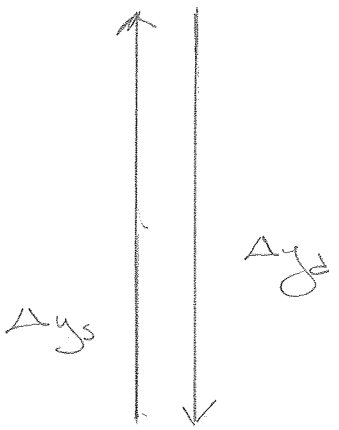
# Falling Object #6




$v_s = -340 \frac{m}{s}$

$t_{tot} = 6.0\,s$

$v_{0d} = 0\,m/s$

$t_{tot} = t_d + t_s \Rightarrow t_d = t_{tot} - t_s$

$\Delta y_d = v_{0d} t - \frac{1}{2} g t_d^2$ $\qquad \Delta y_s = v_s t + \frac{1}{2} a t^2$

$\Delta y_d = -\frac{1}{2} g t_d^2$ $\qquad \Delta y_s = v_s t_s$

$\Delta y_d = -\frac{1}{2} g (t_{tot} - t_s)^2 \Rightarrow t_s = \frac{\Delta y_s}{v_s}$

$= -\frac{1}{2} g \left(t_{tot} - \frac{\Delta y_s}{v_s}\right)^2$

$\Delta y_s = -\Delta y_d$

$\Delta y_d = -\frac{1}{2} g \left(t_{tot} - \frac{(-\Delta y_d)}{v_s}\right)^2$

$-\frac{2}{g} \Delta y_d = \left(t_{tot} + \frac{\Delta y_d}{v_s}\right)^2$

$-\frac{2}{g} \Delta y_d = t_{tot}^2 + \frac{2 t_{tot} \Delta y_d}{v_s} + \frac{\Delta y_d^2}{v_s^2}$

$\frac{1}{v_s^2} \Delta y_d^2 + \left(\frac{2 t_{tot}}{v_s} + \frac{2}{g}\right) \Delta y_d + t_{tot}^2 = 0$

$\Delta y_d^2 + \left(\frac{2 v_s^2 t_{tot}}{v_s} + \frac{2 v_s^2}{g}\right) \Delta y_d + v_s^2 t_{tot}^2 = 0$

$m^2 \qquad "m" \qquad m \qquad m^2$

$\Delta y_d^2 + 2 v_s^2 \left(\frac{g t_{tot} + v_s}{v_s g}\right) \Delta y_d + v_s^2 t_{tot}^2 = 0$

$\frac{m^2}{s^2} s^2$

$\frac{m^2}{s^2} \cdot \frac{m}{s^2}$

$\frac{m}{s^2} \cdot \frac{m}{s^2}$

$m^2 + "m" \cdot m + m^2 = 0$

$$v_s g\,\Delta y_d^2 + 2v_s^2(g t_{tot} + v_s)\Delta y_d + v_s^3 g t_{tot}^2 = 0$$

$$\Delta y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a = v_s g$

$b = 2v_s^2(g t_{tot} + v_s)$

$c = v_s^3 g t_{tot}^2$

$v_s = +340\ m/s$

$g = 9.8\ m/s^2$

$t_{tot} = 6.0\ s$

$$\Delta y = \frac{-2v_s^2(g t_{tot} + v_s) \pm \sqrt{4v_s^4(g t_{tot} + v_s)^2 - 4(v_s g) v_s^3 g t_{tot}^2}}{2 v_s g}$$

$$\Delta y = \frac{-2v_s^2(g t_{tot} + v_s) \pm 2v_s^2\sqrt{g^2 t_{tot}^2 + 2v_s g t_{tot} + v_s^2 - g^2 t_{tot}^2}}{2v_s g}$$

$\sqrt{\frac{m^2}{s^2}\frac{s^2}{s^2}} \quad \frac{m}{s}\frac{m}{s^2}\frac{s}{s} \quad \frac{m^2}{s^2} \quad \frac{m^2}{s^2}\frac{s^2}{s^2}$

$$\Delta y = \frac{-v_s(g t_{tot} + v_s) \pm v_s\sqrt{2v_s g t_{tot} + v_s^2}}{g}$$

$$\Delta y = -340\frac{m}{s}\left(9.8\frac{m}{s^2}(6.0s) + 340\frac{m}{s}\right) \pm 340\frac{m}{s}\sqrt{2\left(340\frac{m}{s}\right)\left(9.8\frac{m}{s^2}\right)(6.0s) + \left(340\frac{m}{s}\right)^2}$$

$9.8\ m/s^2$

$$\boxed{\Delta y = -151.\ m}$$