I. Section 1.1.

1. Let \( A = \{ -3, 0, 1, \pi, 4 \} \), \( B = \{ -7, -3, 0, \frac{7}{3}, \pi \} \) and \( C = \{ 1, 3.14, 12 \} \).

   (a) \( A \cup B = \{ -7, -3, 0, 1, \frac{7}{3}, \pi, 4 \} \) \textbf{Note:} It is conventional to write the elements of a set in ascending order, but it is not necessary.

   (b) \( A \cap B = \{ -3, 0 \} \)

   (c) \( A \cap C = \{ 1 \} \) \textbf{Note:} \( \pi \neq 3.14 \).

   (d) \( B \cap C = \emptyset \) \textbf{Note:} \( \emptyset \) is the set with no elements, called the empty set. It can also be written as \( \{ \} \).

2. Let \( A = \{ x : x \leq \frac{1}{2} \} \), \( B = \{ x : -1 < x \leq \sqrt{2} \} \) and \( C = \{ x : 0 < x < 1 \} \).

   (a) Write \( A \), \( B \) and \( C \) using interval notation. Graph each set on a number line.

   \[
   A = (-\infty, \frac{1}{2}], \quad B = (-1, \sqrt{2}], \quad C = (0, 1)
   \]

   \[
   A: \quad \bullet \quad \frac{1}{2}
   \]

   \[
   B: \quad \bullet \quad \sqrt{2}
   \]

   \[
   C: \quad \bullet \quad \bullet
   \]

   (b) Find the following. Write your answers in interval notation.

   (i.) \( A \cap B = (-1, \frac{1}{2}] \) \quad (ii.) \( A \cup C = (-\infty, 1) \)

3. The symbol \( \mathbb{Z} \) denotes the set of integers and \( \mathbb{Q} \) denotes the set of rational numbers.

   (a) Both \( \mathbb{Z} \) and \( \mathbb{Q} \) are infinite.

   (b) \( \mathbb{Z} \cap \{ -2, -\frac{1}{3}, 0, \sqrt{7}, 15 \} = \{ -2, 0, 15 \} \).

   (c) \( \mathbb{Q} \cap \{ -2, -\frac{1}{3}, 0, \sqrt{7}, 15 \} = \{ -2, -\frac{1}{3}, 0, 15 \} \). \textbf{Note:} Every integer is also a rational number. For example, the integer 15 can be written as \( \frac{15}{1} \), which makes it a rational number.

4. There are infinitely many numbers in \( S = [-1, 2) \). Here are some numbers that are in that interval: \( -1, 0, \frac{1}{2}, \frac{3}{2}, -\frac{1}{2}, 1.99999, \sqrt{2}, -\sqrt{2}, \sqrt{3}, \frac{3}{4}, -\frac{3}{4}, -\frac{15}{16} \).

   Here are some numbers that are \textbf{not} in \( S \): 2, -1.1, \( -\frac{3}{2}, \sqrt{5} \).
II. Section 1.2.

1. Evaluate the following and put them in increasing order.
   (a) \(-2^4 = -16\)
   (b) \((-2)^4 = 16\)
   (c) \((-2)^{-3} = \frac{1}{(-2)^3} = \frac{1}{-8} = -\frac{1}{8}\)

   In increasing order: smallest = \(-2^4\), middle = \((-2)^{-3}\), biggest = \((-2)^4\)

2. Simplify the following using properties of exponents. You can leave negative exponents in your answers.
   (a) \(-(-3x^4)^2 = -(9x^8) = -9x^8\)

   (b) \((x^4y^2) \cdot (x^2y^{-1})^3 = (x^4y^2) \cdot (x^6y^{-3}) = x^{10}y^{-1}\)

   (c) \(\frac{x^8y^2}{x^5y^4} = x^{5}y^{6}\)

   (d) \(\frac{(xy^2z^{-4})^3}{(x^{-2}y^4z^2)^{-2}} = \frac{x^3y^6z^{12}}{x^4y^{-8}z^{-4}} = x^{-1}y^{14}z^{-8}\)

3. Find the following (if they exist).
   (a) \(\sqrt{25} = 5\) Note: \(\sqrt{25} \neq -5\), since the symbol \(\sqrt{x}\) always means the positive square root of \(x\). See margin note on page 17 of the text.

   (b) \(\sqrt{-25}\) does not exist, since you can’t square a number and get a negative.

   (c) \(\sqrt{-8} = -2\), since \((-2)^3 = -8\).

   (d) \(\sqrt{0} = 0\), since \(0^2 = 0\).

   (e) \(\sqrt{0} = 0\), since \(0^3 = 0\).

4. Simplify the following:
   (a) \(\sqrt{24} = \sqrt{4 \cdot 6} = \sqrt{4} \cdot \sqrt{6} = 2\sqrt{6}\)

   (b) \(\sqrt{45} = \sqrt{9 \cdot 5} = \sqrt{9} \sqrt{5} = 3\sqrt{5}\)

   (c) \(\sqrt{20} \cdot \sqrt{5} = \sqrt{100} = 10\)

5. No, \(\sqrt{9} + \sqrt{16} \neq \sqrt{25}\), since \(3 + 4 \neq 5\).