Section 1.1

24. (10 points) Temperature readings \( T \) (in \( ^\circ F \)) were recorded every two hours from midnight to 2:00 Pm in Phoenix on September 10, 2008. The time \( t \) was measured in hours from midnight.

\[
\begin{array}{|c|c|c|c|c|c|c|c|c|}
\hline
\text{t} & 0 & 2 & 4 & 6 & 8 & 10 & 12 & 14 \\
\text{T} & 82 & 75 & 74 & 75 & 84 & 90 & 93 & 94 \\
\hline
\end{array}
\]

a) Use the readings to sketch the graph of \( T \) as a function of \( t \)
b) Use your graph to estimate the temperature at 9:00 am.

Solution:
a) The graph is shown on the Figure 1.

b) The temperature at 8am is 84\(^\circ F\) and the temperature at 10am is 90\(^\circ F\). By looking at the graph, we conclude that the temperature at 9am is approximately the average of these two temperatures, that is, 87\(^\circ F\). The corresponding point is shown in red on the graph.

Find the domain and sketch the graph of the function.

40. (10 points) \( F(x) = x^2 - 2x + 1 \).

Solution: The function \( F \) is defined everywhere, so its domain is the set of all real numbers: \((-\infty, +\infty)\). Remark that \( F(x) = x^2 - 2x + 1 = (x - 1)^2 \), so its graph is a parabola with a minimal point at \( x = 1, y = 0 \). It is shown on Figure 2.

44. (10 points) \( F(x) = |2x + 1| \).

Solution: The function \(|x|\) is defined for all \( x \), hence \( F \) is defined everywhere, and its domain is the set of all real numbers: \((-\infty, +\infty)\). To draw the graph, let us remark that the inequality \( 2x + 1 > 0 \) is equivalent to \( x > -1/2 \). Therefore we have

\[
F(x) = \begin{cases} 
2x + 1, & \text{if } x \geq -\frac{1}{2}, \\
-2x - 1, & \text{if } x < -\frac{1}{2}.
\end{cases}
\]

Therefore \( F \) is a linear function for \( x \geq -\frac{1}{2} \) and for \( x < -\frac{1}{2} \), and its graph consists of two half-lines. It is shown on Figure 3.
50. (10 points)

\[ f(x) = \begin{cases} 
  x + 9, & \text{if } x < -3, \\
  -2x, & \text{if } |x| \leq 3, \\
  -6, & \text{if } x > 3. 
\end{cases} \]

**Solution:** Remark that the inequality \(|x| \leq 3\) is equivalent to \(-3 \leq x \leq 3\), so \(f(x)\) is defined for \(x < -3, -3 \leq x \leq 3\) and \(x > 3\), therefore it is well-defined for every \(x\). The domain of \(f\) is the set of all real numbers: \((-\infty, +\infty)\). The function is linear in each of three parts of its domain, and the graph of \(f(x)\) is shown on Figure 4. Note that for \(x = -3\) one has \(x + 9 = -2x = 6\) and for \(x = 3\) one has \(-2x = -6\), so the graph of \(f(x)\) is continuous at \(x = 3\) and at \(x = -3\).
Figure 1: Temperature in Phoenix
Figure 2: Graph for problem 40

Figure 3: Graph for problem 44
Figure 4: Graph for problem 50