Exercise 91

A rocket is launched in the air. Its height, in meters above sea level, as a function of time, in seconds, is given by $h(t) = -4.9t^2 + 229t + 234$. Find the maximum height the rocket attains.

Solution

Complete the square to write the quadratic function in vertex form.

$$h(t) = -4.9t^2 + 229t + 234$$

$$= -4.9\left(t^2 - \frac{2290}{49}t - \frac{2340}{49}\right)$$

$$= -4.9\left[\left(t^2 - \frac{2290}{49}t + \frac{1145^2}{49^2}\right) - \frac{2340}{49} - \frac{1145^2}{49^2}\right]$$

$$= -4.9\left[\left(t - \frac{1145}{49}\right)^2 - \frac{1\,425\,685}{2401}\right]$$

$$= -4.9\left(t - \frac{1145}{49}\right)^2 + \frac{285\,137}{98}$$

Therefore, the maximum height the rocket attains is $h = \frac{285\,137}{98} \approx 2909.56$ m, which occurs at $t = \frac{1145}{49} \approx 23.37$ s.