

**9** A particle moves in a straight line so that its velocity,  $v$  m/s, is given by  $v = 2t^2 - 8t + 6$ , where  $t$  is the time in seconds after the start of motion. At  $t = 2$ , the displacement of the particle from a fixed point  $O$  is 1 m. Find

**(i)** the times when the particle is instantaneously at rest, [2]

**(ii)** the minimum velocity of the particle and explain the significance of the answer obtained. [3]

**(iii)** the average speed travelled by the particle in the first 5 seconds.

[4]

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(i) the times when the particle is instantaneously at rest, [2]

at rest,  $v = 0$ ,  
 $2t^2 - 8t + 6 = 0$   
 $(t-1)(t-3) = 0$   
 $\therefore t = 1 \text{ s or } t = 3 \text{ s}$

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(ii) the minimum velocity of the particle and explain the significance of the answer obtained, [3]

For minimum velocity,  $a = 0$  (lowest pt in  $v/t$  graph)  
 $v = 2t^2 - 8t + 6$   
 $a = 4t - 8 = 0$   
 $\therefore t = 2 \text{ s}$

When  $t = 2$ ,  $v = 2(2)^2 - 8(2) + 6$   
 $= -2 \text{ m/s}$

The particle's motion is in the opposite direction

(iii) the average speed travelled by the particle in the first 5 seconds.

[4]

$$\text{average speed} = \frac{\text{total dist travelled}}{\text{total time taken}}$$

Given,  $v = 2t^2 - 8t + 6$ ,  $s = 1$ ,  $t = 2$ .

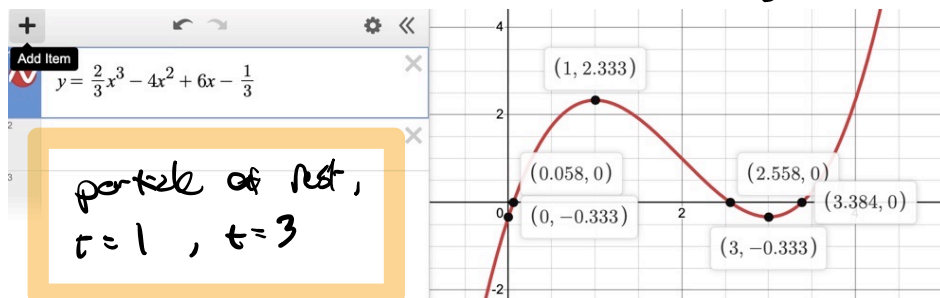
$$s = \int 2t^2 - 8t + 6 \, dt$$

$$s = 2\left(\frac{t^3}{3}\right) - 8\left(\frac{t^2}{2}\right) + 6t + C$$

$$\therefore 1 = 2\left(\frac{2^3}{3}\right) - 8\left(\frac{2^2}{2}\right) + 6(2) + C$$

$$C = -\frac{1}{3}$$

$$\text{Hence, } s = \frac{2t^3}{3} - 4t^2 + 6t - \frac{1}{3}$$

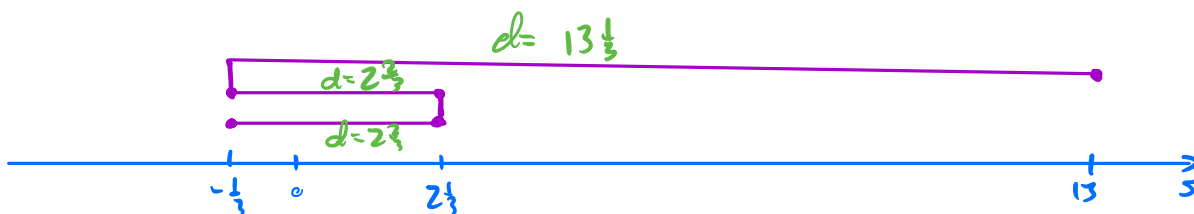


Displacements at  $t = 0$ ,  $s = -\frac{1}{3}$

$$t = 1, s = 2\frac{1}{3}$$

$$t = 3, s = -\frac{1}{3}$$

$$t = 5, s = 13$$



$$\therefore \text{ave speed} = \frac{2\frac{2}{3} + 2\frac{2}{3} + 13\frac{1}{3}}{5} = 3.73 \text{ m/s}$$