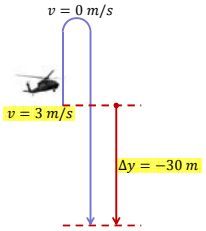
# Solving For Time When the Initial Velocity is Not Zero

- A stone is dropped from a helicopter while the helicopter is *rising* with a constant velocity of 3.0 m/s. If the stone was dropped from a height of 30.0 meters how long will it take for the rock to reach the ground?




$\Delta y = -30.0\ m$
$v_i = 3\ m/s$
$v_f =$
$a = -9.8\ m/s^2$
$t = ?$

$\Delta y = -30.0\ m$
$v_i = 3\ m/s$
$v_f = -24.43\ m/s$
$a = -9.8\ m/s^2$
$t = ?$

~~$\Delta y = v_i \cdot t + \frac{1}{2} a \cdot t^2$~~

$v_f^2 = v_i^2 + 2a \cdot \Delta y$

$v_f = v_i + a \cdot t$

$$v_f^2 = (3\ m/s)^2 + 2(-9.8\ m/s^2)(-30\ m)$$

$$v_f^2 = 9 + 588$$

$$v_f = \sqrt{597}$$

$$v_f = -24.43\ m/s$$

The rock is FALLING so the final velocity is negative

$\Delta y = -30.0\ m$
$v_i = 3\ m/s$
$v_f = -24.43\ m/s$
$a = -9.8\ m/s^2$
$t = ?$

$v_f = v_i + a \cdot t$

$$-24.43\ m/s = 3\ m/s + (-9.8\ m/s^2)t$$

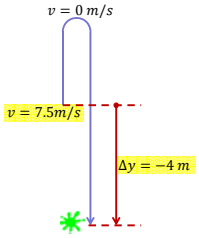
$$+9.8t = +24.43 + 3$$

$$t = \frac{27.43}{9.8}$$

$$\boxed{t = 2.8\ s}$$

## Sample Problem 2

Laying on the second floor in the F Wing a Bowie student spits up into to the air. The phlegm leaves his mouth at 7.50 m/s. How long do the unfortunate students 4.0 meters below have to get out of harm's way?




$\Delta y = -4.0\ m$
$v_i = 7.50\ m/s$
$v_f =$
$a = -9.8\ m/s^2$
$t = ?$

$\Delta y = -4\ m$
$v_i = 7.5\ m/s$
$v_f = -11.60\ m/s$
$a = -9.8\ m/s^2$
$t = ?$

~~$\Delta y = v_i \cdot t + \frac{1}{2} a \cdot t^2$~~

$v_f^2 = v_i^2 + 2a \cdot \Delta y$

$v_f = v_i + a \cdot t$

$$v_f^2 = (7.5\ m/s)^2 + 2(-9.8\ m/s^2)(-4\ m)$$

$$v_f^2 = 56.25 + 78.4$$

$$v_f = \sqrt{134.65}$$

$$v_f = -11.60\ m/s$$

The loogie is FALLING so the final velocity is negative

$\Delta y$ = *-4.0 m*
$v_i$ = *7.5 m/s*
$v_f$ = *-11.60 m/s*
$a$ = *-9.8 m/s²*
$t$ = *?*

$$v_f = v_i + a \cdot t$$

$$-11.60\, m/s = 7.5\, m/s + (-9.8\, m/s^2)t$$

$$+9.8t = +11.60 + 7.5$$

$$t = \frac{19.1}{9.8}$$

$$\boxed{t = 1.95\, s}$$

## Practice

- The cliff diving gazelle is at it again This time it jumps straight downward with a velocity of 4 m/s. If cliff was 30 meters high, how long was the gazelle in the air?