

## Subtracting Fractions

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**Summary:** Learn to subtract fractions.

**Learning Objectives:** To describe the steps needed to subtract fractions. To subtract fractions.

After reading this handout, you should be able to subtract fractions with ease! Before beginning this handout, you should know what a fraction is, what a fraction means, and how to find common denominators. (Please read the Academic Center handout *Finding a Common Denominator* before attempting to subtract fractions.) In addition, some examples will contain variables. You may skip them if you are not familiar with variables, or you may read the handout *Understanding Variables* prior to working through the examples with variables.

### Definitions

Numerator – the top expression in a fraction

Denominator – the bottom expression in a fraction

Variable – a letter or symbol representing an unknown number

Subtracting fractions is very easy once you have a common denominator. All you need to do is simply subtract the two numerators and leave the denominator the same.

If the denominators aren't the same, you'll need to follow these steps to subtract them.

**Step 1) Find a common denominator.**

**Step 2) Change both fractions so that they have the same denominator.**

**Step 3) Subtract the numerators.**

**Step 4) Simplify.**

Let's work through a few examples.

### Example 1

$$\frac{3}{4} - \frac{1}{2} = ?$$

**Step 1) Find a common denominator (covered in the handout *Finding a Common Denominator*).** In this case, the common denominator is 4.



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**Step 2) Change both fractions so that they have the same denominator.**

We do this by finding a number to multiply the numerator and denominator by in each fraction to equal the common denominator. We can do this by dividing our common denominator by the denominator of each fraction. Then, we multiply by that number. In this example, our common denominator is 4 and the denominators of our two fractions are 4 and 2. Since  $4/4 = 1$ , we don't need to multiply the first fraction by anything, since anything times 1 is equal to itself. However,  $4/2=2$ . You need to multiply both the numerator and the denominator by 2. As such,  $\frac{2}{2} * \frac{1}{2} = \frac{2}{4}$ .

The fraction  $\frac{3}{4}$  already has a denominator equal to that of the common denominator (4), so it does not need to be changed.

When you multiply the numerator and the denominator of a fraction by the same number, the value of the fraction remains unchanged:

$$\frac{2}{2} * \frac{1}{2} = \frac{2}{4} \quad \frac{2}{4} = \frac{1}{2}$$

Essentially,  $2/4$  has the same value as  $1/2$ .

Both denominators should be the same at this point. If they are not, revisit step 2.

**Step 3) Subtract the numerators and use the denominator as the denominator in the answer.** You may simplify during this step if you wish, or you may choose to wait.

$$\frac{3}{4} - \frac{1 * 2}{2 * 2} = \frac{3 - (1 * 2)}{4} = \frac{3 - 2}{4} = \frac{1}{4}$$

**Step 4) Simplify and reduce.**

To simplify, simply work out the expression to the greatest possible extent, or to the extent requested in the problem. Then, reduce the fraction to lowest terms. In this case, reduction is not necessary and our answer is simply  $\frac{1}{4}$ .

**Example 2**

Instructions: Simplify.

$$\frac{2x}{3} - \frac{4x + 3}{5}$$

If you do not remember the steps, refer to Example 1.

**Step 1) Find a common denominator.** In this case, our common denominator is 15 because  $5*3=15$ .

**Step 2) Multiply both fractions by the common denominator divided by each individual fraction's denominator.**



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$15/3 = 5$ , so the first fraction is multiplied by  $\frac{5}{5}$ .  $15/5=3$ , so the second fraction is multiplied by  $\frac{3}{3}$ .

$$\frac{2x * 5}{3 * 5} - \frac{(4x + 3) * 3}{5 * 3}$$

Simplify this just to make things easier in Step 3.

$$\frac{10x}{15} - \frac{12x + 9}{15}$$

Step 3) Subtract the numerators.

$$\frac{10x - 12x - 9}{15}$$

Step 4) Simplify. In this case, we combine  $10x$  and  $-12x$  to get  $-2x$ .

$$\frac{-2x - 9}{15}$$

This is our final answer and it cannot be reduced or simplified.

### Example 3

Instructions: Simplify.

$$\frac{-4x^3 + x^2 - 7}{3} - \frac{4x^2}{6}$$

Step 1) Find a common denominator. Our common denominator is 6 because  $3*2=6$ . As such, the second fraction will not need to be touched during Step 2.

Step 2) Multiply each fraction as necessary to get the common denominator on both fractions.

In this case, the first fraction needs to be multiplied by  $\frac{2}{2}$  because  $6/3=2$ .

$$\frac{(-4x^3 + x^2 - 7) * 2}{3 * 2} - \frac{4x^2}{6}$$
$$\frac{-8x^3 + 2x^2 - 14}{6} - \frac{4x^2}{6}$$

Step 3) Subtract the two numerators.

$$\frac{-8x^3 - 2x^2 - 14}{6}$$

Step 4) Since all numbers are divisible by 2, we may divide them all by 2.



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This only works if *all* parts of *all* expressions are divisible by a number. This includes both the numerator and the denominator. As such, our final answer is as follows.

$$\frac{-4x^3 - x^2 - 7}{3}$$

### Exercises

1)

$$\frac{7}{3} - \frac{9}{7}$$

2)

$$\frac{22}{5} - \frac{5}{9} - \frac{7}{15}$$

3)

$$\frac{36x}{15} - \frac{35x}{15}$$

### Answer Key

1)

$$\frac{22}{21}$$

2)

$$\frac{34}{15}$$

3)

$$\frac{x}{15}$$

If you're a currently enrolled UHV student and need further help or don't get the same answer as the answer key, please come speak with a tutor in the Academic Center.



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