8.5 Multiplying and Dividing Real Numbers

**Learning Objectives:**
1. Multiplying real numbers.
2. Find the reciprocal of a real number.
3. Dividing real numbers.
4. Simplifying expressions.

1. **Multiplying Real Numbers**
   **Sign Rules and Rules for Multiplication:** For any real numbers $a$ and $b$,
   
   1. $(-a)(b) = (a)(-b) = a(-b) = -(ab)$
   2. $(-a)(-b) = a(-b) = -ab$
   3. $(a)(0) = (0)(a) = 0$

   **Example 1.** Multiply each of the following.
   
   1. $-4 \cdot 2$
   2. $(-2.1) \cdot (-3.01)$

2. **Rules for Exponents:** For any real numbers $a$,
   
   1. $a^2 = a \cdot a$
   2. $-a^2 = -(a \cdot a)$
   3. $(-a)^2 = a^2$
   4. $a^3 = a \cdot a \cdot a$

   **Example 2.** Find each of the following.
   
   1. $(-4)^2$
   2. $-4^2$
   3. $\left(-\frac{7}{9}\right)^2$

2. **The Reciprocal Real Numbers**
   **Reciprocal or Multiplicative Inverse:** Two numbers whose product is 1 are called reciprocals or multiplicative inverse.

   **Example 3.** Find the reciprocal of the real number.
   
   1. $-\frac{3}{7}$
   2. $-0.3$

3. **Dividing Real Numbers**
   **Sign Rules and Rules for Division:** For any real numbers $a$, $b$ and $c$,
   
   1. $\frac{-a}{-b} = \frac{a}{b}$
   2. $\frac{-a}{b} = -\frac{a}{b}$
   3. $a \div b = \frac{a}{b}$
   4. $\frac{a \div c}{b} = \frac{a \cdot d}{b \cdot c}$
   5. $\frac{0}{a}$
   6. $\frac{a}{0}$
Example 4. Divide each of the following

1. \(\frac{-18}{9}\)  
2. \(-\frac{1}{2} \div \left(-\frac{8}{15}\right)\)

4. Simplifying Expressions

Example 5. Simplify each expression.

1. \(\frac{5 + (-4)^2 + 4 \cdot 8}{4(6 - 4)}\)
2. \(\frac{7(-5) - (-2)}{3^2 + (-9)}\)

Example 6. Evaluate: \(\frac{-6x - 4y}{-2z + 3 - (-10)}\) when \(x = 5, y = -1\) and \(z = 0\)