

Given:

$s(t)$  = height

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

$a(t) = s''(t)$  = acceleration

$s'''(t)$  = jerk

$$s(0) = 400 \text{ m}$$

$$v(0) = 0 \text{ m/s} = s'(0)$$

$$s''(0) = a(0) = -\frac{9.8 \text{ m}}{\text{s}^2} = a(t)$$

$$\rightarrow v(t) = s'(t) = -9.8 \frac{\text{m}}{\text{s}^2} t + C \quad \rightarrow v(0)$$

$$v(0) = 0 \Rightarrow C = 0$$

$$s'(t) = -9.8 t \frac{\text{m}}{\text{s}}$$

$$\Rightarrow s(t) = -\frac{9.8}{2} t^2 \text{ m} + D \quad \rightarrow s(0)$$

$$s(0) = -4.9 (0)^2 \text{ m} + D = D = 400$$

$$\Rightarrow s(t) = -4.9 t^2 + 400$$