

Multiplying and Dividing Fractions

by Sophia



WHAT'S COVERED

This tutorial covers multiplying and dividing fractions, through the exploration of:

1. Review of PEMDAS, the Order of Operations
2. Multiplying and Dividing Fractions
3. Simplifying Fractions
4. Using the Order of Operations with Fractions

1. Review of PEMDAS, the Order of Operations

As you may recall, PEMDAS is the acronym that is used to remember the order of operations. PEMDAS stands for:

Parentheses

Exponents

Multiplication

Division

Addition

Subtraction

The order of operations applies to all numbers, including fractions.

2. Multiplying and Dividing Fractions

Multiplication and division involving fractions is useful when converting between measurements, which is common in many scientific fields, such as chemistry, physics, and nursing.



KEY CONCEPT

When you multiply fractions, you multiply the numerators together to find the numerator of your answer. Similarly, you multiply the denominators together to find the denominator of your answer.

⇒ **EXAMPLE** Suppose you want to multiply $\frac{3}{4}$ times $\frac{1}{5}$.

$$\frac{3}{4} \times \frac{1}{5} \quad \text{Our expression}$$

$$\frac{3}{4} \times \frac{1}{5} = \frac{3}{20} \quad \text{First, multiply the numerators to find our answer's numerator. 3 times 1 equals 3.}$$

$$\frac{3}{4} \times \frac{1}{5} = \frac{3}{20} \quad \text{Next, multiply the denominators to find our answer's denominator. 4 times 5 equals 20.}$$

$$\frac{3}{20} \quad \text{Our Solution}$$

Dividing fractions, on the other hand, is equivalent to multiplying by the **reciprocal**. Finding the reciprocal of a fraction means flipping it, or switching the numerator and the denominator.

⇒ **EXAMPLE** Suppose you want to divide $\frac{3}{8}$ by $\frac{1}{2}$.

$$\frac{3}{8} \div \frac{1}{2} \quad \text{Our Expression}$$

$$\frac{3}{8} \times \frac{2}{1} \quad \text{First, find the reciprocal of } \frac{1}{2} \text{ by flipping it. This is } \frac{2}{1}. \text{ Change the sign to multiplication.}$$

$$\frac{3}{8} \times \frac{2}{1} = \frac{6}{8} \quad \text{Next, multiply the numerators. 3 times 2 is 6.}$$

$$\frac{3}{8} \times \frac{2}{1} = \frac{6}{8} \quad \text{Next, multiply the denominators. 8 times 1 is 8.}$$

$$\frac{6}{8} \quad \text{Our Solution}$$



HINT

It is important to note that you flipped your second fraction, and you changed the division sign to multiplication.



BIG IDEA

You need to make sure that the fraction is simplified, which means that you need to cancel out any common factors of both the numerator (6) and the denominator (8).



TERM TO KNOW

Reciprocal (of a Fraction)

A fraction in which the numerator and denominator have been switched

3. Simplifying Fractions

A simplified fraction is a fraction in which the numerator and the denominator have no common factors other than 1.



DID YOU KNOW

You always want to write fractions in their simplest form so they are easier to compare and calculate with.

⇒ **EXAMPLE** 50/100 can be simplified to 1/2, because both the numerator and the denominator are divisible by 50. It's much easier to say that you ate half of your dinner rather than fifty-hundredths of your dinner!

Referring back to the previous example in which you arrived at an answer of 6/8, how can you simplify this fraction?

$$\frac{6}{8}$$

Our Expression

$$\frac{6}{8} = \frac{2 \times 3}{2 \times 2 \times 2}$$

First, see if the numerator and denominator have any common factors. Expand both numbers into their prime factors. In this case, the prime factors of 6 are 3 and 2. The prime factors of 8 are 2, 2, and 2.

$$\frac{6}{8} = \frac{\cancel{2} \times 3}{\cancel{2} \times 2 \times 2}$$

Since there is at least one 2 in both the numerator and the denominator, you can cancel them out.

$$\frac{6}{8} = \frac{3}{2 \times 2}$$

This leaves 3 in the numerator, and 2 times 2 in the denominator.

$$\frac{6}{8} = \frac{3}{4}$$

Evaluate 2 times 2, which is 4.

$$\frac{3}{4}$$

Our Solution.

$\frac{3}{4}$ is the simplest form of $\frac{6}{8}$.

4. Using the Order of Operations with Fractions

You can also use the order of operations, or PEMDAS, with fractions.

⇒ **EXAMPLE** Suppose you want to simplify the following expression: $\frac{2}{9} \div \left(\frac{1}{3}\right)^2 \times \frac{1}{4}$.

$$\frac{2}{9} \div \left(\frac{1}{3}\right)^2 \times \frac{1}{4} \quad \text{Our Expression}$$

$$\frac{2}{9} \div \left(\frac{1}{3}\right)^2 \times \frac{1}{4}$$

First, evaluate the exponent. $\frac{1}{3}$ times $\frac{1}{3}$ is $\frac{1}{9}$

$$\frac{2}{9} \div \frac{1}{9} \times \frac{1}{4}$$

Next, multiply and divide from left to right. When you divide $\frac{2}{9}$ by $\frac{1}{9}$, you need to multiply by the reciprocal of the second fraction, which is $\frac{9}{1}$

$$\frac{2}{9} \times \frac{9}{1} \times \frac{1}{4} = \frac{18}{4}$$

Since we just have multiplication remaining, we can multiply all 3 numerators together. 2 times 9 times 1 is 18.

$$\frac{2}{9} \times \frac{9}{1} \times \frac{1}{4} = \frac{18}{36}$$

Then, we can multiply all three denominators together. 9 times 1 times 4 equals 36

$$\frac{18}{36} = \frac{2 \times 3 \times 3}{2 \times 2 \times 3 \times 3}$$

Finally, we want to simplify the fraction by finding the prime factors of the numerator and denominator.

$$\frac{18}{36} = \frac{\cancel{2} \times \cancel{3} \times \cancel{3}}{2 \times \cancel{2} \times \cancel{3} \times \cancel{3}}$$

One 2 and two 3's cancel out of both the numerator and denominator

$$\frac{1}{2}$$

Our solution



SUMMARY

Today you learned that you can use **the order of operations, or PEMDAS**, with all numbers, including fractions. You learned **how to multiply fractions** by multiplying the numerators and the denominators together straight across to find the numerator and denominator of your answer. You also learned that when **dividing fractions**, you keep the first fraction the same, change the division sign to multiplication, and then find the reciprocal of the second fraction by flipping it. Lastly, you learned that to **simplify fractions**, you can cancel out any common factors of both the numerator and denominator.

Source: This work is adapted from Sophia author Colleen Atakpu.



TERMS TO KNOW

Reciprocal (of a Fraction)

A fraction in which the numerator and denominator have been switched.