Motion Along a Line

A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the velocity function \( v(t) \) and the acceleration function \( a(t) \). You may use the blank graphs to sketch \( s(t) \), \( v(t) \), and \( a(t) \).

1) \( s(t) = t^3 - t^2 - 56t \)

A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the displacement of the particle and the distance traveled by the particle over the given interval. You may use the blank graph to sketch \( s(t) \).

2) \( s(t) = -t^2 + 6t + 27; \ 0 \leq t \leq 4 \)

3) \( s(t) = -t^3 + 11t^2; \ 3 \leq t \leq 8 \)
A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the maximum speed and times \( t \) when this speed occurs over the given interval. You may use the blank graphs to sketch \( s(t) \) and \( v(t) \).

4) \( s(t) = -t^3 + 18t^2 - 81t; \ 2 \leq t \leq 7 \)

A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the velocity function \( v(t) \), the acceleration function \( a(t) \), the times \( t \) when the particle changes directions, the intervals of time when the particle is moving left and moving right, the times \( t \) when the acceleration is 0, and the intervals of time when the particle is slowing down and speeding up. You may use the blank graphs to sketch \( s(t), v(t), \) and \( a(t) \).

5) \( s(t) = t^3 - 23t^2 + 120t \)
A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the velocity function \( v(t) \) and the acceleration function \( a(t) \). You may use the blank graphs to sketch \( s(t) \), \( v(t) \), and \( a(t) \).

1) \( s(t) = t^3 - t^2 - 56t \)

\[ v(t) = 3t^2 - 2t - 56, \quad a(t) = 6t - 2 \]

A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the displacement of the particle and the distance traveled by the particle over the given interval. You may use the blank graph to sketch \( s(t) \).

2) \( s(t) = -t^2 + 6t + 27; \quad 0 \leq t \leq 4 \)

Displacement: 8
Distance traveled: 10

3) \( s(t) = -t^3 + 11t^2; \quad 3 \leq t \leq 8 \)

Displacement: 120
Distance traveled: \( \frac{3520}{27} \approx 130.37 \)
A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the maximum speed and times \( t \) when this speed occurs over the given interval. You may use the blank graphs to sketch \( s(t) \) and \( v(t) \).

4) \( s(t) = -t^3 + 18t^2 - 81t; \quad 2 \leq t \leq 7 \)

Maximum speed: 27 at \( t = \{6\} \)

A particle moves along a horizontal line. Its position function is \( s(t) \) for \( t \geq 0 \). For each problem, find the velocity function \( v(t) \), the acceleration function \( a(t) \), the times \( t \) when the particle changes directions, the intervals of time when the particle is moving left and moving right, the times \( t \) when the acceleration is 0, and the intervals of time when the particle is slowing down and speeding up. You may use the blank graphs to sketch \( s(t) \), \( v(t) \), and \( a(t) \).

5) \( s(t) = t^3 - 23t^2 + 120t \)

\( v(t) = 3t^2 - 46t + 120, \quad a(t) = 6t - 46 \)

Changes direction at: \( t = \{ \frac{10}{3}, \quad 12 \} \), Moving left: \( \frac{10}{3} < t < 12 \), Moving right: \( 0 \leq t < \frac{10}{3}, \quad t > 12 \)

Acceleration zero at: \( t = \{ \frac{23}{3} \} \), Slowing down: \( 0 \leq t < \frac{10}{3}, \quad \frac{23}{3} < t < 12 \), Speeding up: \( \frac{10}{3} < t < \frac{23}{3}, \quad t > 12 \)

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