

## Exercise 92

A ball is thrown in the air from the top of a building. Its height, in meters above ground, as a function of time, in seconds, is given by  $h(t) = -4.9t^2 + 24t + 8$ . How long does it take to reach maximum height?

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### Solution

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

$$\begin{aligned}h(t) &= -4.9t^2 + 24t + 8 \\&= -4.9 \left( t^2 - \frac{240}{49}t - \frac{80}{49} \right) \\&= -4.9 \left[ \left( t^2 - \frac{240}{49}t + \frac{120^2}{49^2} \right) - \frac{80}{49} - \frac{120^2}{49^2} \right] \\&= -4.9 \left[ \left( t - \frac{120}{49} \right)^2 - \frac{18\,320}{2401} \right] \\&= -4.9 \left( t - \frac{120}{49} \right)^2 + \frac{1832}{49}\end{aligned}$$

Therefore, the maximum height the ball attains is  $h = \frac{1832}{49} \approx 37.39$  m, which occurs at  $t = \frac{120}{49} \approx 2.45$  s.