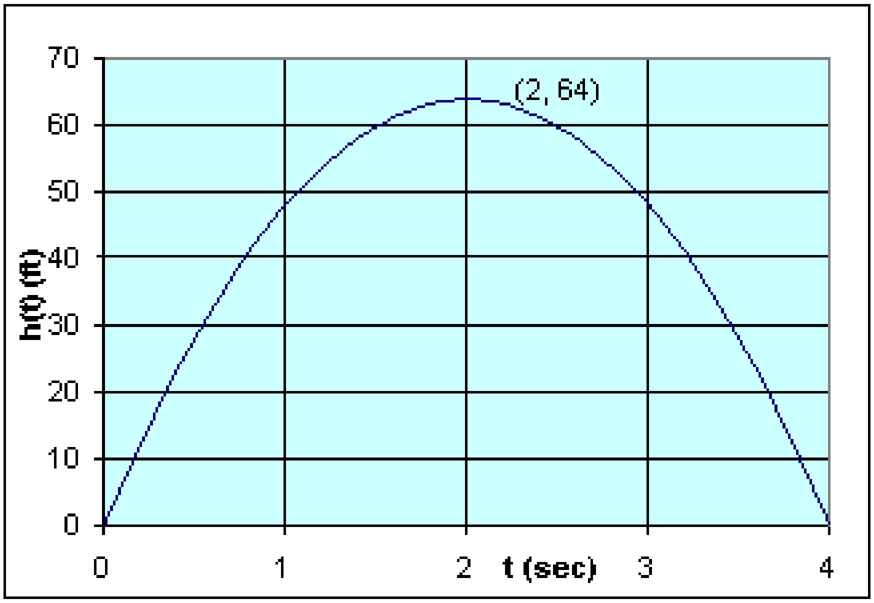
1. a. The graph of $h(t)$ is below. The ball hits the ground at $t = 4$ sec, and the maximum height occurs at $t = 2$ with $h(2) = 64$ ft.

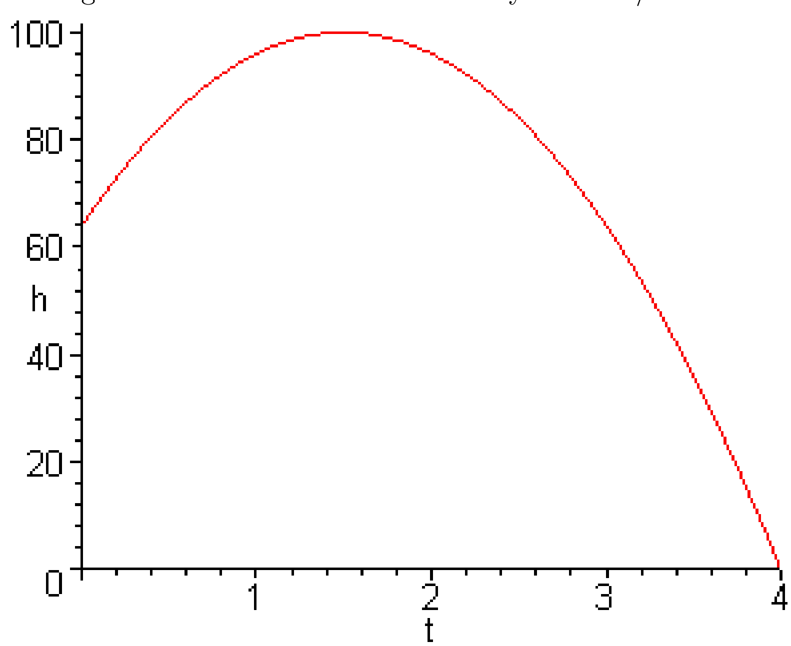
b. The average velocity for $t \in [0,1]$ is 48 ft/sec, for $t \in [1,2]$ is 16 ft/sec, and for $t \in [2,4]$ is -32 ft/sec.



2. a. The average velocity for $t \in [0,2]$ is 16 ft/sec and for $t \in [2, 2.5]$ is -24 ft/sec. Find the average velocity of the ball for the first two seconds. Also, find the average velocity between times $t = 2$ and $t = 2.5$.

b. The maximum height of the ball is at 1.5 sec when the height is 100 ft. A sketch of the graph for the flight of the ball is below.

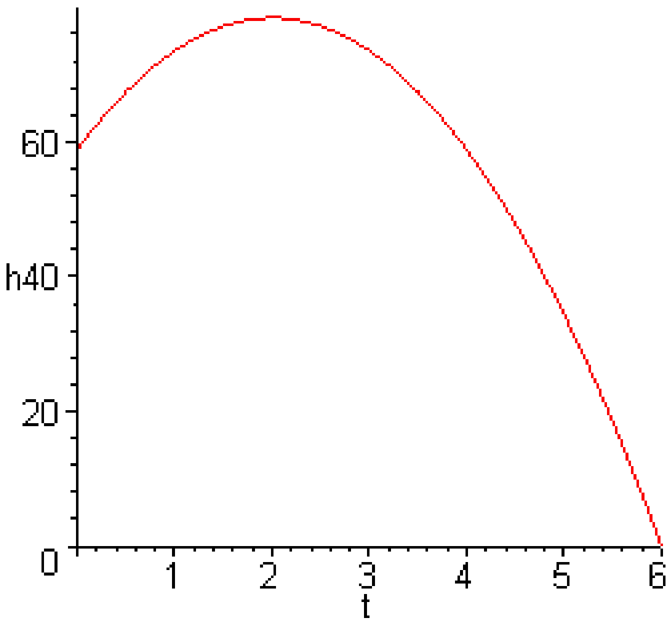
c. The ball hits the ground at $t = 4$ sec with a velocity of -80 ft/sec.

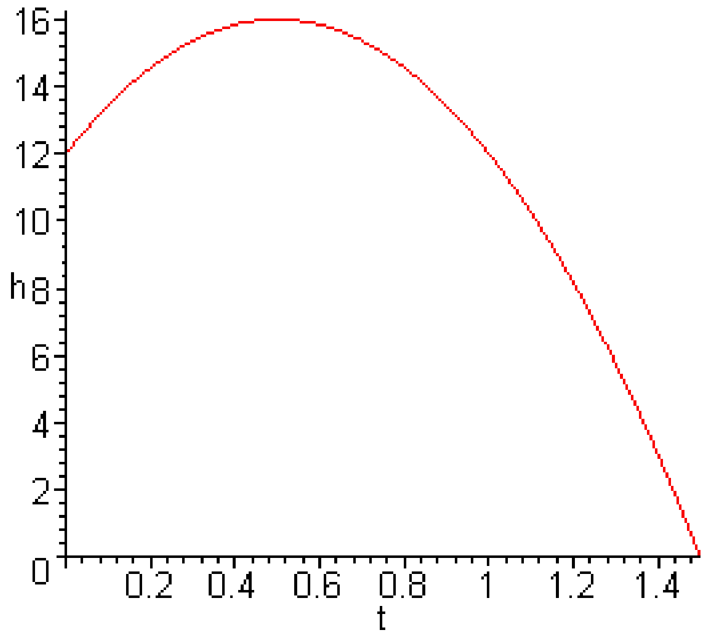


3. a. The average velocity for $t \in [0, 1]$ is 14.7 m/sec, for $t \in [1, 2]$ is 4.9 m/sec, $t \in [2, 3]$ is -4.9 m/sec, $t \in [3, 4]$ is -14.7 m/sec, and $t \in [4, 5]$ is -24.5 m/sec.

b. The maximum height of the object occurs at $t = 2$ sec with $h(2) = 78.4$ m. The object hits the ground at $t = 6$ sec. A sketch of the graph for the height of the object is below to the left.

c. The average velocity between $t = 4$ and $t = 4 + \Delta t$ is $v_{ave} = -19.6 - 4.9\Delta t$, which for small Δt gives $v(4) = -19.6$ m/sec.





4. a. The cat achieves its maximum height at $t = 0.5$ sec with a maximum height of 16 ft, so the cat cannot reach the bird.

b. The average velocity of the cat for the intervals $t \in [0, \frac{1}{2}]$ is 8 ft/sec, $t \in [\frac{1}{2}, 1]$ is -8 ft/sec, and $t \in [1, \frac{3}{2}]$ is -24 ft/sec.

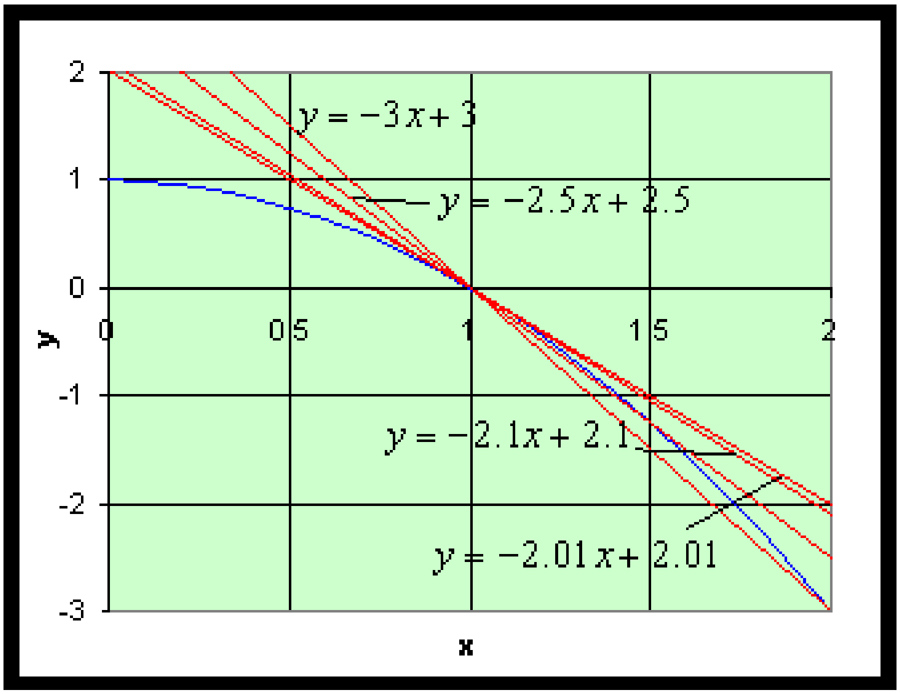
c. The cat hits the ground at $t = 1.5$ sec with a velocity of $v(1.5) = -32$ ft/sec. A sketch of the graph for the height of the cat as a function of t is above to the right.

5. a. The kangaroo jumps with an initial upward velocity of $v_0 = 280\sqrt{6} \simeq 685.9$ cm/sec and stays in the air for $t = \frac{4}{7}\sqrt{6} \simeq 1.40$ sec.

b. The average velocity of the kangaroo between $t = 0$ and $t = 1$ is $v_{ave} = 280\sqrt{6} - 490 \simeq 195.9$ cm/sec.

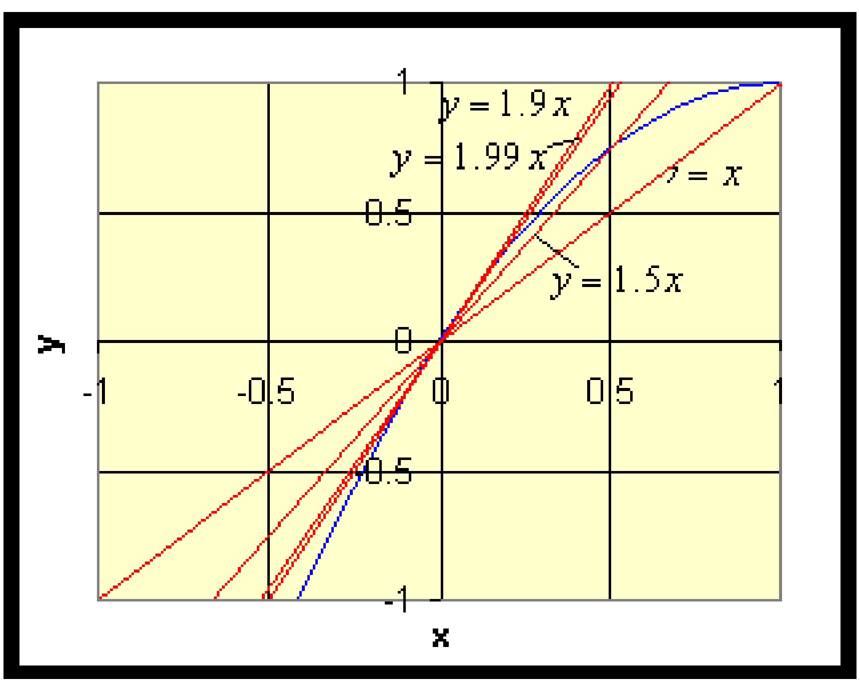
6. a. The sequence of secant lines is given by $y_2 = -3x+3$, $y_{1.5} = -2.5x+2.5$, $y_{1.1} = -2.1x+2.1$, and $y_{1.01} = -2.01x + 2.01$. Below is a graph of the secant lines.

b. The tangent line at $x = 1$ is $y = -2x + 2$. The slope at $x = 1$ is -2, so the derivative of $f(x)$ at $x = 1$ is -2.



7. a. The sequence of secant lines is given by $y_1 = x$, $y_{0.5} = 1.5x$, $y_{0.1} = 1.9x$, and $y_{0.01} = 1.99x$. Below is a graph of the secant lines.

b. The tangent line at $x = 0$ is $y = 2x$. The slope at $x = 0$ is 2, so the derivative of $f(x)$ at $x = 0$ is 2.



8. a. The secant line is $y = (2 + \Delta x)x + 1 - \Delta x$. As $\Delta x \to 0$, the slope of the tangent line is given by $m_t = 2$.

b. The secant line is $y = (1 - \Delta x)x + 1 + \Delta x$. As $\Delta x \to 0$, the slope of the tangent line is given by $m_t = 1$.

c. The secant line is $y = \frac{2}{\sqrt{4+2\Delta x}+2}x + 2 - \frac{2}{\sqrt{4+2\Delta x}+2}$. As $\Delta x \to 0$, the slope of the tangent line is given by $m_t = \frac{1}{2}$.

d. The secant line is $y = 3x - 4$, which is the same as the function. The slope of the tangent line is $m_t = 3$.

e. The secant line is $y = -\frac{1}{2(2+\Delta x)}x + \frac{1}{2} + \frac{1}{2(2+\Delta x)}$. As $\Delta x \to 0$, the slope of the tangent line is given by $m_t = -\frac{1}{4}$.

f. The secant line is $y = \frac{3}{1-\Delta x}x + 3 - \frac{3}{1-\Delta x}$. As $\Delta x \to 0$, the slope of the tangent line is given by $m_t = 3$.