

Rectilinear Motion

$s(t)$ position

$s'(t)$ velocity $v(t)$

$v'(t)$ accel. $a(t)$

$v(t) > 0$ mov. up | right

$v(t) < 0$ mov. down | left

$v(t) = 0$ rest

$v(t)$ changes sign $\rightarrow$ change direction

Gravity : $a(t)$ constant

$$-32 \text{ ft/s}^2$$

$$-9.8 \text{ m/s}^2$$

Find max ht

$$v(t) = 0 \rightarrow t = \star$$

$$s(\star) = \text{max ht.}$$

Find vel at impact

$$s(t) = 0 \rightarrow t = \Delta$$

$$v(\Delta) = \text{vel. at impact}$$

$$\text{speed} = |v|$$

- $v > 0 \quad a > 0 \quad v \uparrow \quad \text{speed} \uparrow$
- $v > 0 \quad a < 0 \quad v \downarrow \quad \text{speed} \downarrow$
- $v < 0 \quad a > 0 \quad v \uparrow \quad \text{speed} \downarrow$
- $v < 0 \quad a < 0 \quad v \downarrow \quad \text{speed} \uparrow$

$$s(t) = 2t^3 - 4t^2 + 2t - 1$$

$$v(t) = 6t^2 - 8t + 2$$

$$v(t) = 0 \rightarrow t = \frac{1}{3} \text{ or } t = 1$$

Part moving right on $(-\infty, \frac{1}{3}) \cup (1, \infty)$
because $v(t) > 0$ on $(-\infty, \frac{1}{3}) \cup (1, \infty)$.

Part moving left on $(\frac{1}{3}, 1)$ because
 $v(t) < 0$ on $(\frac{1}{3}, 1)$.

Part changes dir. at $t = \frac{1}{3}$ because

$$v(t) > 0 \text{ on } (-\infty, \frac{1}{3}) \text{ and } v(t) < 0 \text{ on } (\frac{1}{3}, 1).$$

Part changes dir at $t = 1$ because

$$v(t) < 0 \text{ on } (\frac{1}{3}, 1) \text{ and } v(t) > 0 \text{ on } (1, \infty).$$

$$s(t) = -16t^2 + 64t + 100$$

$$v(t) = -32t + 64$$

Max ht

$$v(t) = 0 \rightarrow t = 2$$

$$s(2) = -16(4) + 128 + 100 = 164$$

$\therefore$ max ht is 164 feet.

Vel at impact

$$s(t) = 0 \rightarrow t = -1.202 \text{ or } t = 5.202$$

$$v(5.202) = -102.450$$

$\therefore$ vel at impact is 102.450 ft/sec downward.