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14.4 Revisiting Linear Motion

Displacement $= s(t)$

Velocity $v(t) = \frac{ds}{dt} = s'(t)$

Acceleration $a(t) = \frac{dv}{dt} = v'(t) = s''(t)$

total distance from t_1 to $t_2 = \int_{t_1}^{t_2} |v(t)|\,dt$

Ex A particle moves along a horizontal line. the particle's displacement, in metres, from origin O is $s(t) = 5 - 2\cos(3t)$ in t seconds

a) Find the particle's velocity and accel. at any time t.

$$v(t) = s'(t) = -2(-\sin(3t))(3) = 6\sin(3t)$$

$$a(t) = v'(t) = 6\cos(3t)(3) = 18\cos(3t)$$

b) Find the initial displacement, vel., accel
$t = 0$

$$s(0) = 5 - 2\cos(3\cdot 0) = 5 - 2\cos(0) = 5 - 2(1) = 3\text{ m}$$

$$v(0) = 6\sin(3\cdot 0) = 6\sin(0) = 6(0) = 0\text{ ms}^{-1}$$

$$a(0) = 18\cos(0) = 18\cdot 1 = 18\text{ ms}^{-2}$$

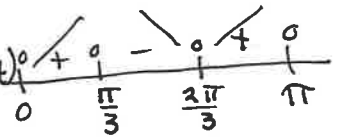
c) Find when part is moving $\rightarrow$, $\leftarrow$, stopped during time $0 \le t \le \pi$

For stopped: $v(t) = 0$

$6\sin(3t) = 0$

$\sin(3t) = 0$ $\quad 3t = 0, \pi, 2\pi, 3\pi$

$t = 0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi$



right when $v(t) > 0 \Rightarrow (0, \pi/3)$ and $(\frac{2\pi}{3}, \pi)$

left when $v(t) < 0 \Rightarrow (\pi/3, 2\pi/3)$

d) definite integral for total distance $0 \le t \le \pi$

$$\int_0^{\pi} |v(t)|\,dt = \int_0^{\pi} 6\sin(3t)\,dt = 6\int_0^{\pi} \sin(3t)\,dt$$

$$= \left[\frac{6}{3}(-\cos(3t))\right]_0^{\pi} = 12\text{m}$$

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