4. [7 points] Dog owner Malik recently bought an Extra-High-Flying Ball$^{\text{TM}}$ at the *Math-tas-tíque Dog Boutique* for his extra-high-jumping Jack Rusell Terrier.

On one particular throw, the ball's height, in feet, is given by:

$$h(t) = -16(t + \tfrac{1}{8})(t - 3),$$

where t is the number of seconds after the ball left Malik's hand.

a. [2 points] At what height was the ball when it was released Malik's hand?
Show all work. Give your final answer in decimal form, NOT exact form.

Solution: Since t is the number of seconds since the ball left Malik's hand, we are looking to compute $h(0)$. We get

$$-16(0 + \frac{1}{8})(0 - 3) = 6$$

height: **6** feet

b. [3 points] What is the maximum height the ball reached and at what time did it reach that height?
Show all work. Give your final answer in decimal form, NOT exact form.

Solution: We are essentially trying to find the coordinates (t, h) of the vertex of this parabola. One way to do this it to utilize the natural symmetry of a parabola. A parabola is symmetric across the vertical line going through its vertex. Since the two zeros will be symmetrical about that line of symmetry, this means that the t-coordinate of the vertex (or the time of maximum height) will be the midpoint of the two zeros.
From the factored form of the function given to us, we can see that the zeros are at $t = -\frac{1}{8}, 3$. The midpoint of these two values can be found using the same method we use to find an average of two numbers:

$$\frac{3 + \left(-\frac{1}{8}\right)}{2} = 1.4375$$

To find the actual maximum height acheived we need to plug that t-value into the original function $h(t)$:

$$-16(1.4375 + \tfrac{1}{8})(1.4375 - 3) = 39.0625$$

height: **39.0625** feet

time: **1.4375** seconds

c. [2 points] Assuming the ball wasn't caught on its way down, how many seconds, total, was the ball in the air?

Solution: Since the ball is in the air starting at $t = 0$ until the time it hits the ground at $t = 3$ (one of the zeros of our function), it is in the air for 3 seconds total before hitting the ground.

time in the air: **3** seconds