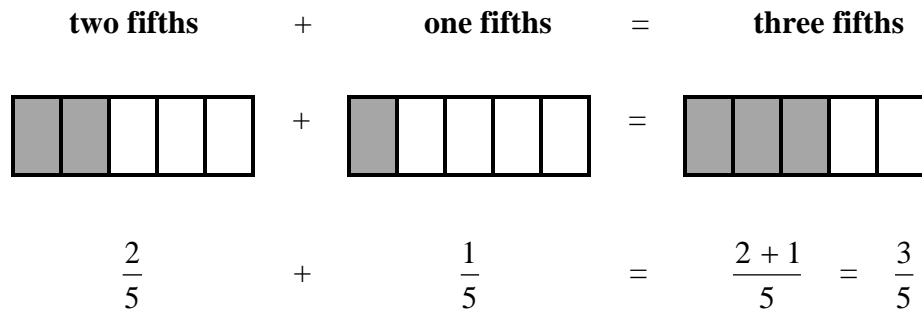


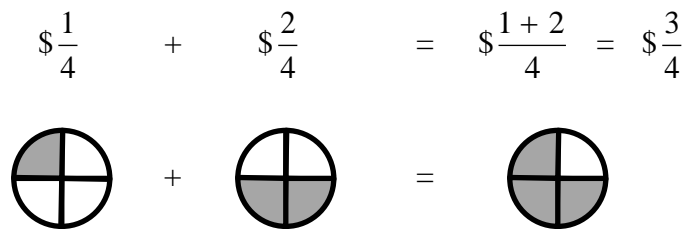
Section 3.2 Adding and subtracting like fractions

In this section, fractions with the same denominator are added and subtracted. The process to add fractions with the same denominator is illustrated below with the fraction $\frac{2}{5}$ represented as a rectangle broken into 5 equal parts with 2 parts shaded and the fraction $\frac{1}{5}$ as a rectangle broken into 5 equal parts with 1 part shaded. The sum of these fractions $\frac{2}{5}$ and $\frac{1}{5}$ with the same denominator is represented by the rectangle that is broken into 5 equal parts with 3, the sum of 2 and 1, shaded parts.

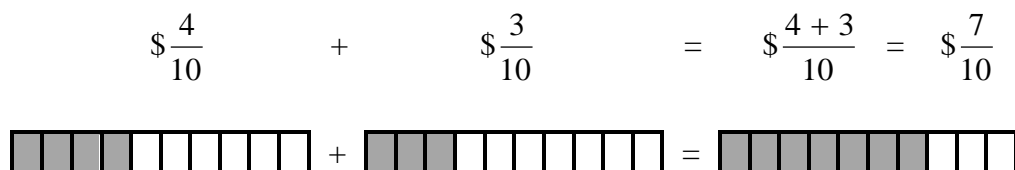


The monetary coins dimes and quarters represent fractional parts of a dollar, with a quarter worth one fourth of a dollar and a dime worth one tenth of a dollar. Below dimes and quarters are used to demonstrated the addition of fractions with the same denominator.

The sum of 1 **quarter** and 2 **quarters** is 3 **quarters**



The sum of 4 **dimes** and 3 **dimes** is 7 **dimes**



Like fractions are fractions with the same denominator.

To add like fractions

Add the numerators of the like fractions and keep the common (like) denominator. If possible reduce the resulting fraction.

$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

Example 1 Add the following fractions: $\frac{2}{7} + \frac{4}{7}$ $\frac{5}{8} + \frac{1}{8}$ $\frac{4}{9} + \frac{3}{9} + \frac{5}{9}$

Add the numerators 2 and 4 and keep the common (like) denominator 7.

$$\frac{2}{7} + \frac{4}{7} = \frac{2+4}{7} = \frac{6}{7}$$

Add the numerators 5 and 1 and keep the common (like) denominator 8. Reduce the fraction $\frac{6}{8}$ by dividing both the numerator and denominator by their GCF 2.

$$\frac{5}{8} + \frac{1}{8} = \frac{5+1}{8} = \frac{6}{8} = \frac{\overset{3}{\cancel{6}}}{\underset{4}{\cancel{8}}} = \frac{3}{4}$$

Add the numerators 4, 3 and 5 and keep the common (like) denominator 9. Reduce the fraction $\frac{12}{9}$ by dividing both the numerator and denominator by their GCF 3 and write the final answer as a mixed number. Note in the original problem do not reduce the fraction $\frac{3}{9}$ since this will result in fractions with different denominators.

$$\frac{4}{9} + \frac{3}{9} + \frac{5}{9} = \frac{4+3+5}{9} = \frac{12}{9} = \frac{\overset{4}{\cancel{12}}}{\underset{3}{\cancel{9}}} = \frac{4}{3} = 1\frac{1}{3}$$

The procedure to subtract like fractions is the similar to that for adding like fractions but instead of adding the numerators they are subtracted.

To subtract like fractions

Subtract the numerators of the like fractions and keep the common (like) denominator. If possible reduce the resulting fraction.

$$\frac{a}{c} - \frac{b}{c} = \frac{a - b}{c}$$

Example 2 Evaluate the following: $\frac{9}{11} - \frac{4}{11}$ $\frac{5}{6} - \frac{3}{6}$ $\frac{8}{9} - \frac{3}{9} + \frac{2}{9}$

Find the difference of numerators 9 and 4 and keep the common denominator 11.

$$\frac{9}{11} - \frac{4}{11} = \frac{9 - 4}{11} = \frac{5}{11}$$

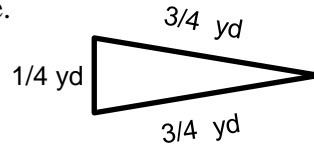
Find the difference of numerators 5 and 3 and keep the like denominator 6. Reduce the fraction $\frac{2}{6}$ by dividing both the numerator and denominator by their GCF 2.

$$\frac{5}{6} - \frac{3}{6} = \frac{5 - 3}{6} = \frac{2}{6} = \frac{\overset{1}{\cancel{2}}}{\underset{3}{\cancel{6}}} = \frac{1}{3}$$

The order of operations requires going from left to right when adding and subtracting. First find the difference of the numerators 8 and 3 which equal 5 then add the numerator 2 and keep the common (like) denominator 9.

$$\frac{8}{9} - \frac{3}{9} + \frac{2}{9} = \frac{8 - 3 + 2}{9} = \frac{5 + 2}{9} = \frac{7}{9}$$

Example 3 Find the perimeter of the following triangle.



To find the perimeter of a triangle sum the length of the three sides. As shown below, the perimeter of this triangle is $1 \frac{3}{4}$ yards.

$$\frac{3}{4} + \frac{3}{4} + \frac{1}{4} = \frac{3 + 3 + 1}{4} = \frac{7}{4} = 1 \frac{3}{4}$$

Example 4 In a survey of favorite traditional ice cream flavors $\frac{4}{7}$ of those surveyed chose chocolate, $\frac{2}{7}$ chose vanilla, and $\frac{1}{7}$ chose strawberry. What fraction of those surveyed choose either vanilla or strawberry as their favorite traditional ice cream flavor?

To find the unknown quantity, the fraction of those surveyed who choose either vanilla or strawberry, add the like fractions $\frac{2}{7}$ and $\frac{1}{7}$. As shown below, $\frac{3}{7}$ either chose vanilla or strawberry as their favorite traditional ice cream flavor.

$$\frac{2}{7} + \frac{1}{7} = \frac{2 + 1}{7} = \frac{3}{7}$$

Like fractions are not only easy to add and subtract but they are also easy to compare. For two like fractions, the fraction with the larger numerator is the larger of the two like fractions. In the next section a method to compare fractions with different denominators is developed.

Example 5 Insert the appropriate symbol $<$ or $>$ to make a true statement

$$\frac{7}{8} \text{ ___ } \frac{5}{8}$$

$$\frac{3}{5} \text{ ___ } \frac{4}{5}$$

$$\frac{7}{8} > \frac{5}{8}$$

Since the numerator of the first like fraction is larger than the second

$$\frac{3}{5} < \frac{4}{5}$$

Since numerator of the first like fraction is smaller than the second

Exercises 3.2

1-12 Add the following like fractions. Write final answers in reduced form.

1. $\frac{1}{4} + \frac{2}{4}$

2. $\frac{2}{5} + \frac{5}{5}$

3. $\frac{5}{9} + \frac{2}{9}$

4. $\frac{1}{8} + \frac{3}{8}$

5. $\frac{5}{16} + \frac{9}{16}$

6. $\frac{7}{10} + \frac{1}{10}$

7. $\frac{3}{5} + \frac{4}{5}$

8. $\frac{5}{9} + \frac{7}{9}$

9. $\frac{5}{8} + \frac{3}{8}$

10. $\frac{1}{7} + \frac{2}{7} + \frac{3}{7}$

11. $\frac{4}{9} + \frac{3}{9} + \frac{5}{9}$

12. $\frac{3}{4} + \frac{3}{4} + \frac{3}{4}$

13-21 Subtract the following like fractions. Write final answers in reduced form.

13. $\frac{3}{5} - \frac{2}{5}$

14. $\frac{3}{4} - \frac{1}{4}$

15. $\frac{2}{3} - \frac{1}{3}$

16. $\frac{7}{9} - \frac{1}{9}$

17. $\frac{5}{8} - \frac{3}{8}$

18. $\frac{11}{12} - \frac{5}{12}$

19. $\frac{7}{10} - \frac{3}{10}$

20. $\frac{7}{16} - \frac{3}{16}$

21. $\frac{1}{4} - \frac{1}{4}$

22-27 Evaluate using the order of operations. Write final answers in reduced form.

22. $\frac{4}{7} + \frac{2}{7} - \frac{3}{7}$

23. $\frac{4}{7} - \frac{2}{7} + \frac{3}{7}$

24. $\frac{7}{8} - \frac{5}{8} + \frac{1}{8}$

25. $\frac{7}{8} - \left(\frac{5}{8} + \frac{1}{8}\right)$

26. $\frac{7}{9} - \left(\frac{3}{9} + \frac{1}{9}\right)$

27. $\frac{7}{9} - \frac{3}{9} + \frac{1}{9}$

28-33 Insert the appropriate symbol < or > to make a true statement

28. $\frac{4}{7} ? \frac{3}{7}$

29. $\frac{3}{5} ? \frac{2}{5}$

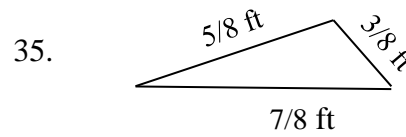
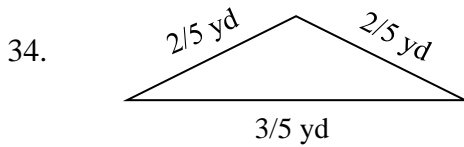
30. $\frac{3}{8} ? \frac{5}{8}$

31. $\frac{8}{9} ? \frac{7}{9}$

32. $\frac{8}{5} ? \frac{7}{5}$

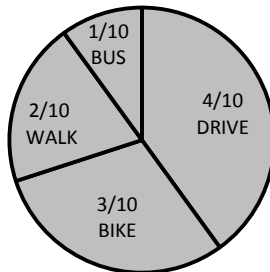
33. $\frac{4}{3} ? \frac{5}{3}$

34-35 Find the perimeter of the following triangles.



36-40 Solve the following application problems. Show the calculations.

36. At a local bookstore $\frac{1}{8}$ of the books sold are mysteries, $\frac{1}{8}$ are science fiction, and $\frac{3}{8}$ are bestsellers. What fraction of the total books sold at this bookstore are either mysteries, science fiction, or bestsellers?
37. A truck filled with decorative rocks drops $\frac{1}{12}$ of the total loaded amount at the first stop and $\frac{7}{12}$ at the second stop. Which stop had the larger delivery? What fraction of the total load is delivered during the first two stops?
38. The following pie chart gives the fraction of students at a university who bike, walk, bus, or drive to campus. Which is the most popular way to get to campus? What fraction of students either bike or walk to campus?



39. A wood board measure $\frac{5}{8}$ of a yard. If the board is cut with one part $\frac{3}{8}$ of a yard long, what is the length of the remaining part of the board?
40. How much larger is a $\frac{9}{16}$ inch length screw than a $\frac{5}{16}$ inch length screw?