

Adding and Subtracting Fractions and Mixed Numbers

1 GETTING THE IDEA

A **mixed number** is a number that has a whole-number part and a fraction part.

whole number



$15\frac{2}{5}$



fraction

To add and subtract fractions and mixed numbers, use **equivalent fractions** with like denominators. You can use **common denominators** of two or more fractions to write equivalent fractions. A common denominator is a **common multiple** of two or more denominators.

Equivalent fractions are two or more fractions that name the same part or amount but have different denominators.

$$\frac{1}{3} = \frac{2}{6} = \frac{3}{9}$$

A **common denominator** is a common multiple of two or more denominators.

$\frac{1}{2}$ and $\frac{2}{5}$ have the common denominator 10.

A **common multiple** is a multiple that two or more numbers share.

Multiples of 3: 3, 6, 9, (12) . . .

Multiples of 4: 4, 8, (12) 16 . . .

3 and 4 have a common multiple of 12.

Example 1

Add $\frac{1}{6} + \frac{1}{4} + \frac{1}{3}$.

Strategy Use equivalent fractions with like denominators.

Step 1

Find a common denominator.

Find multiples of the greatest denominator, 6.

Multiples of 6: 6, 12, 18, 24, ...

Find the least multiple that is also a multiple of 4 and 3.

12 is a multiple of both 4 and 3. 12 is a common denominator.

Step 2

Write equivalent fractions using the common denominator.

Multiply the numerator and denominator by a factor that makes the denominator equal to 12.

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

$$\frac{1}{4} = \frac{1 \times 3}{4 \times 3} = \frac{3}{12}$$

$$\frac{1}{3} = \frac{1 \times 4}{3 \times 4} = \frac{4}{12}$$

Step 3

Add the fractions with like denominators.

$$\begin{aligned} \frac{1}{6} + \frac{1}{4} + \frac{1}{3} &= \frac{2}{12} + \frac{3}{12} + \frac{4}{12} \\ &= \frac{9}{12} \end{aligned}$$

Step 4

Simplify.

$$\frac{9}{12} = \frac{9 \div 3}{12 \div 3} = \frac{3}{4}$$

Step 5

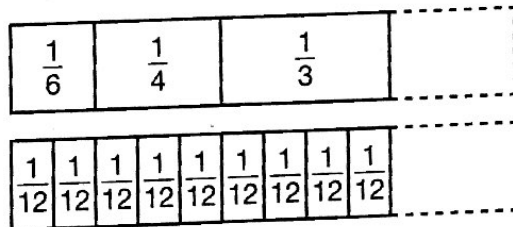
Use fraction strips to check the sum.

The model shows that

$$\frac{1}{6} + \frac{1}{4} + \frac{1}{3} = \frac{2}{12} + \frac{3}{12} + \frac{4}{12} = \frac{9}{12}$$

Solution

$$\frac{1}{6} + \frac{1}{4} + \frac{1}{3} = \frac{9}{12}, \text{ or } \frac{3}{4}$$



Example 2

Add $2\frac{2}{5} + 4\frac{2}{3}$.

Strategy Find a common denominator for the fraction parts.

Step 1 Find a common denominator.

You can multiply the denominators to find a common denominator.

$$5 \times 3 = 15$$

Step 2

Write equivalent fractions using the common denominator.

$$\frac{2}{5} = \frac{2 \times 3}{5 \times 3} = \frac{6}{15}$$

$$\frac{2}{3} = \frac{2 \times 5}{3 \times 5} = \frac{10}{15}$$

Step 3

Rewrite the mixed numbers using the common denominator.

$$2\frac{2}{5} = 2\frac{6}{15} \quad 4\frac{2}{3} = 4\frac{10}{15}$$

Step 4

Regroup the mixed numbers as the sum of the whole number parts and the fraction parts.

$$\begin{aligned} 2\frac{2}{5} + 4\frac{2}{3} &= 2\frac{6}{15} + 4\frac{10}{15} \\ &= \left(2 + \frac{6}{15}\right) + \left(4 + \frac{10}{15}\right) \\ &= (2 + 4) + \left(\frac{6}{15} + \frac{10}{15}\right) \end{aligned}$$

Step 5

Add the whole number parts. Add the fraction parts. Simplify.

$$\begin{aligned} (2 + 4) + \left(\frac{6}{15} + \frac{10}{15}\right) &= 6 + \frac{16}{15} \\ &= 6 + \frac{15}{15} + \frac{1}{15} \\ &= 6 + 1 + \frac{1}{15} \\ &= 7 + \frac{1}{15} \end{aligned}$$

Solution $2\frac{2}{5} + 4\frac{2}{3} = 7\frac{1}{15}$

Example 3

Subtract $\frac{5}{6} - \frac{1}{8}$.

Strategy Use equivalent fractions with like denominators.

Step 1 Find a common denominator.

Make a list of multiples of the greater denominator, 8.

Multiples of 8: 8, 16, 24, 32, 40, ...

Find the least multiple that is also a multiple of 6.

24 is a multiple of 6. 24 is a common denominator.

Step 2 Write equivalent fractions with the common denominator.

$$\frac{5}{6} = \frac{5 \times 4}{6 \times 4} = \frac{20}{24}$$

$$\frac{1}{8} = \frac{1 \times 3}{8 \times 3} = \frac{3}{24}$$

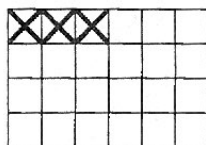
Step 3 Subtract the fractions with like denominators.

$$\begin{aligned}\frac{5}{6} - \frac{1}{8} &= \frac{20}{24} - \frac{3}{24} \\ &= \frac{17}{24}\end{aligned}$$

Step 4 Use addition to check your answer.

$$\frac{17}{24} + \frac{3}{24} = \frac{20}{24} \text{ or } \frac{5}{6} \checkmark$$

Step 5 Model the difference.



The model shows $\frac{5}{6}$ of the rectangle shaded.

20 out of 24 parts are shaded, so $\frac{20}{24}$ is shaded.

3 parts, or $\frac{1}{8}$ of the rectangle, are subtracted, with 17 shaded parts remaining.

$$\frac{5}{6} - \frac{1}{8} = \frac{17}{24}$$

Solution $\frac{5}{6} - \frac{1}{8} = \frac{17}{24}$

Sometimes when you subtract mixed numbers, you may need to change the mixed numbers to **improper fractions**. To change a mixed number to an improper fraction, first multiply the denominator and the whole number, then add the numerator. This gives the numerator of the improper fraction. The denominator of the improper fraction is the same as the fraction part of the mixed number.

$$2\frac{3}{5} = \frac{5 \times 2 + 3}{5} = \frac{13}{5}$$

Example 4

Subtract $2\frac{7}{10} - 1\frac{1}{4}$.

Strategy Change the mixed numbers to improper fractions. Then use equivalent fractions to find the difference.

Step 1

Write the mixed numbers as improper fractions.

$$2\frac{7}{10} = \frac{10 \times 2 + 7}{10} = \frac{27}{10}$$

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

Step 2

Find a common denominator.

Make a list of multiples of the greater denominator, 10.

Multiples of 10: 10, 20, 30, 40, 50, ...

20 is the least multiple that is also a multiple of 4.

Therefore, 20 is a common denominator.

Step 3

Write equivalent fractions with common denominators.

$$\frac{27}{10} = \frac{27 \times 2}{10 \times 2} = \frac{54}{20}$$

$$\frac{5}{4} = \frac{5 \times 5}{4 \times 5} = \frac{25}{20}$$

Step 4

Find the difference.

$$\begin{aligned} \frac{27}{10} - \frac{5}{4} &= \frac{54}{20} - \frac{25}{20} \\ &= \frac{29}{20} \end{aligned}$$

Write the improper fraction as a mixed number.

$$\frac{29}{20} = 29 \div 20 = 1 \text{ R}9 = 1\frac{9}{20}$$

Step 5

Use addition to check your answer.

$$\frac{29}{20} + \frac{25}{20} = \frac{54}{20} = 2\frac{14}{20} = 2\frac{7}{10} \checkmark$$

Solution $2\frac{7}{10} - 1\frac{1}{4} = 1\frac{9}{20}$

COACHED EXAMPLE

Find $\frac{1}{6} + \frac{5}{8} - \frac{2}{3}$.

Find a common denominator.

Make a list of multiples of the greatest denominator, 8.
 Multiples of 8: _____

Find the least multiple of 8 that is also a multiple of 3 and 6. _____

Write equivalent fractions with common denominators.

$$\frac{1}{6} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

$$\frac{5}{8} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

$$\frac{2}{3} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

Rewrite $\frac{1}{6} + \frac{5}{8} - \frac{2}{3}$ using common denominators, and find the answer.

$$\frac{1}{6} + \frac{5}{8} - \frac{2}{3} = \frac{\square}{\square} + \frac{\square}{\square} - \frac{\square}{\square}$$

$$= \frac{\square}{\square} - \frac{\square}{\square}$$

$$= \frac{\square}{\square}$$

Simplify.

$$= \frac{\square}{\square}$$

$$\frac{1}{6} + \frac{5}{8} - \frac{2}{3} = \frac{\square}{\square}$$

3 LESSON PRACTICE

1 Tim walked $\frac{3}{10}$ mile to the post office. Then he walked $\frac{1}{5}$ mile to the gym. What is the total distance that Tim walked?

- A. $\frac{1}{4}$ mile
- B. $\frac{4}{15}$ mile
- C. $\frac{2}{5}$ mile
- D. $\frac{1}{2}$ mile

2 Find the sum:

$$\frac{2}{3} + \frac{1}{6} + \frac{1}{5}$$

- A. $\frac{2}{15}$
- B. $\frac{2}{3}$
- C. $1\frac{1}{3}$
- D. $1\frac{1}{30}$

3 Which sum or difference is greater than 1 whole?

- A. $\frac{4}{7} + \frac{1}{3}$
- B. $\frac{7}{9} + \frac{1}{4}$
- C. $1\frac{1}{10} - \frac{1}{5}$
- D. $1\frac{3}{6} - \frac{3}{4}$

4 Which equation is false?

- A. $1\frac{5}{6} - \frac{1}{3} = 1\frac{3}{6}$
- B. $\frac{1}{2} + \frac{3}{4} = 1\frac{1}{4}$
- C. $\frac{3}{5} - \frac{1}{2} = \frac{2}{3}$
- D. $\frac{8}{10} + \frac{1}{3} = 1\frac{2}{15}$

5 Which expression has a value of $\frac{7}{12}$?

- A. $\frac{3}{4} + \frac{1}{6}$
- B. $\frac{2}{3} + \frac{1}{6}$
- C. $\frac{2}{3} + \frac{1}{4} - \frac{1}{12}$
- D. $\frac{3}{4} - \frac{1}{6}$

6 Which number makes the equation true?

$$\frac{4}{5} - \square = \frac{2}{15}$$

- A. $\frac{2}{10}$
- B. $\frac{1}{3}$
- C. $\frac{1}{2}$
- D. $\frac{2}{3}$

- 7 Which number could be used as a common denominator to find the sum of $\frac{1}{6} + \frac{5}{8}$?

A. 8
B. 12
C. 14
D. 24

- 8 The recipe shows the amounts of three ingredients used to make trail mix.

Trail Mix

$2\frac{1}{3}$ cups almonds

$1\frac{1}{8}$ cups sunflower seeds

$1\frac{3}{4}$ cups raisins

How many cups of trail mix will the recipe make?

A. $5\frac{5}{24}$ cups
B. $4\frac{5}{15}$ cups
C. $4\frac{5}{25}$ cups
D. $1\frac{5}{24}$ cups

- 9 Find the value of $\frac{5}{8} + \frac{2}{3} - \frac{1}{4}$.

A. $\frac{1}{4}$
B. $\frac{6}{7}$
C. $1\frac{1}{24}$
D. $1\frac{13}{24}$

- 10 Duval had $\frac{7}{8}$ quart of milk. He used $\frac{1}{6}$ quart for a recipe. How much milk does Duval have left?

A. $\frac{1}{4}$ quart
B. $\frac{17}{24}$ quart
C. $\frac{6}{8}$ quart
D. $1\frac{1}{24}$ quarts

- 11 Which number makes the equation true?

$$1\frac{5}{8} + \square = 5\frac{7}{24}$$

A. $3\frac{2}{3}$
B. $3\frac{5}{6}$
C. $4\frac{2}{6}$
D. $4\frac{2}{3}$

12 Which equation is true?

A. $1\frac{1}{5} + \frac{5}{6} = 1\frac{6}{30}$

B. $\frac{1}{4} - \frac{1}{12} = \frac{1}{8}$

C. $\frac{2}{3} - \frac{1}{5} = \frac{1}{15}$

D. $\frac{1}{2} + \frac{7}{8} = 1\frac{3}{8}$

13 Subtract: $1\frac{1}{8} - \frac{3}{4}$

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

B. $1\frac{5}{8}$

C. $\frac{3}{8}$

D. $\frac{3}{4}$

14 Which sum is less than 1 whole?

A. $\frac{1}{2} + \frac{1}{4} + \frac{1}{3}$

B. $\frac{2}{5} + \frac{1}{8} + \frac{3}{10}$

C. $\frac{1}{6} + \frac{1}{3} + \frac{5}{8}$

D. $\frac{2}{3} + \frac{1}{8} + \frac{1}{4}$

15 Nicholas is $1\frac{2}{3}$ feet taller than his brother Sam. Sam is $3\frac{3}{8}$ feet tall. How tall is Nicholas?

A. $2\frac{1}{5}$ feet

B. $1\frac{17}{24}$ feet

C. $4\frac{5}{11}$ feet

D. $5\frac{1}{24}$ feet

16 Sasha is having a lemonade sale.

- At the start of the sale, she has $\frac{3}{4}$ gallon of lemonade.
- She is worried that she won't have enough, so she makes another $\frac{2}{3}$ gallon of lemonade.
- She sells $\frac{5}{6}$ gallon of lemonade.

How much lemonade does she have left?

A. 0 gallons

B. $\frac{7}{12}$ gallon

C. $\frac{5}{6}$ gallon

D. $2\frac{1}{4}$ gallons

- 17 Which expression could be used to find the sum of $\frac{3}{5}$ and $\frac{1}{3}$?

- A. $\frac{5}{15} + \frac{9}{15}$
B. $\frac{1}{8} + \frac{3}{8}$
C. $\frac{1}{15} + \frac{3}{15}$
D. $\frac{1}{5} + \frac{3}{5}$

- 18 Which equation has a sum of $\frac{11}{12}$?

- A. $\frac{3}{4} + \frac{2}{3} + \frac{1}{12}$
B. $\frac{3}{4} + \frac{5}{6} + \frac{2}{3}$
C. $\frac{1}{4} + \frac{1}{2} + \frac{1}{6}$
D. $\frac{1}{3} + \frac{1}{4} + \frac{5}{12}$

- 19 The table below shows the amount of time Luis practiced his trumpet last week.

Day	Monday	Wednesday	Thursday
Time (in hours)	$1\frac{1}{3}$	$2\frac{1}{2}$	$1\frac{3}{4}$

Part A

Luis wants to find the total time he spent practicing. What is the first step he should take to add the times?

Part B

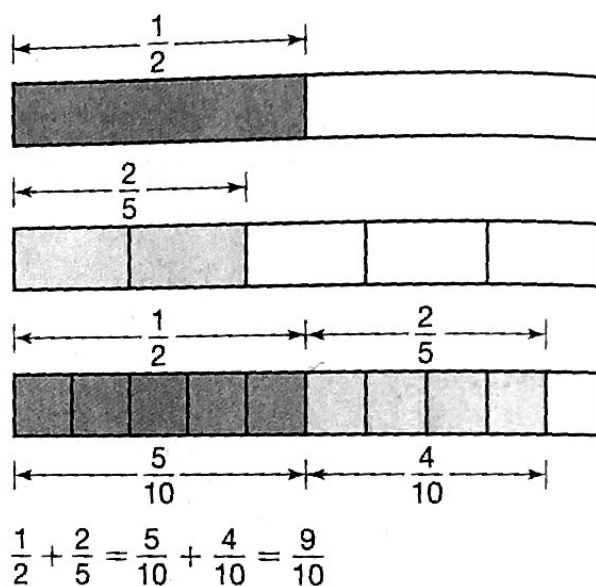
Find the total number of hours Luis practiced his trumpet. Show all your work.

Problem Solving: Adding and Subtracting Fractions and Mixed Numbers

1 GETTING THE IDEA

You can write **equations** and use models to add and subtract fractions in word problems.

For example, the model shows a snack made of $\frac{1}{2}$ cup almonds and $\frac{2}{5}$ cup cranberries.



Example 1

Lela bought $\frac{4}{5}$ yard of fabric to use on projects. She used $\frac{1}{4}$ yard on her first project. How much fabric does Lela have left?

Strategy Determine the operation needed to solve the problem. Write an equation.

Step 1 Write an equation.

You want to find out how much fabric is left after Lela uses some. Subtract to find out how much remains after some is taken away.

$$\frac{4}{5} - \frac{1}{4} = \square$$

Step 2 Write equivalent fractions using a common denominator.

A common denominator of $\frac{4}{5}$ and $\frac{1}{4}$ is 20.

$$\frac{4}{5} = \frac{4 \times 4}{5 \times 4} = \frac{16}{20} \quad \frac{1}{4} = \frac{1 \times 5}{4 \times 5} = \frac{5}{20}$$

Step 3 Subtract the fractions with like denominators.

$$\frac{4}{5} - \frac{1}{4} = \frac{16}{20} - \frac{5}{20} = \frac{11}{20}$$

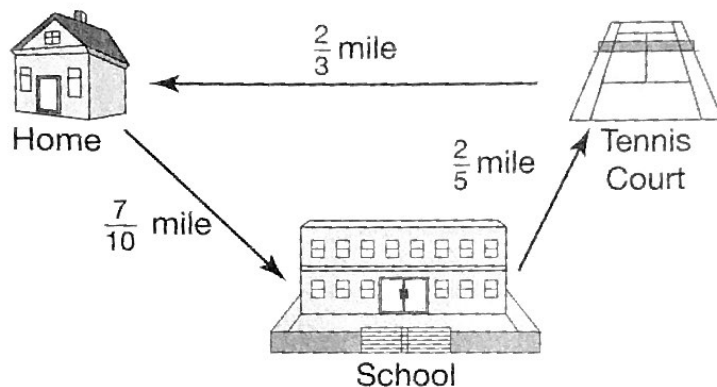
Step 4 Use addition to check your answer.

$$\frac{11}{20} + \frac{5}{20} = \frac{16}{20} \text{ or } \frac{4}{5} \checkmark$$

Solution Lela has $\frac{11}{20}$ yard of fabric left.

Example 2

On Mondays, Regan walks the route shown on the map. What is the total number of miles Regan walks on Mondays?



Strategy Determine the operation needed to solve the problem. Write an equation.

Step 1 Write an equation.

The three distances are shown on the map. Add to find the total.

$$\frac{7}{10} + \frac{2}{5} + \frac{2}{3} = \square$$

Step 2 Write equivalent fractions using a common denominator.

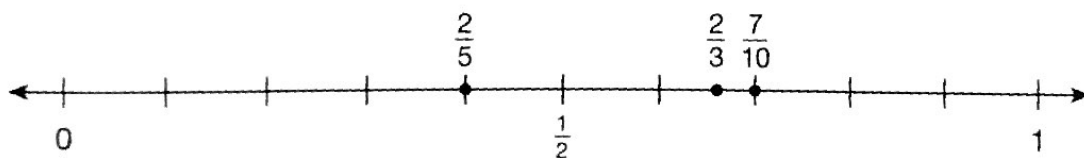
A common denominator of $\frac{7}{10}$, $\frac{2}{5}$, and $\frac{2}{3}$ is 30.

$$\frac{7}{10} = \frac{21}{30} \quad \frac{2}{5} = \frac{12}{30} \quad \frac{2}{3} = \frac{20}{30}$$

Step 3 Add the fractions with like denominators.

$$\frac{7}{10} + \frac{2}{5} + \frac{2}{3} = \frac{21}{30} + \frac{12}{30} + \frac{20}{30} = \frac{53}{30}, \text{ or } 1\frac{23}{30}$$

Step 4 Use benchmark fractions to determine if your answer is reasonable.



All three fractions are closer to $\frac{1}{2}$ than to 0 or 1. Estimate the sum.

$$\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 1\frac{1}{2}. \leftarrow \text{This is close to } 1\frac{23}{30}. \text{ The answer is reasonable.}$$

Solution Regan walks $1\frac{23}{30}$ total miles on Mondays.

Example 3

Sanjay is making fruit punch for his birthday party. He uses $1\frac{1}{4}$ quarts of juice and $2\frac{1}{2}$ quarts of sparkling water. How much fruit punch does he make?

Strategy Determine the operation needed to solve the problem. Write an equation.

Step 1 Write an equation.

You can add the amounts of the two ingredients to find the total amount of fruit punch.

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

Step 2 Rewrite the mixed numbers with common denominators.

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

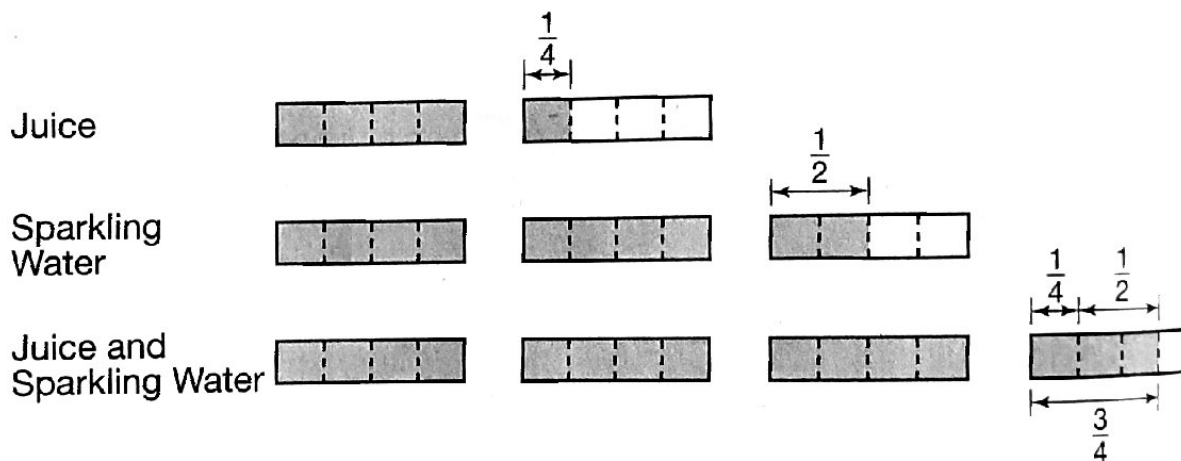
Step 3 Regroup the mixed numbers as the sum of the whole number parts and the sum of the mixed number parts.

$$1\frac{1}{4} + 2\frac{2}{4} = (1 + 2) + \left(\frac{1}{4} + \frac{2}{4}\right)$$

Step 4 Add the whole number parts and add the fraction parts.

$$(1 + 2) + \left(\frac{1}{4} + \frac{2}{4}\right) = 3\frac{3}{4}$$

Step 5 Use a model to check your answer.



$$1\frac{1}{4} + 2\frac{1}{2} = 3\frac{3}{4}$$

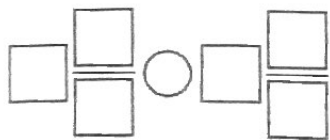
Solution Sanjay makes $3\frac{3}{4}$ quarts of fruit punch.

2 COACHED EXAMPLE

Savannah bought a spool of $3\frac{2}{3}$ yards of twine. She used $1\frac{3}{4}$ yards of twine for a project. How much twine does she have left?

Write an equation.

To find out how much she has left, which operation should you use? _____



Write the mixed numbers as improper fractions.

$$3\frac{2}{3} = \frac{\square \times \square + \square}{\square} = \frac{\square}{\square}$$

$$1\frac{5}{6} = \frac{\square \times \square + \square}{\square} = \frac{\square}{\square}$$

Write the improper fractions with a common denominator.

$$\frac{\square}{\square} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

$$\frac{\square}{\square} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

$$\frac{\square}{\square} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

$$\frac{\square}{\square} = \frac{\square \times \square}{\square \times \square} = \frac{\square}{\square}$$

_____ the improper fractions with like denominators.

$$\frac{\square}{\square} - \frac{\square}{\square} = \frac{\square}{\square}$$

Rewrite the improper fraction as a mixed number.

$$\frac{\square}{\square} = \square \frac{\square}{\square}$$

Savannah has _____ yards of twine left.

3 LESSON PRACTICE

- 1** On Saturday, Ana worked $\frac{1}{4}$ of a day washing cars for a fundraiser. On Sunday, she worked $\frac{1}{3}$ of a day babysitting. How much did she work on Saturday and Sunday combined?
- A. $\frac{1}{12}$ day
B. $\frac{1}{7}$ day
C. $\frac{1}{6}$ day
D. $\frac{7}{12}$ day
- 2** Randy has $2\frac{1}{6}$ feet of ribbon. She estimates that she will have less than 1 foot of ribbon left after using $1\frac{3}{4}$ feet for a project. Which best explains whether her estimation is reasonable?
- A. Her estimation is correct because after using 1 foot she will have $1\frac{1}{6}$ feet left. Since $\frac{3}{4}$ is more than $\frac{1}{6}$, she will have to use part of the other whole foot.
B. Her estimation is incorrect because she is only using 1 whole foot of ribbon and part of another, so she will still have a whole foot and part of another one left.
C. Her estimation is incorrect because $2\frac{1}{6}$ and $1\frac{3}{4}$ is almost 3 whole feet.
D. Her estimation is correct because when you subtract a fraction, your answer is always less than 1.
- 3** Meg bought two pieces of ribbon to decorate a picture frame. One piece was $\frac{3}{5}$ yard. The other piece was $\frac{1}{2}$ yard long. What is the total length of ribbon Meg bought?
- A. $\frac{1}{10}$ yard
B. $\frac{2}{5}$ yard
C. $\frac{4}{7}$ yard
D. $1\frac{1}{10}$ yards
- 4** Ines has $\frac{3}{5}$ quart of orange juice. She drinks $\frac{1}{3}$ quart. How much orange juice does she now have?
- A. $\frac{2}{15}$ quart
B. $\frac{4}{15}$ quart
C. $\frac{14}{15}$ quart
D. $\frac{2}{2}$ quart
- 5** Dion grated $\frac{1}{2}$ cup of cheese for a pasta dish. The recipe calls for $\frac{2}{3}$ cup. Which equation shows how Dion could find out how much more cheese he needs to grate?
- A. $\frac{1}{2} + \frac{2}{3} = \frac{3}{5}$
B. $\frac{1}{2} + \frac{2}{3} = 1\frac{1}{6}$
C. $\frac{1}{2} - \frac{2}{3} = \frac{1}{3}$
D. $\frac{2}{3} - \frac{1}{2} = \frac{1}{6}$

6 Jake and Paco each ordered a small pizza. Jake ate $\frac{7}{8}$ of his pizza. Paco ate $\frac{2}{3}$ of his pizza. How much more pizza did Jake eat than Paco?

- A. $\frac{5}{24}$ of a pizza
- B. $\frac{5}{8}$ of a pizza
- C. $\frac{5}{5}$ of a pizza
- D. $1\frac{13}{24}$ of a pizza

7 Nico is combining granola, nuts, and raisins to make $1\frac{3}{4}$ cups of snacks. Which of the following combinations of raisins, nuts, and granola could he use to have a total of $1\frac{3}{4}$ cups of snacks?

- A. $\frac{2}{3}$ cup granola
 $\frac{1}{8}$ cup nuts
 $\frac{1}{12}$ cup raisins
- B. $\frac{3}{4}$ cup granola
 $\frac{1}{2}$ cup nuts
 $\frac{2}{3}$ cup raisins
- C. 1 cup granola
 $\frac{2}{3}$ cup nuts
 $\frac{1}{12}$ cup raisins
- D. 1 cup granola
 $\frac{1}{4}$ cup nuts
 $\frac{1}{8}$ cup raisins

8 Nana wants to paint her bedroom walls light blue. She will mix $\frac{3}{8}$ gallon white and $\frac{1}{2}$ gallon blue paint to get the shade she wants. Which expression could be used to find the total amount of paint that Nana mixes?

- A. $\frac{3}{8} + \frac{1}{8}$
- B. $\frac{3}{4} + \frac{2}{4}$
- C. $\frac{3}{8} - \frac{1}{2}$
- D. $\frac{3}{8} + \frac{4}{8}$

9 Kade made $\frac{5}{6}$ cup salad dressing. He uses $\frac{2}{3}$ cup dressing on a salad. How much salad dressing is left?

- A. $\frac{1}{6}$ cup
- B. $\frac{1}{3}$ cup
- C. $\frac{1}{2}$ cup
- D. $1\frac{1}{2}$ cups

10 Tandi tapes together two pieces of paper to make a banner. One piece is $2\frac{3}{5}$ feet long. The second piece of paper is $3\frac{1}{3}$ feet long. How long is the banner that Tandi makes?

- A. $\frac{11}{15}$ foot
- B. $5\frac{4}{15}$ feet
- C. $5\frac{1}{2}$ feet
- D. $5\frac{14}{15}$ feet

- 6** Jake and Paco each ordered a small pizza. Jake ate $\frac{7}{8}$ of his pizza. Paco ate $\frac{2}{3}$ of his pizza. How much more pizza did Jake eat than Paco?
- A. $\frac{5}{24}$ of a pizza
 B. $\frac{5}{8}$ of a pizza
 C. $\frac{5}{5}$ of a pizza
 D. $1\frac{13}{24}$ of a pizza
- 7** Nico is combining granola, nuts, and raisins to make $1\frac{3}{4}$ cups of snacks. Which of the following combinations of raisins, nuts, and granola could he use to have a total of $1\frac{3}{4}$ cups of snacks?
- A. $\frac{2}{3}$ cup granola
 $\frac{1}{8}$ cup nuts
 $\frac{1}{12}$ cup raisins
 B. $\frac{3}{4}$ cup granola
 $\frac{1}{2}$ cup nuts
 $\frac{2}{3}$ cup raisins
 C. 1 cup granola
 $\frac{2}{3}$ cup nuts
 $\frac{1}{12}$ cup raisins
 D. 1 cup granola
 $\frac{1}{4}$ cup nuts
 $\frac{1}{8}$ cup raisins

- 8** Nana wants to paint her bedroom walls light blue. She will mix $\frac{3}{8}$ gallon white and $\frac{1}{2}$ gallon blue paint to get the shade she wants. Which expression could be used to find the total amount of paint that Nana mixes?
- A. $\frac{3}{8} + \frac{1}{8}$
 B. $\frac{3}{4} + \frac{2}{4}$
 C. $\frac{3}{8} - \frac{1}{2}$
 D. $\frac{3}{8} + \frac{4}{8}$
- 9** Kade made $\frac{5}{6}$ cup salad dressing. He uses $\frac{2}{3}$ cup dressing on a salad. How much salad dressing is left?
- A. $\frac{1}{6}$ cup
 B. $\frac{1}{3}$ cup
 C. $\frac{1}{2}$ cup
 D. $1\frac{1}{2}$ cups
- 10** Tandi tapes together two pieces of paper to make a banner. One piece is $2\frac{3}{5}$ feet long. The second piece of paper is $3\frac{1}{3}$ feet long. How long is the banner that Tandi makes?
- A. $\frac{11}{15}$ foot
 B. $5\frac{4}{15}$ feet
 C. $5\frac{1}{2}$ feet
 D. $5\frac{14}{15}$ feet

- 11** Kate is planting a garden. She will plant $\frac{3}{10}$ of her garden with herbs, and $\frac{3}{5}$ of her garden will be vegetables. She will plant flowers in the rest of her garden. Which statement about Kate's garden is true?

- A. $\frac{1}{2}$ of Kate's garden is herbs and flowers.
 B. $\frac{7}{10}$ of Kate's garden is flowers and vegetables.
 C. $\frac{6}{10}$ of Kate's garden is herbs and vegetables.
 D. $\frac{1}{5}$ of Kate's garden is flowers.

- 12** Mrs. Hooper is filling her sand table with sand. She needs 7 pounds of sand in all. The table below shows the weights of different sizes of bags of sand.

Size	Small	Medium	Large
Weight (in pounds)	$1\frac{1}{4}$	$2\frac{2}{3}$	$3\frac{1}{12}$

Which combination of bags of sand could she buy so that she has the exact amount of sand needed to fill the sand table?

- A. 2 medium bags and 1 small bag
 B. 2 large bags and 1 small bag
 C. 1 small bag, 1 medium bag, and 1 large bag
 D. 1 medium bag and 1 large bag

Use the recipe for questions 13 and 14.

Yuriko wants to follow the recipe to make her fruit salad.

Fruit Salad

- $\frac{1}{3}$ cup blueberries
 $\frac{5}{8}$ cup strawberries
 $\frac{5}{6}$ cup apples

- 13** Yuriko only has $\frac{1}{2}$ cup strawberries. How much more does she need to make the fruit salad?

- A. $\frac{1}{8}$ cup
 B. $\frac{1}{4}$ cup
 C. $\frac{4}{8}$ cup
 D. $1\frac{1}{8}$ cups

- 14** How much fruit salad will the recipe make?

- A. $\frac{11}{24}$ cup
 B. $\frac{11}{17}$ cup
 C. $1\frac{3}{8}$ cups
 D. $1\frac{19}{24}$ cups

- 15** Henry has $2\frac{1}{3}$ pounds of Swiss cheese and $1\frac{3}{8}$ pounds of cheddar cheese. Which expression can be used to find how much more Swiss cheese he has than cheddar?

- A. $2\frac{1}{8} - 1\frac{3}{8}$
 B. $\frac{9}{24} - \frac{7}{24}$
 C. $\frac{56}{24} - \frac{33}{24}$
 D. $2\frac{1}{3} + 1\frac{3}{8}$

- 16** Tiana and Liz are painting a wall together. Tiana has painted $\frac{1}{6}$ of the wall. Liz has painted $\frac{2}{3}$ of the wall. How much of the wall do they still have to paint?

- A. $\frac{1}{12}$ of the wall
 B. $\frac{1}{6}$ of the wall
 C. $\frac{1}{2}$ of the wall
 D. $\frac{5}{6}$ of the wall

- 17** The table below shows the ingredients, in cups, that Rosa used in her smoothie recipe.

Berry Delicious Smoothie

Mixed Berries	Yogurt	Milk
$2\frac{1}{2}$ cups	$1\frac{1}{3}$ cups	$1\frac{1}{4}$ cups

Part A

Write each mixed number as an improper fraction. Find a common denominator. Then write equivalent fractions for the improper fractions. Show all your work.

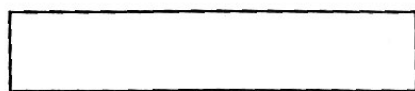
Part B

Find the total number of cups of ingredients in Rosa's smoothie. Show all your work.

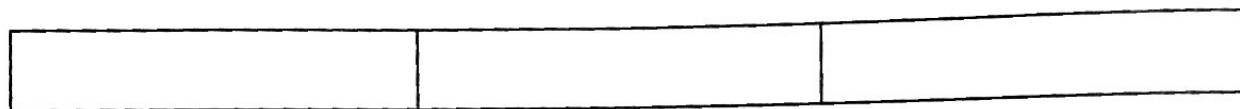
Interpreting Multiplication of Fractions

1 GETTING THE IDEA

Sometimes multiplication can be used for scaling, or resizing. Cody drew a rectangle that is 5 centimeters long. He drew another rectangle that has the same width, but it is 3 times as long.



5 centimeters



5×3 centimeters, or 15 centimeters

When you multiply 5 by 3, the product has a value equal to 3 groups of 5. Since this is more than one 5, the product is greater than the factor 5.

When you multiply a given number by a number greater than 1, such as a mixed number, the product is greater than the given number.

Example 1

Multiply $5 \times 2\frac{2}{3}$. How does the product compare to 5?

Strategy Use the distributive property.

Step 1 Use the distributive property to rewrite the problem.

$$\begin{aligned} 5 \times 2\frac{2}{3} &= 5 \times \left(2 + \frac{2}{3}\right) \\ &= (5 \times 2) + \left(5 \times \frac{2}{3}\right) \end{aligned}$$

Step 2 Multiply.

$$\begin{aligned} (5 \times 2) + \left(5 \times \frac{2}{3}\right) &= 10 + \left(\frac{5}{1} \times \frac{2}{3}\right) \\ &= 10 + \frac{10}{3} \\ &= 10 + 3\frac{1}{3} \\ &= 13\frac{1}{3} \end{aligned}$$

Step 3 Compare the product to 5.

$$13\frac{1}{3} > 5$$

Solution The product, $13\frac{1}{3}$, is greater than 5.

When you multiply a given number by a number less than 1, such as a fraction, the product is less than the given number.

Example 2

How does the product of $5 \times \frac{3}{4}$ compare to 5? Justify your answer.

Strategy Use reasoning.

Step 1 Determine what $5 \times \frac{3}{4}$ means.

$5 \times \frac{3}{4}$ means there are 5 groups of $\frac{3}{4}$.

Step 2 Use reasoning to compare the product of 5 groups of $\frac{3}{4}$ to 5.

5 groups of 1 has a product of 5.

Because $\frac{3}{4} < 1$, the product of 5 groups of $\frac{3}{4}$ will be less than 5.

Solution The product of 5×1 is 5. Since $\frac{3}{4} < 1$, the product of $5 \times \frac{3}{4}$ is less than 5.

You can use similar reasoning to determine what happens when you multiply a fraction by a mixed number or a fraction.

Example 3

How does the product of $\frac{3}{4} \times 2\frac{2}{3}$ compare to $\frac{3}{4}$? Justify your answer.

Strategy Use reasoning.

Step 1 Compare the factor $2\frac{2}{3}$ to 1.

$$2\frac{2}{3} > 1$$

Step 2 Use reasoning to compare the product to $\frac{3}{4}$.

$\frac{3}{4} \times 1$ has a product of $\frac{3}{4}$.

Because $2\frac{2}{3} > 1$, the product of $\frac{3}{4} \times 2\frac{2}{3}$ is greater than $\frac{3}{4}$.

Solution Since $2\frac{2}{3} > 1$, the product of $\frac{3}{4} \times 2\frac{2}{3}$ is greater than $\frac{3}{4}$.

2 COACHED EXAMPLE

How does the product of $\frac{2}{5} \times \frac{3}{4}$ compare to $\frac{2}{5}$ and to $\frac{3}{4}$? Explain your reasoning.

Determine how the product of $\frac{2}{5} \times \frac{3}{4}$ compares to $\frac{2}{5}$.

Compare the factor $\frac{3}{4}$ to 1.

$$\frac{3}{4} \bigcirc 1$$

$\frac{2}{5} \times 1$ is _____. Since $\frac{3}{4} \bigcirc 1$, the product of $\frac{2}{5} \times \frac{3}{4}$ is _____ than $\frac{2}{5}$.

Determine how the product of $\frac{2}{5} \times \frac{3}{4}$ compares to $\frac{3}{4}$.

Compare the factor $\frac{2}{5}$ to 1.

$$\frac{2}{5} \bigcirc 1$$

$\frac{3}{4} \times 1$ is _____. Since $\frac{2}{5} \bigcirc 1$, the product of $\frac{2}{5} \times \frac{3}{4}$ is _____ than $\frac{3}{4}$.

The product of $\frac{2}{5} \times \frac{3}{4}$ is _____ than $\frac{2}{5}$ and _____ than $\frac{3}{4}$ because

3 LESSON PRACTICE

1 Which comparison is true?

A. $\frac{3}{8} \times \frac{5}{6} < \frac{3}{8}$

B. $\frac{3}{8} \times \frac{7}{8} > \frac{3}{8}$

C. $\frac{3}{8} \times 1 > \frac{3}{8}$

D. $\frac{3}{8} \times 1\frac{1}{2} < \frac{3}{8}$

2 Which product is less than 7?

A. $7 \times \frac{7}{7}$

B. $7 \times 7\frac{1}{7}$

C. $7 \times \frac{9}{16}$

D. $7 \times 2\frac{1}{7}$

3 During basketball practice, Tamika made 24 free throws. Kara made $1\frac{3}{8}$ times as many free throws as Tamika. Rosie made $\frac{5}{6}$ as many free throws as Tamika. Which statement is true?

- A. Tamika made more free throws than Kara.
- B. Kara made more free throws than Rosie.
- C. Tamika made fewer free throws than Rosie.
- D. Kara made fewer free throws than Tamika.

4 Which of the following correctly describes the product of $\frac{7}{12}$ and $\frac{5}{12}$.

A. The product of $\frac{7}{12}$ and $\frac{5}{12}$ is less than $\frac{7}{12}$ but greater than $\frac{5}{12}$.

B. The product of $\frac{7}{12}$ and $\frac{5}{12}$ is less than $\frac{5}{12}$ but greater than $\frac{7}{12}$.

C. The product of $\frac{7}{12}$ and $\frac{5}{12}$ is greater than both $\frac{5}{12}$ and $\frac{7}{12}$.

D. The product of $\frac{7}{12}$ and $\frac{5}{12}$ is less than both $\frac{5}{12}$ and $\frac{7}{12}$.

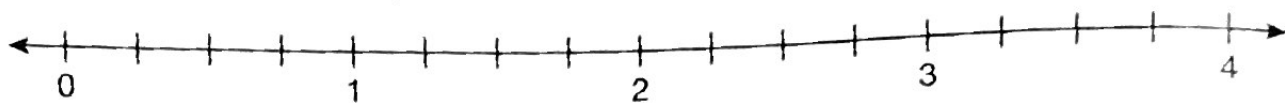
5 Mitch hiked $1\frac{1}{2}$ miles on Friday.

On Saturday, he hiked $\frac{3}{4}$ times as far as he did on Friday. On Sunday, he hiked $\frac{7}{8}$ times as far as he did on Saturday.

Which list shows the days that Mitch hiked in order from the day he hiked the least distance to the day he hiked the greatest distance?

- A. Friday, Saturday, Sunday
- B. Saturday, Sunday, Friday
- C. Sunday, Saturday, Friday
- D. Saturday, Friday, Sunday

- 6 Tanya correctly graphed the product of $2\frac{3}{4} \times \frac{3}{4}$ on a number line like the one shown. Which statement correctly describes the location of her point?



- A. The point that represents the product is to the left of $2\frac{3}{4}$ and to the right of $\frac{3}{4}$.
- B. The point that represents the product is to the right of $2\frac{3}{4}$ and the left of $\frac{3}{4}$.
- C. The point that represents the product is to the right of both $2\frac{3}{4}$ and $\frac{3}{4}$.
- D. The point that represents the product is to the left of both $2\frac{3}{4}$ and $\frac{3}{4}$.
-
- 7 Which comparison is true?
- A. $\frac{2}{3} \times \frac{3}{3} = \frac{2}{3}$
- B. $\frac{2}{3} \times 1\frac{1}{3} < \frac{2}{3}$
- C. $\frac{3}{3} \times 1\frac{1}{3} < 1\frac{1}{3}$
- D. $\frac{2}{3} \times \frac{4}{3} < \frac{2}{3}$
- 8 Which product is less than $\frac{1}{4}$?
- A. $\frac{1}{4} \times \frac{5}{5}$
- B. $\frac{1}{4} \times \frac{1}{2}$
- C. $1\frac{1}{8} \times \frac{1}{4}$
- D. $4 \times \frac{1}{4}$
- 9 Mrs. Ortega's class is taking a survey of how much sleep fifth graders get.
- Drew said that he usually sleeps for $9\frac{1}{4}$ hours.
 - Van reported that he sleeps $1\frac{1}{8}$ times as long as Drew.
 - Angie stated that she sleeps $\frac{7}{8}$ as long as Drew.
 - Becca said that she sleeps $1\frac{3}{16}$ as long as Drew.
- Which statement is true?
- A. Angie sleeps longer than Drew.
- B. Drew sleeps longer than Van.
- C. Becca sleeps less than Van.
- D. Drew sleeps less than Becca.

10 Which product is greater than 3?

A. $\frac{2}{3} \times 3$

B. $3 \times \frac{9}{8}$

C. $3 \times \frac{2}{2}$

D. $\frac{4}{5} \times 3$

11 Which correctly compares the product of $1\frac{1}{8} \times \frac{4}{5}$ to the factors?

A. The product is greater than $1\frac{1}{8}$ and less than $\frac{4}{5}$.

B. The product is less than $1\frac{1}{8}$ and greater than $\frac{4}{5}$.

C. The product is greater than both $1\frac{1}{8}$ and $\frac{4}{5}$.

D. The product is less than both $1\frac{1}{8}$ and $\frac{4}{5}$.

12 Which comparison is false?

A. $\frac{5}{6} \times \frac{7}{8} < \frac{7}{8}$

B. $1\frac{5}{6} \times \frac{1}{2} < 1\frac{5}{6}$

C. $\frac{7}{8} \times \frac{7}{7} = \frac{7}{8}$

D. $1\frac{1}{2} \times 1\frac{5}{6} < 1\frac{5}{6}$

Use the following information to answer questions 13 and 14.

Gabriella lives in Oklahoma. The land area of Oklahoma is 68,667 square miles. Gabriella read these facts about the size of other states compared to Oklahoma.

- Arizona is about $1\frac{2}{3}$ the size of Oklahoma.
- Florida is about $\frac{4}{5}$ the size of Oklahoma.
- Vermont is about $\frac{1}{8}$ the size of Oklahoma.
- California is about $2\frac{1}{4}$ the size of Oklahoma.
- Alaska is about $8\frac{1}{3}$ the size of Oklahoma.

13 Which state has a land area that is less than the land area of Oklahoma?

- A. Florida
- B. Alaska
- C. Arizona
- D. California

14 Which state has a land area that is greater than the land area of Arizona?

- A. Oklahoma
- B. Vermont
- C. California
- D. Florida

15 Which correctly compares the product of $1\frac{2}{5} \times 5\frac{1}{8}$ to its factors?

- A. The product is less than $1\frac{2}{5}$ and greater than $5\frac{1}{8}$.
- B. The product is less than $5\frac{1}{8}$ and greater than $1\frac{2}{5}$.
- C. The product is less than both $5\frac{1}{8}$ and $1\frac{2}{5}$.
- D. The product is greater than both $5\frac{1}{8}$ and $1\frac{2}{5}$.

16 Which comparison is true?

- A. $1\frac{1}{7} \times \frac{4}{4} > \frac{4}{4}$
- B. $2\frac{1}{3} \times \frac{3}{4} < \frac{3}{4}$
- C. $\frac{2}{7} \times \frac{6}{8} > \frac{2}{7}$
- D. $\frac{5}{4} \times \frac{7}{8} > \frac{7}{8}$

17 Kenneth built a robot that is $9\frac{1}{4}$ inches tall. He plans to make a scale drawing of the robot. To find the dimensions for the drawing, Kenneth will multiply each dimension of the actual robot by the same factor.

Part A

Describe a factor that Kenneth should use to make a scale drawing that is taller than $9\frac{1}{4}$ inches. Use words, numbers, or models to justify your answer.

Part B

Describe a factor that Kenneth should use to make a scale drawing that is shorter than $9\frac{1}{4}$ inches. Use words, numbers, or models to justify your answer.