Displacement, velocity and acceleration models

6 questions | 23 marks

Equivalent correct methods earn the corresponding marks.

1. For $s(t) = 3t^2 + 2t$ metres, find v, a and $v(2)$. [3 marks]

Differentiate s, then v; substitute 2 into v.

Answer: $v = 6t + 2$ m/s; $a = 6$ m/s²; $v(2) = 14$ m/s.

2. For $s(t) = t^2 - 4t$ metres, with t in seconds and $0 \le t \le 5$, find the rest time and total distance. [5 marks]

$v = 2t - 4 = 0$ at 2 with sign change − to +.

Positions $0,\ -4, 5$ give distance $4 + 9 = 13$.

Answer: Rest at $t = 2$ s; distance 13m.

3. For $s(t) = t^3 - 6t^2 + 9t$ metres, with t in seconds and $0 \le t \le 4$, find rest times, displacement and total distance. [6 marks]

$v = 3(t - 1)(t - 3)$ changes sign at 1 and 3.

Positions at 0,1,3,4 are 0,4,0,4; displacement 4 and distance $4 + 4 + 4 = 12$.

Answer: Rest at 1s and 3s; displacement 4m; distance 12m.

4. Velocity is -7m/s. State the speed and direction. [2 marks]

Use the magnitude for speed and sign for direction.

Answer: Speed 7m/s; negative direction.

5. For $s(t) = t^2$, can velocity be zero while acceleration is nonzero? [3 marks]

$v = 2t$ but $a = 2$.

Zero instantaneous velocity does not imply zero acceleration.

Answer: Yes: at $t = 0$, $v = 0$ and $a = 2$.

6. For $s(t) = 10 - 2t$, find displacement from 1s to 4s and total distance. [4 marks]

Positions are 8m and 2m, so displacement $= -6$ m.

Velocity has no sign change, giving distance 6m.

Answer: Displacement -6m; distance 6m.