Exercise 9

If a rock is thrown vertically upward from the surface of Mars with velocity 15 m/s, its height after t seconds is is $h = 15t - 1.86t^2$.

(a) What is the velocity of the rock after 2 s?

(b) What is the velocity of the rock when its height is 25 m on its way up? On its way down?

Solution

Part (a)

To determine the velocity, take the derivative of the position function.

$$\begin{aligned} v(t) &= \frac{dh}{dt} \\ &= \frac{d}{dt}(15t - 1.86t^2) \\ &= 15 - 3.72t \end{aligned}$$

After 2 seconds, the velocity is

$$v(2) = 15 - 3.72(2) = 7.56 \ \frac{\text{m}}{\text{s}}.$$

Part (b)

Start by finding out when the rock is 25 meters above the surface: Set $h(t) = 25$ and solve the equation for t.

$$h(t) = 25$$

$$15t - 1.86t^2 = 25$$

$$1.86t^2 - 15t + 25 = 0$$

$$t = \frac{15 \pm \sqrt{15^2 - 4(1.86)(25)}}{2(1.86)}$$

$$t \approx \{2.3535, 5.71102\}$$

Since the rock is thrown vertically upward, the rock is on its way up at $t \approx 2.3535$ and is on its way down at $t \approx 5.71102$. Plug these two times into the velocity function.

$$\text{On its way up:} \qquad v(2.3535) \approx 15 - 3.72(2.3535) \approx 6.245 \ \frac{\text{m}}{\text{s}}$$

$$\text{On its way down:} \qquad v(5.71102) \approx 15 - 3.72(5.71102) = -6.245 \ \frac{\text{m}}{\text{s}}$$