

# Algebra Essentials and Applications Internet Activity

## ME1 Motion Equations Investigations

The equations that model motion are given by:

$$\begin{array}{l}
 s = s_0 + v_0t + \frac{1}{2}\alpha t^2 \\
 v = v_0 + \alpha t
 \end{array}
 \quad \text{where} \quad
 \left\{ \begin{array}{l}
 t \text{ is time} \\
 s \text{ is altitude} \\
 s_0 \text{ is the initial altitude} \\
 v \text{ is velocity} \\
 v_0 \text{ is the initial velocity} \\
 \alpha \text{ is acceleration}
 \end{array} \right.$$

For example, suppose someone is standing on an eighty-foot cliff ( $s_0 = 80$ ) overlooking a lake and throws a rock in the air at the speed sixty-four feet per second ( $v_0 = 64$ ). In terms of feet and seconds,  $\alpha = -32$ . (If the units are meters and seconds,  $\alpha = -9.8$ .) The motion equations become:

$$\begin{array}{l}
 s = 80 + 64t - 16t^2 \\
 v = 64 - 32t
 \end{array}$$

A model rocket is fired at 192 feet per second upward from the ground.

1. Since the rocket is fired from the ground, what is the initial altitude,  $s_0$ ?

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2. What is the initial velocity,  $v_0$ ?

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3. What is the equation for the altitude,  $s$ ?

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4. Using your equation for  $s$ , fill in the table below.

$t$	0	2	4	6	8	10	12
$s$	0						

5. Plot the points and graph the equation. What kind of curve is your graph?

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6. When does the rocket return to the ground?

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7. Based on the numbers in your table and your graph, when does it appear that the rocket reaches its maximum altitude? What is the maximum altitude?

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8. What is the equation for velocity,  $v$ ?

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9. What is the velocity of the rocket when it blasts off? Using your answer to Exercise 6, what is the velocity of the rocket when it returns to the ground? If there is a difference in signs, what does that mean?

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10. Using the result from Exercise 8, solve the equation  $v = 0$  to find when the maximum altitude occurs. Does this answer agree with the answer to Exercise 7?

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