

Calculus Practice: Rectilinear Motion 1

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.

1) $s(t) = t^4 - 13t^3$

2) $s(t) = t^3 - 10t^2$

3) $s(t) = -t^2 + 7t + 120$

4) $s(t) = t^4 - 14t^3$

5) $s(t) = t^2 - 27t + 180$

6) $s(t) = -t^4 + 9t^3$

A particle moves along a vertical 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 down and moving up, the times t when the acceleration is 0, and the intervals of time when the particle is slowing down and speeding up.

7) $s(t) = -t^2 + 13t - 36$

8) $s(t) = t^2 - 16t + 39$

9) $s(t) = -t^2 + 12t + 28$

10) $s(t) = t^4 - 10t^3$

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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.

1) $s(t) = t^4 - 13t^3$

$v(t) = 4t^3 - 39t^2, a(t) = 12t^2 - 78t$

Changes direction at: $t = \left\{ \frac{39}{4} \right\}$, Moving left: $0 < t < \frac{39}{4}$, Moving right: $t > \frac{39}{4}$ Acceleration zero at: $t = \left\{ 0, \frac{13}{2} \right\}$, Slowing down: $\frac{13}{2} < t < \frac{39}{4}$, Speeding up: $0 \leq t < \frac{13}{2}$ and $\frac{39}{4} < t < \infty$

2) $s(t) = t^3 - 10t^2$

$v(t) = 3t^2 - 20t, a(t) = 6t - 20$

Changes direction at: $t = \left\{ \frac{20}{3} \right\}$, Moving left: $0 < t < \frac{20}{3}$, Moving right: $t > \frac{20}{3}$ Acceleration zero at: $t = \left\{ \frac{10}{3} \right\}$, Slowing down: $0 \leq t < \frac{10}{3}$, Speeding up: $t > \frac{10}{3}$

3) $s(t) = -t^2 + 7t + 120$

$v(t) = -2t + 7, a(t) = -2$

Changes direction at: $t = \left\{ \frac{7}{2} \right\}$, Moving left: $t > \frac{7}{2}$, Moving right: $0 \leq t < \frac{7}{2}$ Acceleration zero: Never, Slowing down: $0 \leq t < \frac{7}{2}$, Speeding up: $t > \frac{7}{2}$

4) $s(t) = t^4 - 14t^3$

$v(t) = 4t^3 - 42t^2, a(t) = 12t^2 - 84t$

Changes direction at: $t = \left\{ \frac{21}{2} \right\}$, Moving left: $0 < t < \frac{21}{2}$, Moving right: $t > \frac{21}{2}$ Acceleration zero at: $t = \{0, 7\}$, Slowing down: $7 < t < \infty$

$$5) s(t) = t^2 - 27t + 180$$

$$v(t) = 2t - 27, a(t) = 2$$

Changes direction at: $t = \left\{\frac{27}{2}\right\}$, Moving left: $0 \leq t < \frac{27}{2}$, Moving right: $t > \frac{27}{2}$

Acceleration zero: Never, Slowing down: $0 \leq t < \frac{27}{2}$, Speeding up: $t > \frac{27}{2}$

$$6) s(t) = -t^4 + 9t^3$$

$$v(t) = -4t^3 + 27t^2, a(t) = -12t^2 + 54t$$

Changes direction at: $t = \left\{\frac{27}{4}\right\}$, Moving left: $t > \frac{27}{4}$, Moving right: $0 < t < \frac{27}{4}$

Acceleration zero at: $t = \left\{0, \frac{9}{2}\right\}$, Slowing down: $\frac{9}{2} < t < 9$, Speeding up: $0 < t < \frac{9}{2}$

A particle moves along a vertical 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 down and moving up, the times t when the acceleration is 0, and the intervals of time when the particle is slowing down and speeding up.

$$7) s(t) = -t^2 + 13t - 36$$

$$v(t) = -2t + 13, a(t) = -2$$

Changes direction at: $t = \left\{\frac{13}{2}\right\}$, Moving down: $t > \frac{13}{2}$, Moving up: $0 \leq t < \frac{13}{2}$

Acceleration zero: Never, Slowing down: $0 \leq t < \frac{13}{2}$, Speeding up: $t > \frac{13}{2}$

$$8) s(t) = t^2 - 16t + 39$$

$$v(t) = 2t - 16, a(t) = 2$$

Changes direction at $t = \{8\}$, Moving down: $0 \leq t < 8$, Moving up: $t > 8$

Acceleration zero: Never, Slowing down: $0 \leq t < 8$, Speeding up: $t > 8$

$$9) s(t) = -t^2 + 12t + 28$$

$$v(t) = -2t + 12, a(t) = -2$$

Changes direction at: $t = \{6\}$, Moving down: $t > 6$, Moving up: $0 \leq t < 6$

Acceleration zero: Never, Slowing down: $0 \leq t < 6$, Speeding up: $t > 6$

$$10) s(t) = t^4 - 10t^3$$

$$v(t) = 4t^3 - 30t^2, a(t) = 12t^2 - 60t$$

Changes direction at: $t = \left\{\frac{15}{2}\right\}$, Moving down: $0 < t < \frac{15}{2}$, Moving up: $t > \frac{15}{2}$

Acceleration zero at: $t = \{0, 5\}$, Slowing down: $5 < t < 10$, Speeding up: $0 < t < 5$