

# Multiplying Fractions

## Objective 1 Perform Multiplication with Fractions

Recall that multiplication represents repeated addition of the same quantity.

$$\frac{1}{2} \cdot 6 = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 3$$

We can also write the 6 as an improper fraction  $\frac{6}{1}$  and multiply. We will reduce by dividing out a common factor of 2.

$$\frac{1}{2} \cdot \frac{6}{1} = \frac{1 \cdot 6}{2 \cdot 1} = \frac{1 \cdot 6}{2 \cdot 1} = \frac{6}{2} = \frac{\overset{3}{\cancel{6}}}{\underset{1}{\cancel{2}}} = \frac{3}{1} = 3$$

Notice how we multiply  $\frac{1}{2}$  to  $\frac{6}{1}$ . We multiply straight across the numerators and straight across the denominators.

Whenever we are multiplying fractions together we can use a technique called "cross-cancelling", but it is **very important** that you remember that this technique can only be used when multiplying fractions together!

$$\frac{1}{2} \cdot \frac{6}{1} = \frac{1}{\cancel{2}} \cdot \frac{\overset{3}{\cancel{6}}}{1} = \frac{3}{1} = 3$$

Here it is understood that you are dividing out a common factor of 2 before multiplying.

Dividing out common factors before multiplying fractions together is very useful, especially when you are working with large numbers. Sometimes you will have to divide out factors multiple times. Notice how the following challenging problem is worked.

$$\frac{72}{35} \cdot \frac{55}{108} \cdot \frac{14}{110} = \frac{\overset{8}{\cancel{72}}}{\underset{5}{\cancel{35}}} \cdot \frac{\overset{1}{\cancel{55}}}{\underset{12}{\cancel{108}}} \cdot \frac{\overset{2}{\cancel{14}}}{\underset{2}{\cancel{110}}} = \frac{8 \cdot 1 \cdot 2}{5 \cdot 12 \cdot 2} =$$

$$\frac{\overset{2}{\cancel{8}} \cdot 1 \cdot \overset{1}{\cancel{2}}}{5 \cdot \underset{3}{\cancel{12}} \cdot \underset{1}{\cancel{2}}} = \frac{2 \cdot 1 \cdot 1}{5 \cdot 3 \cdot 1} = \frac{2}{15}$$

There are different ways of approaching the problem above. But no matter how many steps it takes you, we should all end up with the same answer!

Answer the following homework questions.

In Exercises 1 - 9, multiply by first dividing out common factors.

1)  $\frac{1}{2} \cdot \frac{8}{3}$

4)  $\frac{24}{6} \cdot \frac{9}{8}$

7)  $\frac{6x^2}{7a^2} \cdot \frac{21a}{12x}$

2)  $\frac{4}{3} \cdot \frac{6}{8}$

5)  $\frac{15}{10} \cdot \frac{5}{30}$

8)  $\frac{x}{y} \cdot \frac{y}{x}$

3)  $\frac{40}{3} \cdot \frac{9}{10}$

6)  $\frac{16x}{5} \cdot \frac{20}{12y}$

9)  $\frac{ab}{c} \cdot \frac{c}{a} \cdot \frac{c}{b}$

Recall that exponents are used to represent repeated multiplications.

**Example 1:** Simplify each expression.

$$a) \left(-\frac{1}{2}\right)^2 - 9\left(\frac{1}{3}\right)^2$$

$$b) \left(\frac{1}{2}\right)^2 \cdot 8 + \left(\frac{2}{3}\right)^2 \cdot 9$$

$$\left(\quad\right)\left(\quad\right)\left(\quad\right) - 9\left(\quad\right)\left(\quad\right)$$

$$\left(\quad\right)\left(\quad\right) \cdot 8 + \left(\quad\right)\left(\quad\right) \cdot 9$$

$$-\frac{1}{8} - 9 \cdot \frac{1}{9}$$

$$\frac{1}{4} \cdot 8 + \frac{1}{9} \cdot 9$$

Answer the following homework questions.

In Exercises 10 - 15, simplify each expression.

$$10) \left(\frac{1}{2}\right)^2 \cdot 8$$

$$12) \left(\frac{3}{2}\right)^3 \cdot \frac{8}{9}$$

$$14) 3 \cdot \left(\frac{7}{3}\right)^2 \cdot \frac{5}{21}$$

$$11) -\frac{2}{3} \left(\frac{7}{6}\right)$$

$$13) 16 \left(\frac{5}{4}\right)^2 \cdot \frac{7}{25}$$

$$15) -\left(\frac{1}{2}\right)^2 \cdot \frac{5}{6} \cdot 16$$