

1. (10 points) If a ball is thrown into the air with an initial velocity of 40 ft/s, its height in feet t seconds later is given by $y = 40t - 16t^2$.

- (a) Find the average velocity over the interval $[2, 3]$.

$$\begin{aligned} v_{\text{avg}} &= \frac{v(3) - v(2)}{3 - 2} = \frac{(40 \cdot 3 - 16 \cdot 3^2) - (40 \cdot 2 - 16 \cdot 2^2)}{3 - 2} \\ &= \frac{-24 - 16}{1} \\ &= -40 \text{ ft/sec.} \end{aligned}$$

- (b) Write the instantaneous velocity when $t = 2$ as a limit.

$$v_{\text{inst}} = \lim_{t \rightarrow 2} \frac{v(t) - v(2)}{t - 2} = \lim_{t \rightarrow 2} \frac{40t - 16t^2 - 16}{t - 2}$$

- (c) Evaluate the limit in (b).

$$\begin{aligned} v_{\text{inst}} &= \lim_{t \rightarrow 2} \frac{40t - 16t^2 - 16}{t - 2} \\ &= \lim_{t \rightarrow 2} \frac{(t - 2)(-16t + 8)}{t - 2} \\ &= \lim_{t \rightarrow 2} (-16t + 8) \\ &= -32 + 8 = -24 \text{ ft/sec.} \end{aligned}$$