Add and Subtract Fractions and Mixed Numbers

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2.1 Add and Subtract Fractions and Mixed Numbers

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[Figure 1]

Donna and her friend Andrew work at The Balloon Factory. They are in charge of taking inventory before the big sale tomorrow. Donna opens the first two boxes and finds that one box is $\frac{1}{2}$ full, while the other box is $\frac{1}{3}$ full. The boxes are the same size, so she empties one box into the other. What does she write on the top for the sum of the contents? Meanwhile, Andrew is working in the stockroom with the helium balloons. He finds $3\frac{1}{4}$ boxes of red balloons and $2\frac{2}{3}$ boxes of green balloons. What does he record as the sum of these two types?

In this concept, you will learn to add and subtract fractions and mixed numbers.

Adding and Subtracting Fractions

A **fraction** is a number that names a part of a whole or a part of a group. If a rectangle is $\frac{1}{3}$ shaded, it means that if the rectangle were divided into three equal parts, one of those parts would be shaded.

[Figure 2]

Most fractions represent numbers less than 1, meaning that the numerator is less than the denominator.

To represent a number greater than 1, you use an improper fraction or a mixed number. An **improper fraction** has a numerator that is larger than its denominator, such as $\frac{5}{3}$, or can be written as a mixed number. A **mixed number** is a number that has both wholes and parts, so you will see a whole number and a fraction with mixed numbers. $1\frac{2}{3}$ is a mixed number that is equal to $\frac{5}{3}$.

Let's take a look at adding and subtracting fractions.

The first thing to consider when adding and subtracting fractions is the denominator of the fractions. Are they the same? Remember that the denominator tells you how many parts the whole is divided into. The numerator tells you how many parts you have out of the whole. In our rectangle example above, we say that the fraction of the shaded area is $\frac{1}{3}$, because 1 part of the 3 parts is shaded.

When adding or subtracting fractions, the denominators of the fractions must be the same, then you can simply add or subtract the numerators. For example, notice in the fractions below, both denominators are 8 so you just add the numerators $(1+2=3)$.

Subtracting fractions that have the same denominator is the same. In the example below, both denominators are the same so you just need to subtract the numerators $(10-3=7)$.

$$\frac{10}{12}-\frac{3}{12}=\frac{7}{12}$$

If the denominators are not the same, you need to find a common denominator. You do this by creating an equal fraction that has the denominator you need. Look at the fractions below.

$$\frac{1}{2}=\frac{4}{8}$$

These two fractions are equal. This means that they both represent the same part of the whole. The fraction one-half has simply been renamed in terms of eighths. This is the same thing that we do when finding common denominators. We rename the fractions in terms of the common denominator.

Let's look at an example.

Add: $\frac{1}{4} + \frac{2}{5}$

First, find a common denominator by finding the least common multiple of the denominators, 4 and 5.

The first few multiples of 4 are 4, 8, 12, 16, and 20. The first few multiples of 5 are 5, 10, 15, and 20. So the least common multiple is 20.

Now, find how to rename each fraction to a fraction with 20 as the denominator.

You need to multiply the denominator by 5 to get a denominator of 20. So, multiply the first fraction by the equivalent of 1, or $\frac{5}{5}$.

$$\frac{1}{4} \times \frac{5}{5} = \frac{5}{20}$$

Now, do the same for the other fraction.

You need to multiply the denominator by 4 to get a denominator of 20. So, multiply the second fraction by the equivalent of 1, or $\frac{4}{4}$.

$$\frac{2}{5} \times \frac{4}{4} = \frac{8}{20}$$

Next, add the fractions.

$$\frac{5}{20} + \frac{8}{20} = \frac{13}{20}$$

The answer is $\frac{13}{20}$.

You will also work with mixed numbers and fractions. There is an added step when working with this combination.

Subtract: $2\frac{7}{8} - \frac{2}{3}$

First change the mixed number to an improper fraction. To do this, multiply the denominator by the whole number, then add the numerator.

$$8 \times 2 + 7 = 23$$
$$2\frac{7}{8} = \frac{23}{8}$$

Next, find a common denominator.

The first few multiples of 8 are 8, 16, and 24. Since 24 is also divisible by 3, it is the least common multiple. Rename each fraction as a fraction with the common denominator.

$$\frac{23}{8} \times \frac{3}{3} = \frac{69}{24}$$
$$\frac{2}{3} \times \frac{8}{8} = \frac{16}{24}$$

Then, find the difference.

$$\frac{69}{24} - \frac{16}{24} = \frac{53}{24}$$

Notice that the answer is an improper fraction. You need to put your answer into a mixed fraction to finish this question.

Finally, simplify the difference to a mixed number.

$$\frac{53}{24} + 2\frac{5}{24}$$

The answer is $2\frac{5}{24}$.

Examples

Example 1

Earlier, you were given a problem about Donna and Andrew with their inventory.

Donna combined two boxes of regular balloons into one box. She wanted to know what to record for her final total. She had $\frac{1}{2}$ box that she combined with $\frac{1}{3}$ of a box.

To find the total, Donna must first find a common denominator. Since 2 and 3 are both multiples of 6, it is the least common multiple.

Next, rename each fraction as a fraction with the common denominator.

$$\frac{1}{2} \times \frac{3}{3} = \frac{3}{6}$$
$$\frac{1}{3} \times \frac{2}{2} = \frac{2}{6}$$

Then, add the two fractions.

$$\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$

So Donna would write $\frac{5}{6}$ on the top of the box of balloons.

Andrew was doing inventory on helium balloons. He wanted to know the total of his two boxes to record on his inventory. He had $3\frac{1}{4}$ of one box and $2\frac{2}{3}$ of another box.

First, change the mixed number to improper fractions. To do this, multiply the denominator by the whole number, then add the numerator.

$$4 \times 3 + 1 = 13 \qquad 3 \times 2 + 2 = 8$$
$$3\frac{1}{4} = \frac{13}{4} \qquad 2\frac{2}{3} = \frac{8}{3}$$

Next, find a common denominator.

The first few multiples of 4 are 4, 8, and 12. Since 12 is also divisible by 3, it is the least common multiple. Rename each fraction as a fraction with the common denominator.

$$\frac{39}{12} + \frac{32}{12} = \frac{71}{12}$$

Then, add the two fractions.

Notice that the answer is an improper fraction. You need to put your answer into a mixed fraction to finish this problem.

Finally, simplify the solution to a mixed number.

$$\frac{71}{12} = 5\frac{11}{12}$$

So, Andrew should write $5\frac{11}{12}$ as the total number of red and green helium balloons.

Example 2

$$\frac{4}{6} + \frac{5}{8} = \_\_\_\_\_$$

First, notice that these two fractions have uncommon denominators. The lowest common denominator for 6 and 8 is 24.

Next, rename each fraction with a denominator of 24.

$$\frac{4}{6} \times \frac{4}{4} = \frac{16}{24}$$
$$\frac{5}{8} \times \frac{3}{3} = \frac{15}{24}$$

Then, add the two fractions.

$$\frac{16}{24} + \frac{15}{24} = \frac{31}{24}$$

Since the numerator is greater than the denominator you can put your final answer into an improper fraction.

$$\frac{31}{24} = 1\frac{7}{24}$$

The answer is $1\frac{7}{24}$.

Example 3

Subtract: $\frac{4}{9} - \frac{1}{6}$

First, find a common denominator. The first few multiples of 9 are 9 and 18. Since 18 is also divisible by 6, it is the least common multiple.

Next, rename each fraction as a fraction with the common denominator.

$$\frac{4}{9} \times \frac{2}{2} = \frac{8}{18}$$
$$\frac{1}{6} \times \frac{3}{3} = \frac{3}{18}$$

Then, find the difference.

$$\frac{8}{18} - \frac{3}{18} = \frac{5}{18}$$

The answer is $\frac{5}{18}$.

Example 4

Add: $\frac{10}{12} + \frac{2}{6}$

First, find a common denominator. Since 12 is also divisible by 6, it is the least common multiple.

Next, rename each fraction as a fraction with the common denominator.

$$\frac{2}{6} \times \frac{2}{2} = \frac{4}{12}$$

Then, add the two fractions.

$$\frac{10}{12}+\frac{4}{12}=\frac{14}{12}$$

Since the numerator is greater than the denominator you can put your final answer into an improper fraction. Remember you need to put your answer into simplest form.

$$\frac{14}{2}=1\frac{2}{12}$$
$$1\frac{2}{12}=1\frac{1}{6}$$

The answer is $1\frac{1}{6}$.

Example 5

Subtract: $\frac{4}{8}+\frac{1}{4}$

First, find a common denominator. Since 8 is also divisible by 4, it is the least common multiple.

Next, rename each fraction as a fraction with the common denominator.

$$\frac{1}{4}+\frac{2}{2}=\frac{2}{8}$$

Then, find the difference.

$$\frac{4}{8}-\frac{2}{8}=\frac{2}{8}$$

Remember, you need to put your final answer into simplest form.

$$\frac{2}{8}=\frac{1}{4}$$

The answer is $\frac{1}{4}$.

Review

Add or subtract the following fractions. Be sure that your answer is in simplest form.

1. $\frac{3}{6}+\frac{1}{6}$
2. $\frac{2}{5}+\frac{1}{5}$
3. $\frac{6}{10}+\frac{1}{10}$
4. $\frac{8}{12}+\frac{2}{12}$
5. $\frac{9}{16}+\frac{1}{16}$
6. $\frac{10}{20}+\frac{3}{20}$
7. $\frac{18}{20}-\frac{3}{20}$
8. $\frac{20}{21}-\frac{13}{21}$
9. $\frac{16}{18}-\frac{10}{18}$
10. $\frac{24}{25}-\frac{9}{25}$
11. $\frac{18}{36}-\frac{2}{36}$
12. $\frac{28}{30}-\frac{10}{30}$

Add or subtract the following mixed numbers and fractions. Be sure that your answer is in simplest form.

13. $6\frac{1}{2}+3$
14. $6\frac{4}{5}-\frac{1}{5}$
15. $8\frac{1}{2}+\frac{1}{3}$
16. $9\frac{4}{5}-2\frac{1}{5}$
17. $6\frac{4}{9}-4\frac{1}{9}$

18. $5\frac{1}{2}+2\frac{1}{4}$
19. $8\frac{4}{6}+2\frac{2}{6}$
20. $12\frac{5}{8}-2\frac{1}{8}$

Review (Answers)

To see the review answers, return to the Table of Contents and select 'Other Versions' or 'Resources'.

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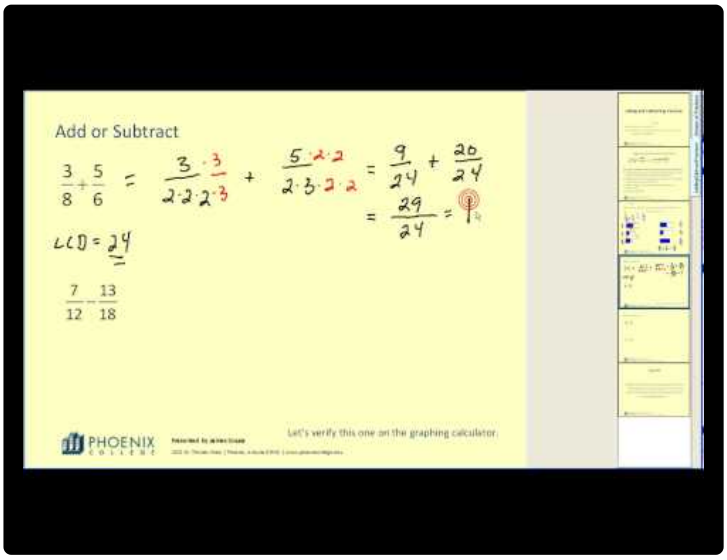

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