

# Position, Velocity, and Acceleration

# Position, Velocity, Acceleration

1.  $x(t) = t^3 - 3t^2 - 24t + 10, \quad t = 0, 5$

$$v(t) = 3t^2 - 6t - 24$$

$$a(t) = 6t - 6$$

$$x(0) = 10$$

$$x(5) = -60$$

$$v(0) = -24$$

$$v(5) = 21$$

$$a(0) = -6$$

$$a(5) = 24$$

Resting Position

$$0 = 3t^2 - 6t - 24$$

$$0 = t^2 - 2t - 8$$

$$0 = (t - 4)(t + 2)$$

$$t = 4$$

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1.  $x(t) = t^3 - 3t^2 - 24t + 10, \quad t = 0, 5$

Displacement

$$\int_0^5 (3t^2 - 6t - 24) dt = \boxed{-70}$$

Total Distance

$$\int_0^4 \left| (3t^2 - 6t - 24) \right| dt + \int_4^5 \left| (3t^2 - 6t - 24) \right| dt = \boxed{90}$$

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2.  $x(t) = 6t + 3\cos(t) + 5, t = 0, \pi$

$$v(t) = 6 - 3\sin t$$

$$a(t) = -3\cos t$$

$$x(0) = 8$$

$$x(\pi) = 6\pi + 2$$

$$v(0) = 6$$

$$v(\pi) = 6$$

$$a(0) = -3$$

$$a(\pi) = 3$$

Resting Position

$$0 = 6 - 3\sin t$$

$$2 = \sin t$$

*none*

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2.  $x(t) = 6t + 3\cos(t) + 5, \quad t = 0, \pi$

Displacement

$$\int_0^{\pi} (6 - 3\sin t) dt = x(\pi) - x(0) = 6\pi - 6 \approx 12.849$$

Total Distance

$$\int_0^{\pi} |(6 - 3\sin t)| dt = 6\pi - 6 \approx 12.849$$

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3.  $v(t) = -6t^2 - 6t + 36, t = 0, 5$

Total Distance

$$0 = -6t^2 - 6t + 36$$

$$0 = t^2 + t - 6$$

$$t = 2$$

$$\int_0^2 |(-6t^2 - 6t + 36)| dt + \int_2^5 |(-6t^2 - 6t + 36)| dt = 233$$

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4.  $v(t) = 3t^2 - 12t - 15, \quad x(0) = 12$

$$x(t) = t^3 - 6t^2 - 15t + 12$$

$$a(t) = 6t - 12$$

Resting Position

$$0 = 3t^2 - 12t - 15$$

$$0 = t^2 - 4t - 5$$

$$0 = (t - 5)(t + 1)$$

$$t = 5$$

$$v(a(t) = 0)$$

$$0 = 6t - 12$$

$$v(2) = -27$$

$$x(5)$$

$$x(5) = -88$$