Chapter 1 Project ➤ Finding Falling Times Numerically

For many problems, you can gain insight by using a numerical approach instead of, or in addition to, using an algebraic approach or a graphical approach.

Example ➤ Finding the Falling Time for an Object

An astronaut standing on the surface of the moon throws a rock at a height of 6 feet into space. The height $s$ of the rock can be modeled by the position equation

$$s = -2.7t^2 + 27t + 6$$

where $t$ is the falling time in seconds. How much time will elapse before the rock strikes the lunar surface?

Solution

To solve this problem numerically, create a table showing the height of the rock for different times, as shown below. As you can see, the time $t$ that corresponds to a height of $s = 0$ is $t \approx 10.2$ seconds.

<table>
<thead>
<tr>
<th>Time, $t$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height, $s$</td>
<td>6</td>
<td>30.3</td>
<td>49.2</td>
<td>62.7</td>
<td>70.8</td>
<td>73.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time, $t$</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>10.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height, $s$</td>
<td>70.8</td>
<td>62.7</td>
<td>49.2</td>
<td>30.3</td>
<td>6</td>
<td>0.492</td>
</tr>
</tbody>
</table>

Chapter Project Investigations

1. Use the model and table in the example.
   (a) Find the average velocity of the rock during its first second of fall.
   (b) Was the rock falling faster during its next second of fall? Explain.
   (c) Find the height of the rock after 10.1 seconds.
   (d) Using part (c), approximate the terminal velocity of the rock.

2. If the rock had been thrown on Earth, the height $s$ of the rock would be modeled by the position equation

$$s = -16t^2 + 27t + 6.$$ 

where $t$ is the falling time in seconds. Use this model to create a table to find how much time will elapse before the rock strikes Earth’s surface.

3. Solve the equation from Question 2 algebraically. Do you obtain the same answer?