1) Find formulas for the following linear functions:

- a) This function has a slope \( \frac{1}{2} \) and passes through the point \((-2, -7)\) \(\Rightarrow y + 7 = \frac{1}{2}(x + 2)\)
- b) This function has a slope of 7 and x-intercept of 9. \(y - 0 = 7(x - 9)\) \(\Rightarrow (9, 0)\)
- c) A line is perpendicular to the line \(y = 2x - 4\) and passes through the point \((-5, 6)\) \(\Rightarrow m: 2 \Rightarrow m \perp = -\frac{1}{2} \Rightarrow y - 6 = -\frac{1}{2}(x + 5)\)
- d) In this function, \(f(-2) = 3\) and \(f(-4) = 7\).

\[
\begin{align*}
(2, 3) & \quad (4, 7) \\
\Rightarrow m = \frac{-2 - 3}{2 - 7} & \Rightarrow y - 3 = -2(x + 2) \\
\Rightarrow m = \frac{-7 - 4}{2} & \Rightarrow y - 7 = -2(x + 4)
\end{align*}
\]

2) Find the average rate of change of for each of the following:

- a) \(f(x) = 2x^2 - 5x\) on the x-interval from \([-1, 4]\) and \([x, x+h]\).
  \[
  \frac{f(x+h) - f(x)}{h} = \frac{(2x+h)^2 - 5(x+h) - (2x^2 - 5x)}{h} = \frac{2x^2 + 4xh + h^2 - 5x - 5h - 2x^2 + 5x}{h} = \frac{4xh + h^2 - 5h}{h} = \frac{4x + h - 5}{4x + h - 5}
  \]
- b) Based on your answer from a), what is \(f'(x)\)?
  \[
  \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = 4x - 5 \quad \text{so} \quad f'(x) = 4x - 5
  \]
- c) Use the population data below to find the average rate of change in population between the years 2000 and 2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2004</th>
<th>2008</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>10,200</td>
<td>13,550</td>
<td>16,700</td>
<td>19,800</td>
</tr>
</tbody>
</table>

\[
\frac{19,800 - 10,200}{2012 - 2000} = \frac{9,600}{12} = 800
\]

3) The wild rabbits of Australia have recently been seriously threatened by a virus that was accidentally released into their population.

Suppose that the following table gives \(r\), the number of rabbits (in millions) remaining \(t\) months after the release of the virus.

<table>
<thead>
<tr>
<th>(t ) (months)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>(r) (millions)</td>
<td>1940</td>
<td>1842</td>
<td>1649</td>
<td>1328</td>
<td>1140</td>
<td>989</td>
<td>765</td>
<td>502</td>
<td>296</td>
<td>104</td>
</tr>
</tbody>
</table>

- a) Assuming linearity, express \(r\) as a function of \(t\).
  \[
  r(t) = -106.097t + 2213.466
  \]

- b) Use the linear model found in part (a) to estimate the rabbit population 15 months after the release of the virus.

\[
\text{Estimated rabbit population} = 422 \text{ millions}
\]

- c) What is the physical significance of the slope? How the rabbit pop is changing per year?

\[
\text{Slope: losing 106.097 million rabbits/year.}
\]

- d) What are \(t\) and \(r\) intercepts, and their significance?

\[
\text{\(t\)-intercept: 20.86 (4 years until 0 rabbits remain)}
\quad \text{\(r\)-intercept: 2213 (initial rabbit pop.)}
\]

- e) Evaluate and interpret \(f(-1)\).

\[
\text{The } \# \text{ of rabbit present 1 month before we started tracking the data.}
\]

\[
\text{The } \# \text{ of rabbit present 1 month before we started tracking the data.}
\]

\[
\text{The } \# \text{ of rabbit present 1 month before we started tracking the data.}
\]
4) A ball is thrown straight up in the air. The velocity of the ball, in feet per second, is given by the equation: \( v(t) = -32t + 40 \).

a) Evaluate and interpret \( v(3) \).
\[
-32(3) + 40 = 4
\]

b) Evaluate and interpret the slope and both intercepts of \( v(t) \).
\[
\begin{align*}
\text{Initial velocity} & \quad \text{when} \ t = 0 \quad \Rightarrow \quad v(0) = 40 \\
\text{Time when speed is 0} & \quad \Rightarrow \quad t = 1.25
\end{align*}
\]

5) Let \( v(t) \) give the value of a 1987 Honda Civic \( t \) years after it was first purchased. Suppose that in 1991 the car’s value was $5500 and that its 1995 value is $3000.

\[
\begin{align*}
\text{Value} & = 5500 \quad \text{at} \ t = 4 \\
\text{Value} & = 3000 \quad \text{at} \ t = 8
\end{align*}
\]

a) If the Civic depreciates in value at a constant annual rate, find a formula for \( v(t) \).
\[
\begin{align*}
\frac{5500 - 3000}{4} & = 625 \\
\therefore \quad \frac{5500 - 3000}{8} & = 625
\end{align*}
\]

b) What is the financial significance of the slope of your formula? $625 per year

c) What is the financial significance of the \( v \)-intercept and the \( t \)-intercept of your graph?
\[
\begin{align*}
\text{Initial Value} & = 5500 \\
\text{Time} & = 12.8 \quad \text{(The time it takes for the car to reach a value of 0.)}
\end{align*}
\]

6) The number of pairs of shoes, \( S \), in thousands, that suppliers are willing to produce for a price \( p \) is given by the function: \( S(p) = \frac{1}{2} p - 5 \).

The number of pairs of shoes, \( C \), in thousands, that consumers are willing to buy at price \( p \) is given by the function \( C(p) = \frac{-2}{5} p + 40 \).

a) Evaluate and interpret \( S(50) = 20 \).

b) What is the significance of the slope in each of the two equations?

c) What is the significance of the \( p \) and \( S \) intercepts?

d) What is the significance of the \( p \) and \( C \) intercepts?

e) At what price will the number of shoes the suppliers are willing to produce (supply) equal the number of shoes the consumers are willing to buy (demand)?

\[
\begin{align*}
\text{At} \quad p = 50, \quad \text{the initial cost to the company to make the product}.
\end{align*}
\]