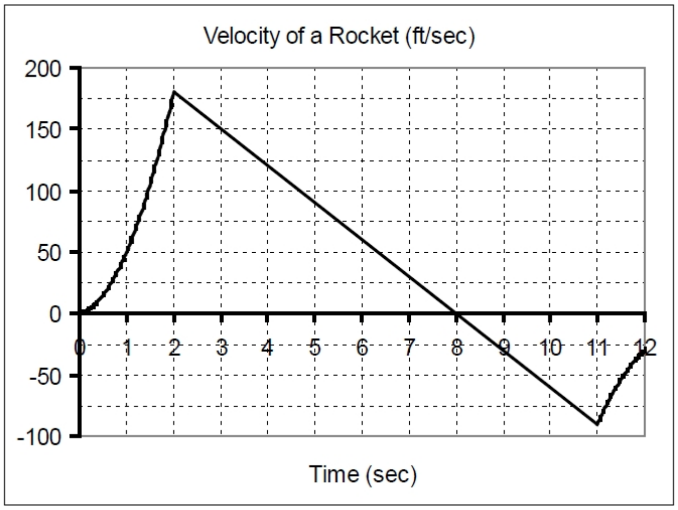
Section 5.3

Rocket Problem

When a model rocket is launched, the fuel burns for a few seconds, accelerating the rocket upwards. After burnout, the rocket coasts upward for a while and then begins to fall. A parachute is deployed shortly after the rocket starts to fall in order to slow it down. Use the graph below to answer the following questions. Be sure to include units in your answers.



1. How fast was the rocket traveling 4 seconds after it was launched?

2. Was the rocket going up or down 6 seconds after it was launched? How do you know?

3. When did the rocket reach its highest point? How high did it go?

4. When was the parachute deployed? How do you know?

5. Estimate $\int_6^{10} v(t)dt$ and give a practical interpretation.

6. Estimate $\int_6^{10} |v(t)|\, dt$ and give a practical interpretation.

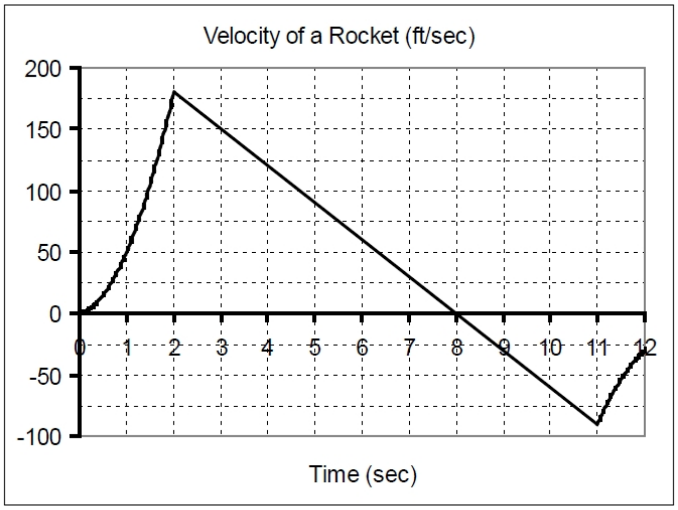
7. Find the average velocity over the first 8 seconds.

8. Find $v'(6)$ and give a practical interpretation.

9. Find the average acceleration over the first 8 seconds.

Solutions. Note, since these values are approximated from the graph, your answers may vary slightly!

When a model rocket is launched, the fuel burns for a few seconds, accelerating the rocket upwards. After burnout, the rocket coasts upward for a while and then begins to fall. A parachute is deployed shortly after the rocket starts to fall in order to slow it down. Use the graph below to answer the following questions. Be sure to include units in your answers.



1. How fast was the rocket traveling 4 seconds after it was launched?

$$v \approx 120 \text{ ft/sec}$$

2. Was the rocket going up or down 6 seconds after it was launched? How do you know?

   The rocket was going up because $v(6)$ is positive.

3. When did the rocket reach its highest point? How high did it go?

$$t \approx 8 \text{ sec} \qquad \int_0^8 v(t)dt \approx 675 \text{ ft.}$$

4. When was the parachute deployed? How do you know?

   At $t \approx 8$ seconds since $v(t)$ becomes less negative.

5. Estimate $\int_6^{10} v(t)dt$ and give a practical interpretation.

   $\int_6^{10} v(t)dt \approx 0$ feet. The rocket is at the same height at 6 seconds and at 10 seconds.

6. Estimate $\int_6^{10} |v(t)|\, dt$ and give a practical interpretation.

   $\int_6^{10} |v(t)|\, dt \approx 120$ feet. The rocket traveled a total distance of 120 feet between 6 and 10 seconds.

7. Find the average velocity over the first 8 seconds.

$$\frac{\Delta s}{\Delta t} = \frac{s(8) - s(0)}{8 - 0} \approx \frac{675}{8} \text{ ft/sec}$$

8. Find $v'(6)$ and give a practical interpretation.

$$v'(6) \approx -\frac{175}{6} \text{ ft/sec}^2$$

9. Find the average acceleration over the first 8 seconds.

$$\frac{\Delta v}{\Delta t} = \frac{v(8) - v(0)}{8 - 0} \approx 0 \text{ ft/sec}^2$$