Section 1.3

Linear Function
A linear function is one that can be written in the form

\[ f(x) = mx + b \quad \text{or} \quad y = mx + b \]

where \( m \) is the slope and \( b \) is the \( y \)-intercept (when \( x = 0 \)) of the linear function.

The Slope \( m \)
The slope of a line between two points \((x_1, y_1)\) and \((x_2, y_2)\) is given by the following formula:

\[ m = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \]

Finding the Intercepts
The \( x \)-intercept of a line is where it crosses the \( x \)-axis. To find it, set \( y = 0 \) and solve for \( x \). The \( y \)-intercept is where it crosses the \( y \)-axis. To find it, set \( x = 0 \) and solve for \( y \). If the equation of the line is \( y = mx + b \) then \( b \) is the \( y \)-intercept.

Problem 1. Find \( f(0) \), and then find the equation of the given linear function.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

Problem 2. Decide which of the two given functions is linear.

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>( g(x) )</td>
<td>-1</td>
<td>8</td>
<td>14</td>
<td>17</td>
<td>26</td>
</tr>
</tbody>
</table>
Problem 3. Find the slope of the given line, if it is defined. Graph the equation.

a) \[ y = \frac{2}{3} x + 4 \]

b) \[ 6x - 3y = 1 \]

c) \[ 3x + 1 = 0 \]

d) \[ 3y + 1 = 0 \]
**Problem 4.** Find a linear equation whose graph is the straight line with the given properties.

a) Through $(1, 3)$ with slope 3

b) Through $\left(\frac{1}{2}, 1\right)$ and $\left(-\frac{1}{2}, \frac{3}{4}\right)$

c) Through $\left(\frac{1}{3}, -1\right)$ and parallel to the line $3x - 4y = 8$

**Problem 5.** The RideEm Bicycles factory can produce 100 bicycles in a day at a total cost of $10,500 and it can produce 120 bicycles a day at a total cost of $11,000. What are the company’s daily fixed costs, and what is the marginal cost per bicycle?

**Problem 6.** The following table shows worldwide sales of Nokia cell phones and their average wholesale process in 2004.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Second</th>
<th>Fourth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale Price ($)</td>
<td>111</td>
<td>105</td>
</tr>
<tr>
<td>Sales (millions)</td>
<td>45.4</td>
<td>51.4</td>
</tr>
</tbody>
</table>

a) Use the data to obtain a linear demand function for (Nokia) cell phones, and use your demand equation to predict sales if Nokia lowered the price further to $103.

b) Fill in the blanks: For every ______ increase in price, sales of cell phones decrease by ______ units.
**Problem 7.** You can sell 90 pet chias per week if they are marked at $1 each, but only 30 each week if they are marked at $2 per chia. Your chia supplier is prepared to sell you 20 chias each week if they are marked at $1/chia, and 100 each week if they are marked at $2 per chia.

a) Write down the associated linear demand and supply functions.

b) At what price should the chias be marked so that there is neither a surplus nor a shortage of chias?

**Problem 8.** The position of a model train, in feet along a railroad track, is given by

\[ s(t) = 2.5t + 10 \]

after \( t \) seconds.

a) How fast is the train moving?

b) Where is the train after 4 seconds?

c) When will it be 25 feet along the track?