}$

ANS : a

Solution: 8

$V_0 \rightarrow$ max velocity



$$V_{av} = 72\ km/hr = 20\ m/sec$$

$$\Delta x = V_{av}\, T = 25 \times 20$$

$$= 500\ m$$

now Area $= \Delta x = 500$

$$\frac{1}{2} V_0 \left[25 + 25 - \frac{2V_0}{5}\right] = 500$$

$$50 V_0 - \frac{2V_0^2}{5} = 1000$$

$$\frac{2V_0^2}{5} - 50V_0 + 1000 = 0$$

$$\Rightarrow V_0 = 25\ m/sec,\ 100\ m/sec$$

$$\text{acceleration} = \tan\alpha = \frac{V_0}{t_1} = 5$$

$$\text{Retardation} = \tan\beta = \frac{V_0}{t_3} = 5$$

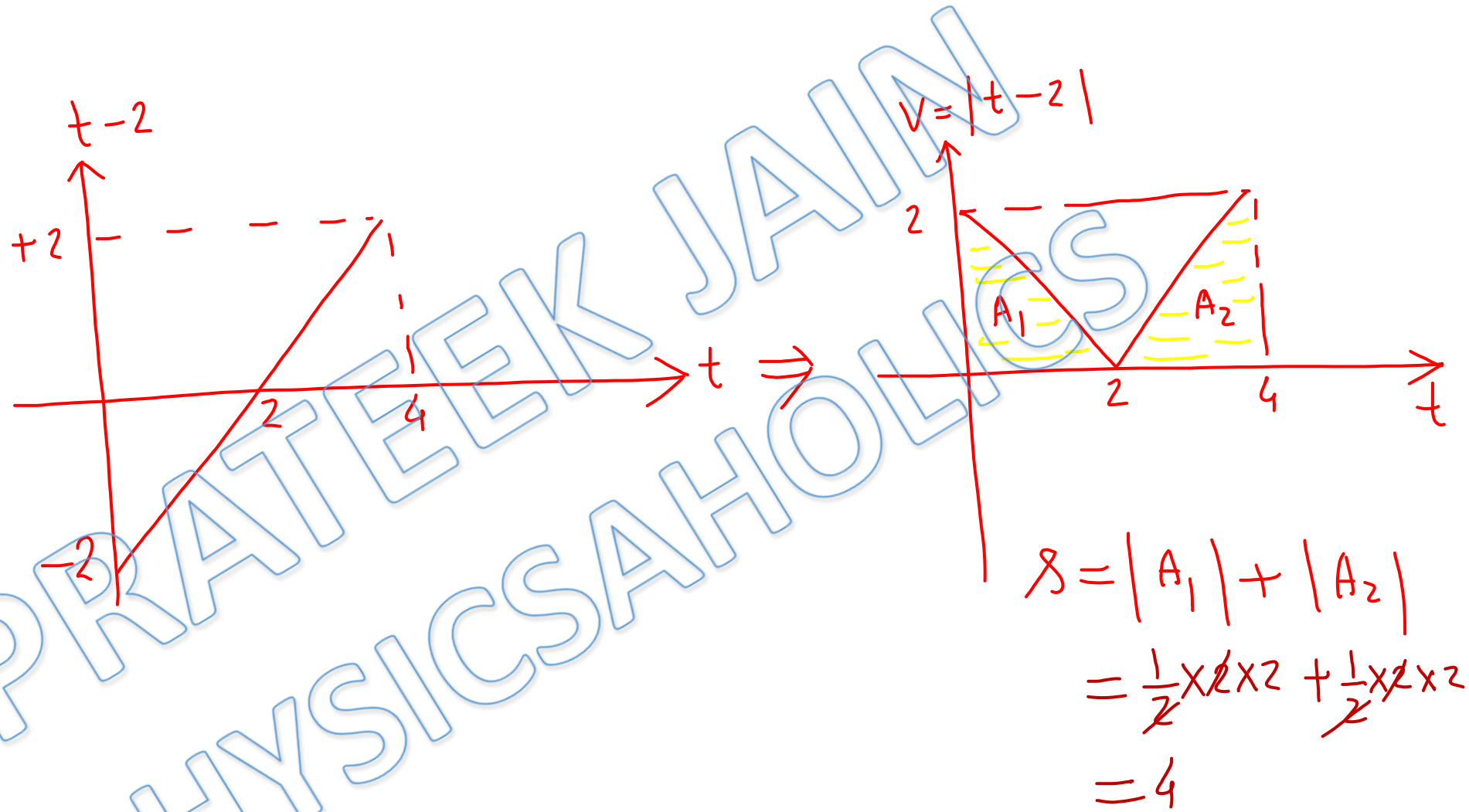
$$\Rightarrow t_1 = t_3 = \frac{V_0}{5}$$

$$\Rightarrow t_2 = 25 - \frac{2V_0}{5}$$

$$\Rightarrow t_2 = 15\ sec,\ -15\ sec \text{ (not acceptable)}$$

ANS : c

Solution: 9



$$S = |A_1| + |A_2|$$

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

$$= 4$$

ANS : d

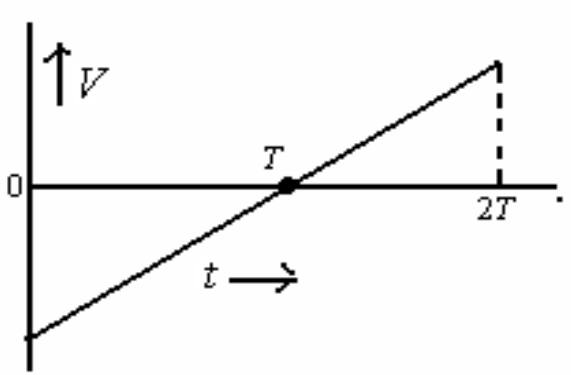
Solution: 10

before collision & after collision $a = g \downarrow = +g$

during collision with net acceleration will be -ve for short time to change the direction of velocity.

ANS : c

Solution: 11



between time $t=0$ to $t=T$

a = +ve & V = -ve

acceleration & velocity are in opposite direction ⇒ speed of particle will decrease in this time interval

So, in $t=0$ to $t=T$, ⇒ Retarding Motion

between time $t=T$ to $t=2T$

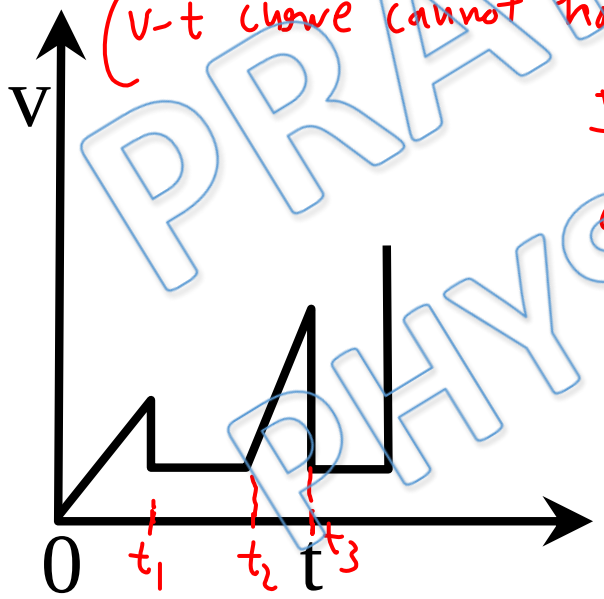
V = +ve , a = +ve

So, speed of particle will increases

So in $t=T$ to $t=2T$ Particle will accelerate

ANS : a

Solution: 12



(V-t curve cannot be parallel to V-axis)

(V-t curve cannot have sharp turn in real world)

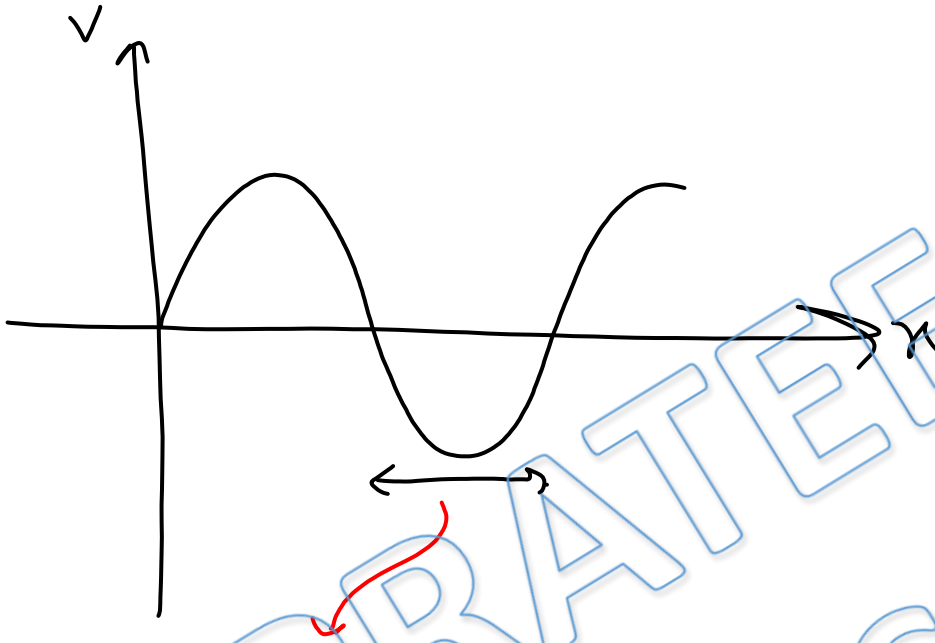
In graph, $t = t_1, t_2, t_3$ are times, when particle changing its velocity instantly and that is not possible in reality. Particle will always take some time to change its velocity

So, this graph cannot be realised in practice

Ans C

ANS : c

Solution: 13



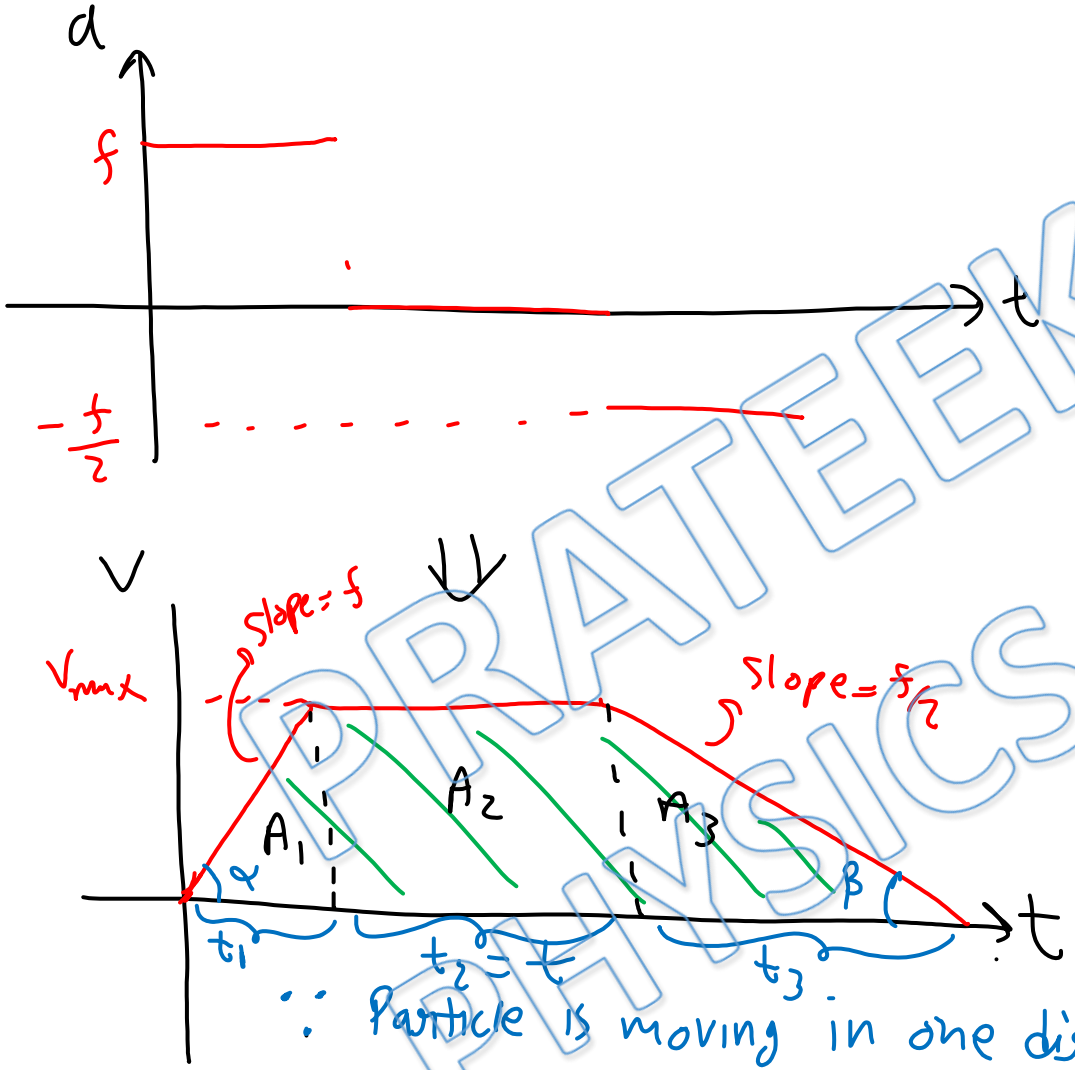
Ans. d

In this region, velocity of particle is negative, and still its displacement (x) is increasing, that is not possible.

So, this a-x curve cannot be realized in practice.

ANS : d

Solution: 14



accelerating distance = S = A_1

acceleration = $\tan\alpha = f = \frac{v_{max}}{t_1}$ — ①

deceleration = $\tan\beta = f/2 = \frac{v_{max}}{t_2}$ — ②

$\frac{①}{②} \Rightarrow t_2 = 2t_1$

$\Rightarrow A_3 = 2A_1 = 2S$

$\Rightarrow A_1 = S,\ A_3 = 2S \Rightarrow A_2 = (15-3)S = 12S$

So, $12S = v_{max}\, t$

$S = \frac{v_{max}\, t}{12}$

And, $S = \frac{1}{2} f t_1^2 = \frac{v_{max}\, t}{12}$

∴ Particle is moving in one direction.

So, |displacement| = distance covered = Area (under) v-t curve.

ANS : a

from,

$$s = \frac{1}{2} f t_1^2 = \frac{v_{max}\, t}{12}$$

and $f = \frac{v_{max}}{t_1}$

$$\Rightarrow \frac{1}{2} f t_1^2 = \frac{(f t_1)\, t}{12}$$

$$t_1 = \frac{t}{6}$$

$$s = \frac{1}{2} f t_1^2$$

$$= \frac{1}{2} f \left(\frac{t}{6}\right)^2$$

$$= \frac{1}{2} f \frac{t^2}{36}$$

$$\Rightarrow \boxed{s = \frac{1}{72} f t^2}$$

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