Key

Science 10

Worksheet: Freely Falling Bodies

1. A tourist drops a rock from rest from a guard rail overlooking a valley. What is the velocity of the rock after 4.0 s?

$\vec{v}_i = 0\ m/s$

$\vec{a} = -9.80\ m/s^2$

$t = 4.0\ s$

$\vec{v}_f = ?$

$\boxed{\vec{v}_f = \vec{v}_i + \vec{a}t}$

$\vec{v}_f = \vec{a}t$

$\vec{v}_f = \left(-9.80\ \frac{m}{s^2}\right)(4.0\ s)$

$\vec{v}_f = -39\ m/s$

The velocity after 4.0 s is 39 m/s, down.

2. Suppose the tourist in question #1 threw the rock downward. If the velocity of the rock was 47.2 m/s [down] after 4.0 s, what was the initial velocity of the rock?

$\vec{v}_i = ?$

$\vec{a} = -9.80\ m/s^2$

$t = 4.0\ s$

$\vec{v}_f = -47.2\ \frac{m}{s}$

$\vec{v}_f = \boxed{\vec{v}_i} + \vec{a}t$

$\vec{v}_f - \vec{a}t = \vec{v}_i$

$\left(-47.2\ \frac{m}{s}\right) - \left(-9.80\ \frac{m}{s^2}\right)(4.0\ s) = \vec{v}_i$

$\vec{v}_i = -8.0\ m/s$

The initial velocity was 8.0 m/s, down.

3. Suppose the tourist in question #1 threw the rock with an initial velocity of 8.0 m/s [up]. Determine the velocity of the rock after 4.0 s.

$\vec{v}_i = +8.0\ m/s$

$\vec{a} = -9.80\ m/s^2$

$t = 4.0\ s$

$\vec{v}_f = ?$

$\boxed{\vec{v}_f} = \vec{v}_i + \vec{a}t$

$\vec{v}_f = \left(+8.0\ \frac{m}{s}\right) + \left(-9.80\ \frac{m}{s^2}\right)(4.0\ s)$

$\vec{v}_f = -31\ m/s$

The velocity after 4.0 s was 31 m/s, down.

(The rock reached its highest point and was moving downward after 4.0 s.)

$\vec{V}_i = 15\,m/s$ initial vel = +15 m/s

4. A man throws a rock upward with an initial speed of 15 meters per second. Determine the time that it takes for the rock to reach its maximum height.

$\vec{V}_f = 0\,m/s$ max height

$\vec{V}_i = +15\,m/s$

$\vec{a} = -9.80\,m/s^2$

$\vec{V}_f = 0\,m/s$

$t = ?$

$\vec{V}_f = \vec{V}_i + \vec{a}t$

$0 = \vec{V}_i + \vec{a}t$

$-\vec{V}_i = \vec{a}t$

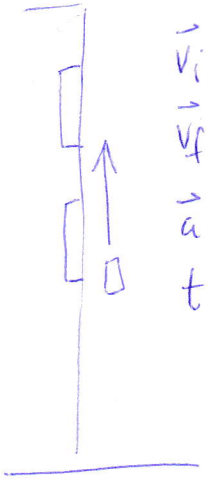
$t = \dfrac{-\vec{V}_i}{\vec{a}}$

$t = \dfrac{-(+15\,m/s)}{-9.80\,m/s^2}$

$t = 1.5\,s$

It takes 1.5 s for the rock to reach its maximum height.

5. A college student wants to toss a textbook to his roommate who is leaning out of a window directly above him. He throws the book upwards with an initial velocity of 8.0 m/s. The roommate catches it while it is travelling at 3.0 m/s [up]. How long was the book in the air?



$\vec{V}_i = +8.0\,m/s$

$\vec{V}_f = +3.0\,m/s$

$\vec{a} = -9.80\,m/s^2$

$t = ?$

$\vec{V}_f = \vec{V}_i + \vec{a}t$

$\vec{V}_f - \vec{V}_i = \vec{a}t$

$\dfrac{\vec{V}_f - \vec{V}_i}{\vec{a}} = \dfrac{\vec{a}t}{\vec{a}}$

$t = \dfrac{\vec{V}_f - \vec{V}_i}{\vec{a}}$

$t = \dfrac{\left(+3.0\,\frac{m}{s} - \left(+8.0\,\frac{m}{s}\right)\right)}{-9.80\,\frac{m}{s^2}}$

$t = 0.51\,s$

The book was in the air for 0.51 s.