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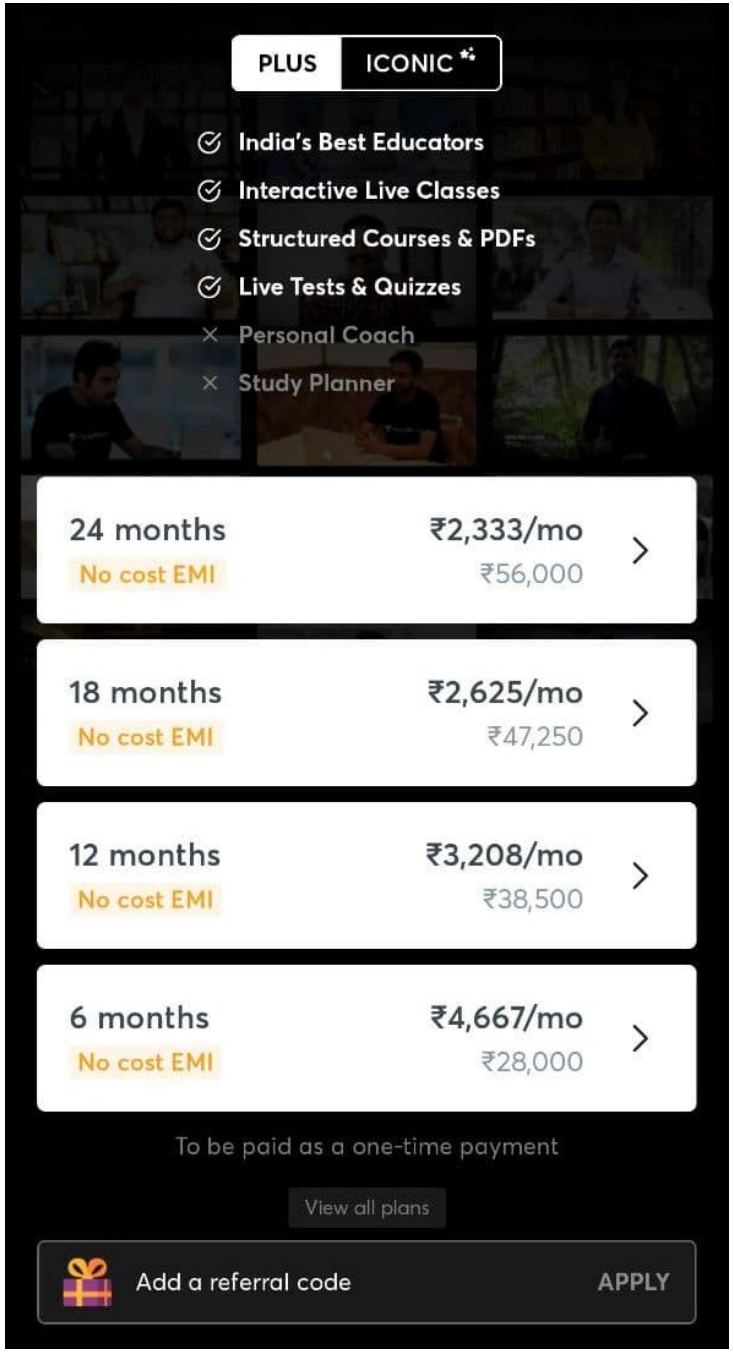

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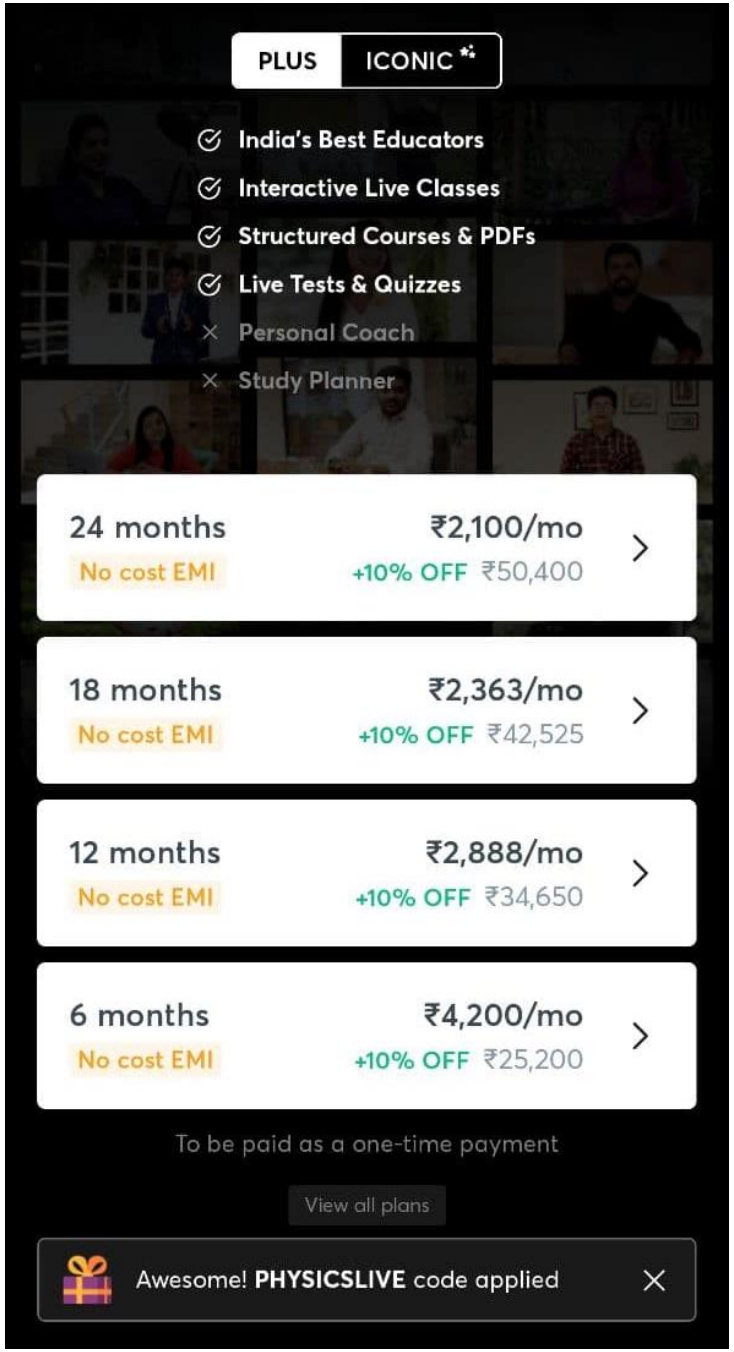

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JEE Main
Physics DPP

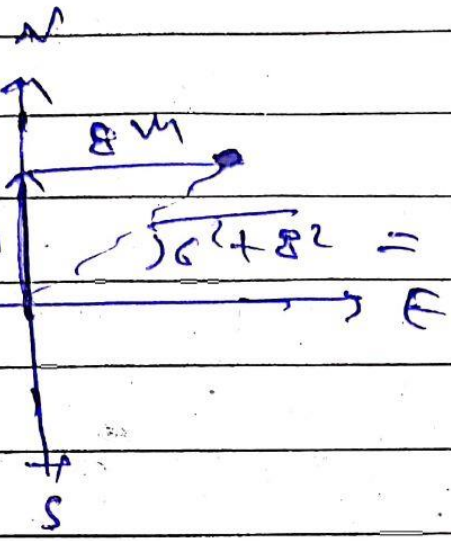
DPP-1 Kinematics: Speed, Velocity, Distance and Displacement

By Physicsaholics Team

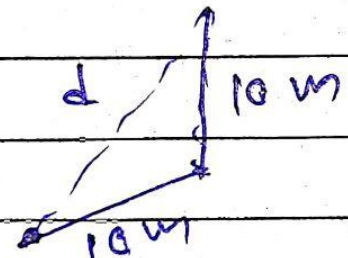
Q) A Body moves 6 m north. 8 m east and 10m vertically upwards, what is its resultant displacement from initial position:

(a) $10\sqrt{2}$ m (b) 10 m (c) $\frac{10}{\sqrt{2}}$ m (d) 20 m

Ans. a



N00 ; 10m in Horizontal plane
& 10 m Vertically upwards



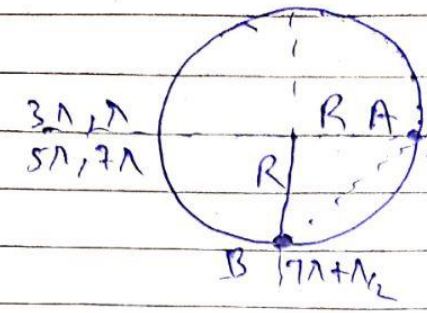
$d = \sqrt{10^2 + 10^2}$

$\boxed{d = 10\sqrt{2}\ m}$

Q) An athlete completes one round of a circular track of radius R in 40 sec with uniform speed. What will be his displacement at the end of 2 min. 30 sec?

(a) zero (b) $\sqrt{2}$R (c) $\frac{5}{2}\pi R$ (d) $\frac{15}{2}\pi R$

Ans. b



at time $t = 2\text{min } 30\text{sec}$

$= 120 + 30 = 150\text{sec}$

$\omega = \frac{2\pi}{40} = \frac{\pi}{20}$ ~~rad~~/sec

angle covered in $t = 150$ sec.

$\omega = \frac{\pi}{2} \times 15.0$

$= 15\frac{\pi}{2}$

$= (14+1)\frac{\pi}{2} = 7\pi + \frac{\pi}{2}$

∴ if at $t=0$

Particle is at 'A'

then at $t = 2\text{min } 30$ sec.

Particle will be at 'B'

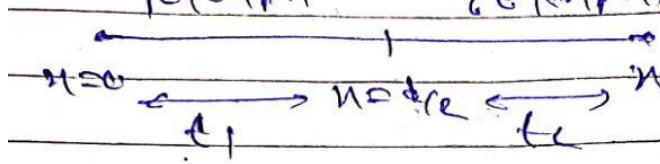
$\therefore d = \sqrt{R^2 + R^2}$

$\boxed{d = \sqrt{2}R}$

Q) A car covers the first half of the distance between two places at 40 kmph and the other half at 60 kmph. The average speed of the car is:

(a) 40 kmph
(b) 48 kmph
(c) 50 kmph
(d) 60 kmph

Ans. b



$$t_1 = \frac{d/2}{40} = \frac{d}{80}\ h.$$

$$t_2 = \frac{d/2}{60} = \frac{d}{120}\ h.$$

$$V = \frac{d}{t} = \frac{d}{t_1 + t_2}$$

$$V = \frac{d}{\frac{d}{80} + \frac{d}{120}} = \frac{1}{\frac{1}{80} + \frac{1}{120}}$$

$$V = \frac{1}{\frac{1}{40}\left(\frac{1}{2} + \frac{1}{3}\right)} = \frac{40}{\frac{1}{2} + \frac{1}{3}}$$

$$V = \frac{40}{5/6} = 40 \times \frac{6}{5}$$

$$\boxed{V = 48 \text{ kmph}}$$

Q) A particle is constrained to move on a straight line path. It returns to the starting point after 10 sec. The total distance covered by the particle during this time is 30 m. Which of the following statements about the motion of the particle is false?

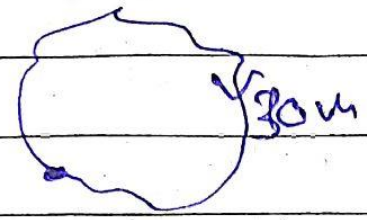
(a) Displacement of the particle is zero

(b) Average speed of the particle is 3 m/s

(c) Displacement of the particle is 30 m

(d) Average velocity of the particle is zero.

Ans. c



$t = 10$ sec.

Distance = 30m.

∴ initial position = final position

∴ **Displacement = Zero**

Avg. speed $= \frac{\text{Distance}}{\text{time}} = \frac{30\text{m}}{10\text{ sec.}}$

Avg speed = 3 m/sec

Avg. Velocity $= \frac{\text{Displacement}}{\text{time}} = \frac{0\text{m}}{10\text{ se}}$

Aveg. Velocity = Zero

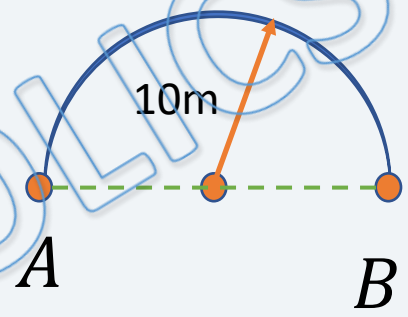
Q) A particle moves along a semicircle of radius 10m from A to B in 5 seconds. The average velocity of the particle is:

(a) $2\pi\ m/s^{-1}$

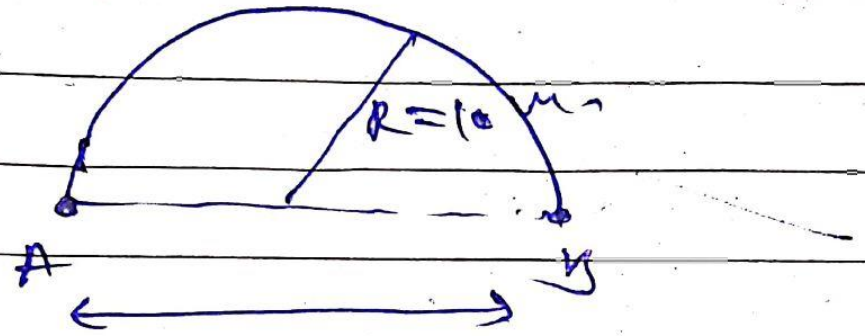
(b) $4\pi\ m/s^{-1}$

(c) $2\ m/s^{-1}$

(d) $4\ m/s^{-1}$



Ans. d



$d = 2R$

displacement $= 2R$

$= 2 \times 10 = 20$ m.

Time $= 5$ sec.

Avg. Velocity $= \frac{\text{Displacement}}{\text{Time}}$

$= \frac{20}{5}$

Avg. Velocity $= 4$ m/s

Q) A passenger travels along a straight line with velocity V_1 for first half time and with velocity V_2 for next half time, then the mean speed v is given by -

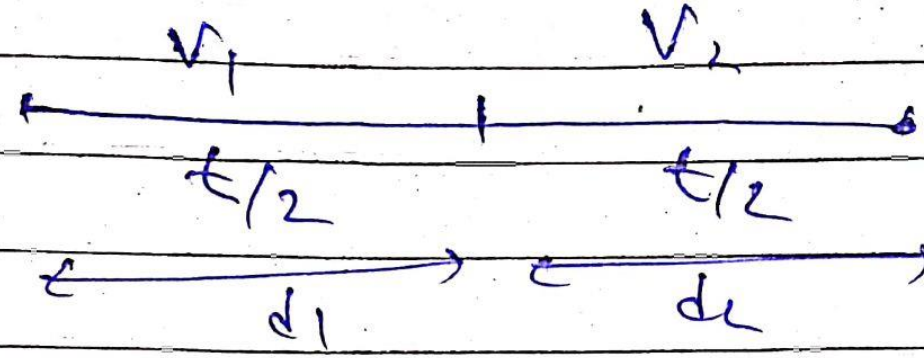
(a) $v = \frac{v_1+v_2}{2}$

(b) $v = \sqrt{v_1 v_2}$

(c) $v = \sqrt{\frac{v_2}{v_1}}$

(d) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

Ans. a



$$d_1 = v_1 \frac{t}{2} \qquad d_2 = v_2 \frac{t}{2}$$

$$d = d_1 + d_2$$

$$\text{Avg. speed} = \frac{v_1 \frac{t}{2} + v_2 \frac{t}{2}}{\frac{t}{2} + \frac{t}{2}}$$

$$\frac{d}{t} = \frac{v_1 + v_2}{1+1}$$

$$\boxed{\text{Avg. Speed} = \frac{v_1 + v_2}{2}}$$

Q) A particle's position as a function of time is described as $y = 2t^2 + 3t + 4$. What is the average velocity of the particle from $t = 0$ to $t = 3$ sec?

(a) 3 m/s

(b) 6 m/s

(c) 9 m/s

(d) 12 m/s

Ans. c

Q4 $y = 2t^2 + 3t + 4$

at $t = 0$; $y_1 = 4$ m.

at $t = 3$ sec; $y_2 = 2(3)^2 + 3(3) + 4$

$= 18 + 9 + 4$

$y_2 = 31$ m.

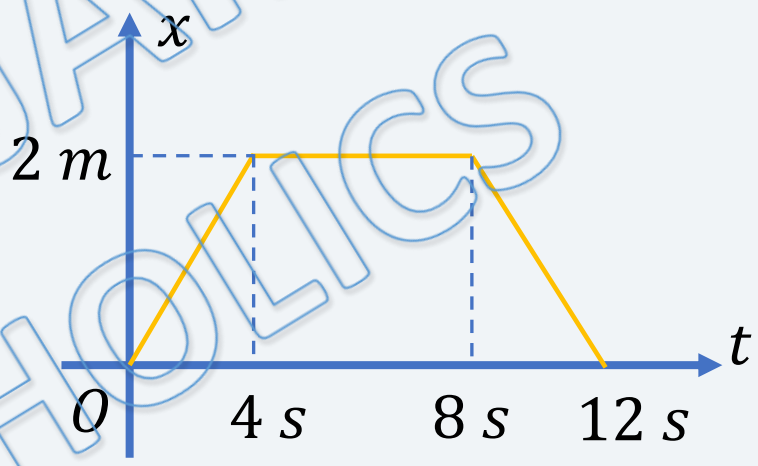
Displacement $= y_2 - y_1$

$= 27$ m.

Avg velocity $= \frac{27}{3} = 9$ m/s

Avg. velocity = 9 m/s

Q) Position-time graph of a particle is shown below. What is the average velocity of the particle between the times $t = 0\ s$ to $t = 12\ s$?



(a) 1.33 m/s

(b) zero

(c) 12 m/s

(d) -01.33 m/s

Ans. b

at $t = 0$; $x_1 = 0$

at $t = 12\ s$; $x_2 = 0$

$\therefore$ displacement = Zero

$\therefore$ Avg. Velocity = $\frac{\text{Zero}}{12}$

Avg. Velocity = 0 m/s

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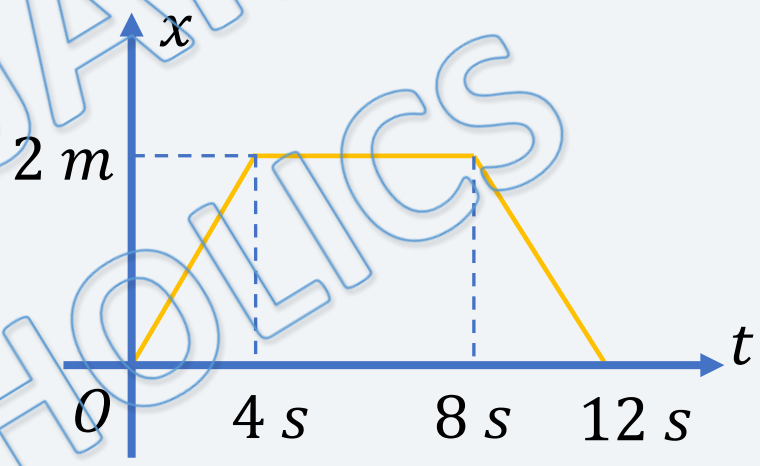
Q) Position-time graph of a particle is shown below. What is the average speed of the particle between the times $t = 8\ s$ to $t = 12\ s$?



(a) 0.5 m/s

(b) -0.5 m/s

(c) zero

(d) 2 m/s

Ans. a

at $t = 8$ sec; $x_1 = 2$ m.

at $t = 12$ sec; $x_2 = 0$ m.

distance $= |x_2 - x_1|$

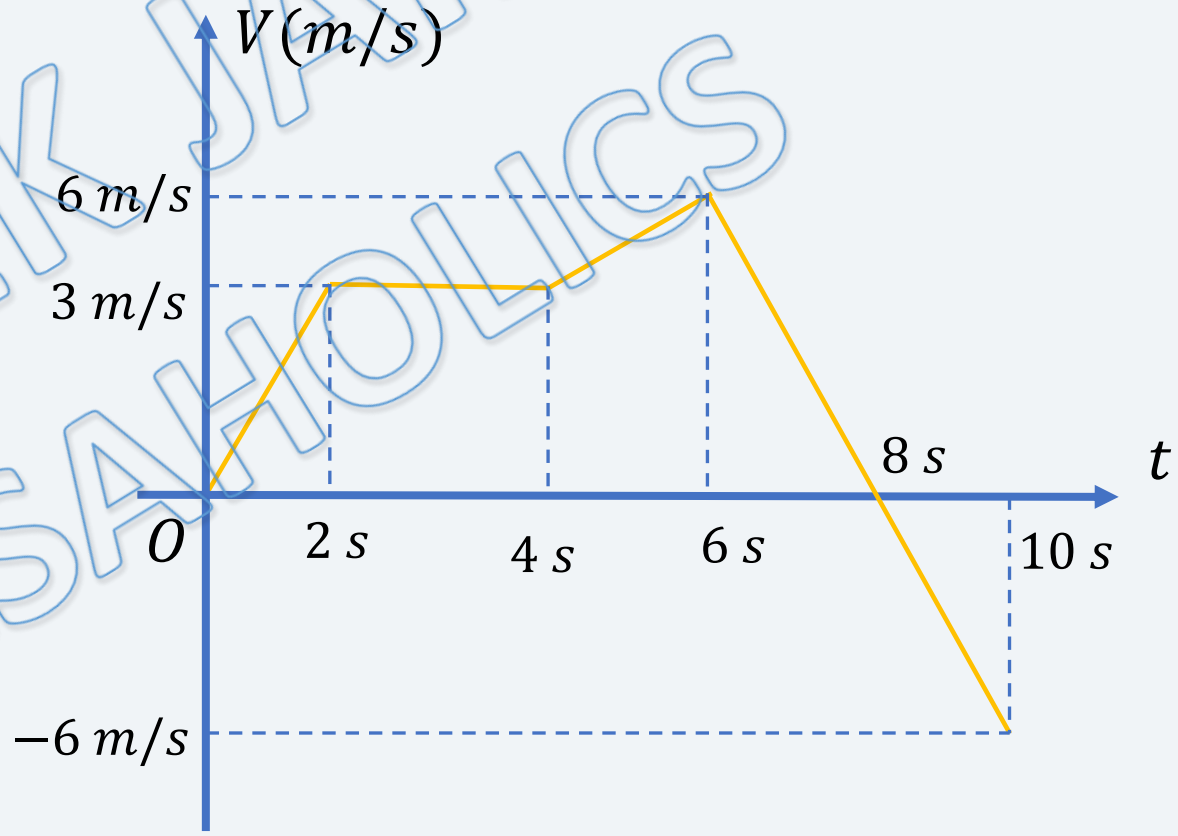
$= |0 - 2| = |-2|$

distance $= 2$ m.

$\therefore$ Avg speed $= \frac{\text{distance}}{\text{time}} = \frac{2\text{ m}}{4\text{ sec}}$

Avg speed $= 0.5$ m/s

Q) Velocity-time graph of a particle is shown below. What is the average velocity of the particle between the times $t = 2\ s$ to $t = 6\ s$?



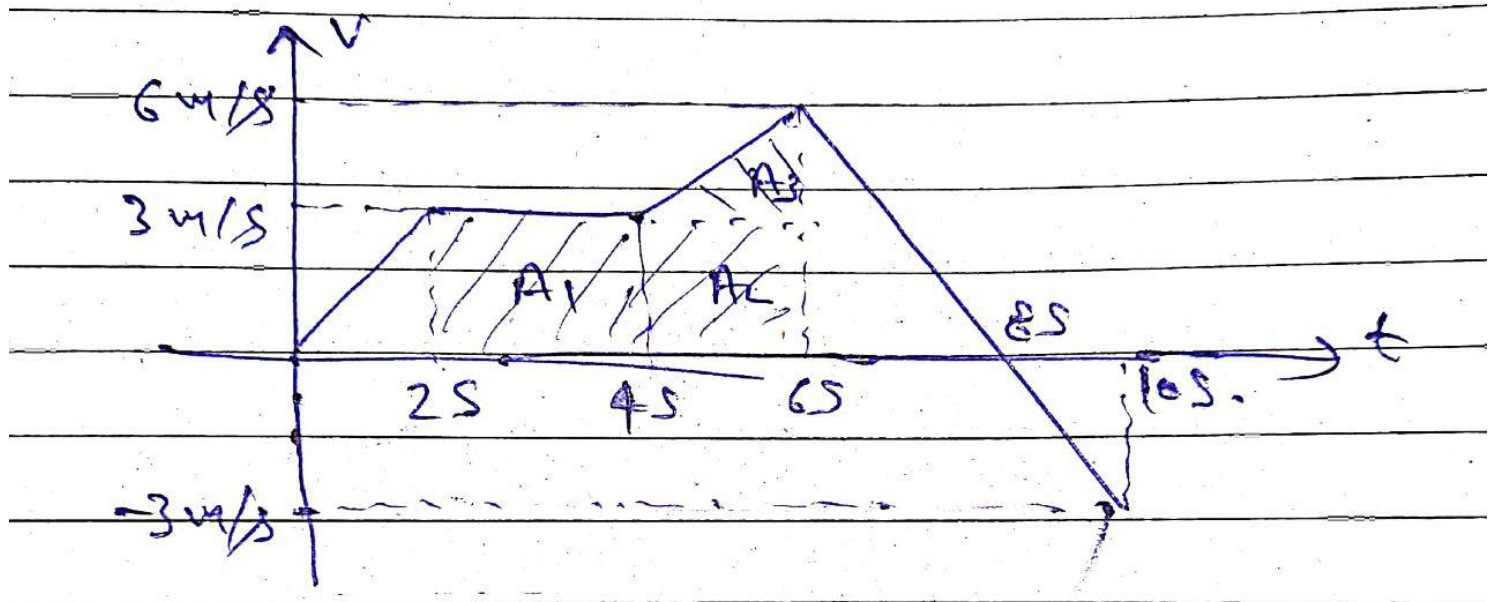
(a) 0.5 m/s

(b) 3.5 m/s

(c) -3.5 m/s

(d) 5 m/s

Ans. b



from $t = 2$ Se to $t = 6$ Sec

displacement $= A_1 + A_2 + A_3$

$= (2 \times 3) + (2 \times 3) + \frac{1}{2} \times 2 \times 3$

$= 6 + 6 + 3$

$= 15$ m.

Avg. Velocity $= \frac{15}{4} = 3.5$ m/s

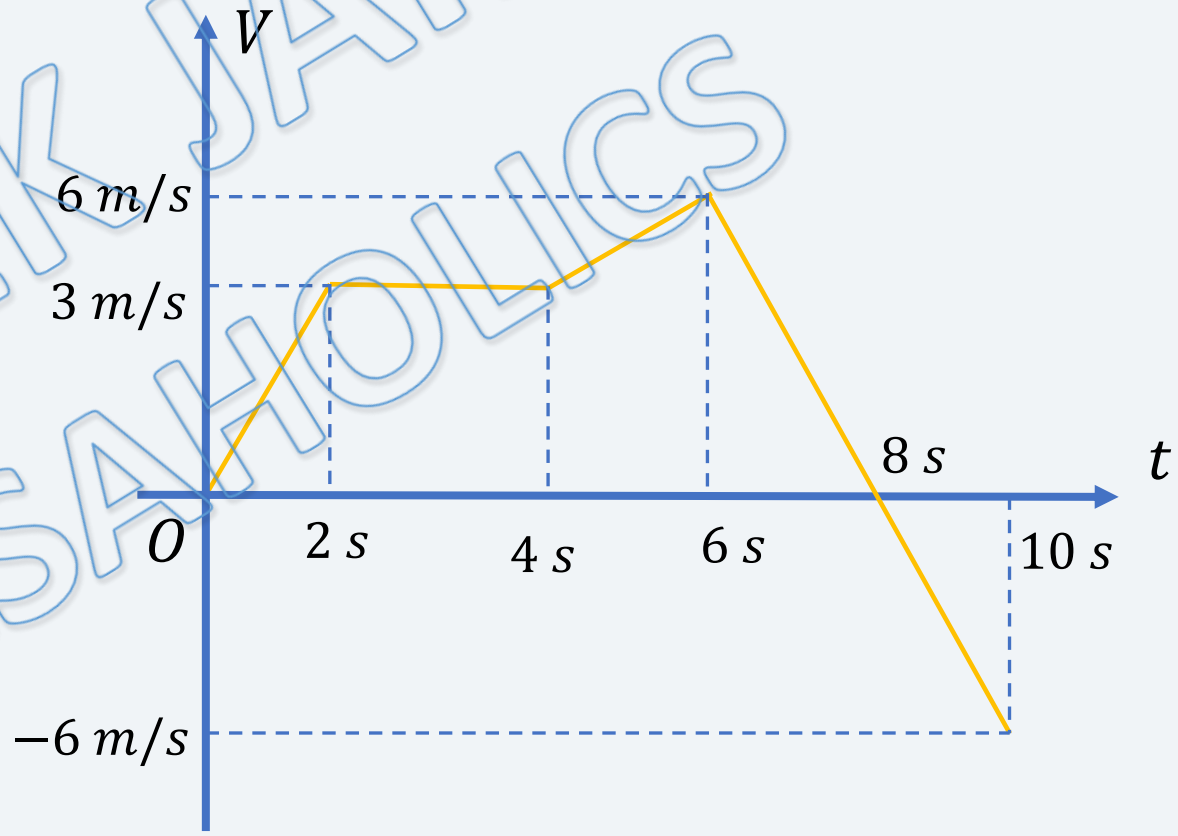
Q) Velocity-time graph of a particle is shown below. What is the average speed of the particle between the times $t = 0\ s$ to $t = 10\ s$?

(a) 3.5 m/s

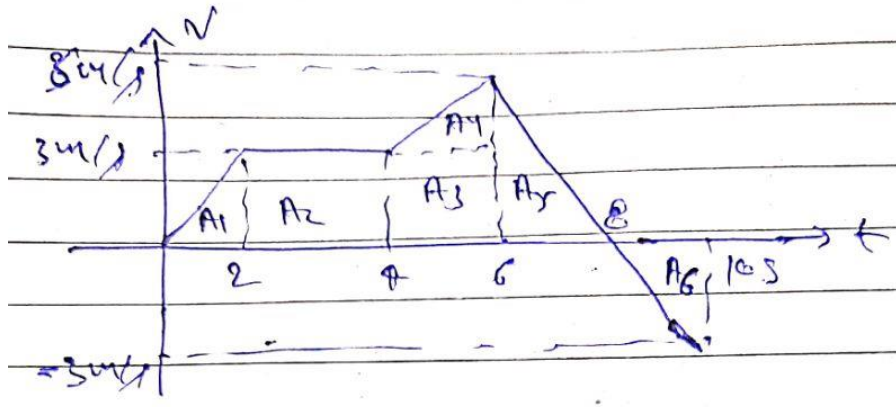
(b) -3.5 m/s

(c) 3

(d) -3 m/s



Ans. c



distance covered = $A_1 + A_2 + A_3 + A_4 + A_5 + |A_6|$

$= \left(\frac{1}{2} \times 2 \times 3\right) + (2 \times 3) + (2 \times 3) + \left(\frac{1}{2} \times 2 \times 3\right) + \left(\frac{1}{2} \times 2 \times 6\right) + \left|\left(\frac{1}{2} \times 2 \times 6\right)\right|$

$= 3 + 6 + 6 + 3 + 6 + 6$

$d = 30\ m$

Avg. speed $= \frac{d}{t}$

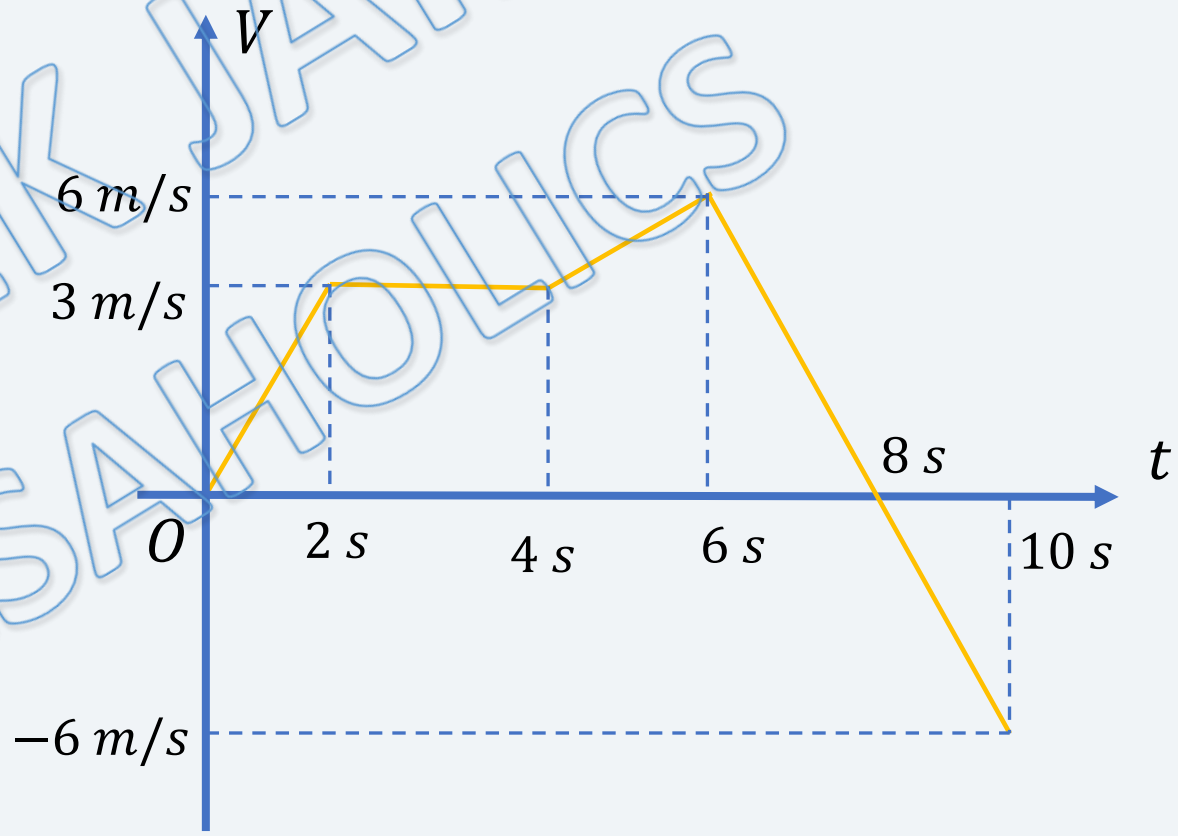
$= \frac{30}{10}$

Avg. speed = 3 m/s

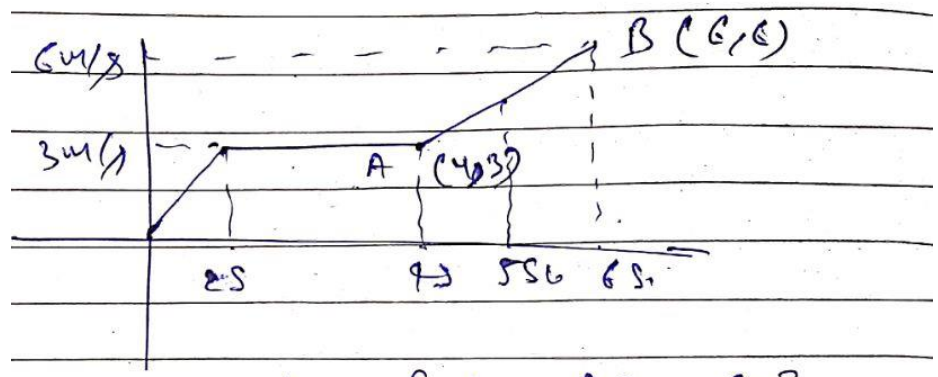
Q) Velocity-time graph of a particle is shown below. What is the instantaneous velocity of the particle at $t = 5\ s$?

(a) 4 m/s (b) -4 m/s

(c) -4.5 m/s (d) 4.5 m/s



Ans. d



slope of line AB = $\frac{6-3}{6-4}$

$= \frac{3}{2}$ m/s²

at $t = 4$ sec

$v = 3$ m/s

in 1 sec.

from A → B

velocity increases = $\frac{3}{2}$ m/s

∴ Velocity at $t = 5$ sec.

$v = (v_{at\ t=4s}) + \frac{3}{2}$

$v = 3 + \frac{3}{2} = 3 + 1.5$

$\boxed{v = 4.5 \text{ m/s}}$

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