Operations with Fractions

Just for Fun

Fraction Word Search

Can you find this list of words in the word search table at the right?

Words can be horizontal, vertical, or diagonal.

SIMPLIFY
FRACTION
IMPROPER
MIXED
NUMERATOR
PART
EQUIVALENT
WHOLE

K	V	W	W	X	J	J	O	S	E
F	Q	P	U	K	M	P	P	Q	W
R	O	T	A	R	E	M	U	N	V
A	E	T	W	W	F	I	U	Z	X
C	D	P	H	P	V	X	Y	A	M
T	K	H	O	A	Q	E	N	N	L
I	E	Z	L	R	E	D	W	F	G
O	M	E	E	T	P	U	Z	M	Q
N	N	E	W	F	O	M	H	W	I
T	C	S	I	M	P	L	I	F	Y

A Game for 2 or more

Compose It

Make as many words as you can from the letters of the word "fraction." Words must contain at least four letters. The person with the most words after 3 minutes wins!

A Game for 2 or more

Winfrac

Play with one or more classmates.

You will need two 8- or 10-sided dice, a pencil, and paper.

Take turns to roll the two dice. Use the 2 numbers to create a proper fraction.

The player with the larger fraction wins a point.

The first player to reach 10 points wins the game.

Activating Prior Knowledge

Equivalent Fractions

➢ $\frac{1}{3}, \frac{2}{6}, \frac{3}{9}$, and $\frac{4}{12}$ are equivalent fractions. To find equivalent fractions, multiply or divide the numerator and denominator by the same number.

Check

1. Write 3 equivalent fractions for each fraction.

a) $\frac{6}{24}$ _____ b) $\frac{21}{14}$ _____ c) $\frac{30}{72}$ _____

Relating Mixed Numbers and Improper Fractions

➢ To convert $3\frac{5}{8}$ to an improper fraction:

$3\frac{5}{8} = 3 + \frac{5}{8}$

$= \frac{24}{8} + \frac{5}{8}$

$= \frac{29}{8}$

➢ To convert $\frac{17}{5}$ to a mixed number:

$\frac{17}{5} = \frac{15}{5} + \frac{2}{5}$

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

Check

2. Convert each mixed number to an improper fraction.

a) $3\frac{4}{5} =$ _____ b) $5\frac{4}{9} =$ _____ c) $3\frac{7}{20} =$ _____ d) $2\frac{1}{24} =$ _____

$= \frac{\square}{5} +$ _____

$=$ _____

3. Convert each improper fraction to a mixed number.

a) $\frac{27}{8} = \frac{\square}{8} + \frac{\square}{8}$ b) $\frac{41}{18} =$ _____ c) $\frac{41}{15} =$ _____ d) $\frac{29}{12} =$ _____

$=$ _____

Adding and Subtracting Fractions

➢ To add or subtract fractions with the same denominator, add or subtract the numerators.

$\frac{1}{5} + \frac{2}{5} = \frac{3}{5}$ $\frac{9}{13} - \frac{3}{13} = \frac{6}{13}$

➤ To add or subtract fractions with different denominators:

- Use the least common multiple of the denominators as the common denominator.
- Write equivalent fractions with this common denominator.

To add $\frac{1}{4}+\frac{5}{6}$, find the least common multiple of 4 and 6.

The least common multiple of 4 and 6 is 12.

$$\frac{1}{4}+\frac{5}{6}=\frac{3}{12}+\frac{10}{12}$$
$$=\frac{13}{12}$$

To subtract $\frac{5}{8}-\frac{1}{12}$, find the least common multiple of 8 and 12.

The least common multiple of 8 and 12 is 24.

$$\frac{5}{8}-\frac{1}{12}=\frac{15}{24}-\frac{2}{24}$$
$$=\frac{13}{24}$$

➤ To add or subtract mixed numbers, add or subtract the fractions and then add or subtract the whole numbers. Sometimes, you need to regroup a whole number to subtract the fractions. Simplify if necessary.

$$2\tfrac{1}{4}+3\tfrac{5}{6}=2\tfrac{3}{12}+3\tfrac{10}{12}$$
$$=5\tfrac{13}{12}$$
$$=5+1\tfrac{1}{12}$$
$$=6\tfrac{1}{12}$$

$$5\tfrac{1}{8}-3\tfrac{1}{2}=5\tfrac{1}{8}-3\tfrac{4}{8}$$
$$=4\tfrac{9}{8}-3\tfrac{4}{8}$$
$$=1\tfrac{5}{8}$$

Check

4. Add. Write the answer in simplest form. Write improper fractions as mixed numbers.

a) $\frac{7}{10}+\frac{1}{6}=$ _____ + _____
$=$ _____
$=$ _____

b) $\frac{1}{2}+\frac{3}{7}=$ _____

c) $3\frac{1}{3}+4\frac{1}{2}=$ _____
$=$ _____

d) $2\frac{5}{6}+1\frac{3}{8}=$ _____

5. Subtract. Write the answer in simplest form. Write improper fractions as mixed numbers.

a) $\frac{3}{4}-\frac{3}{10}=$ _____
$=$ _____

b) $\frac{5}{8}-\frac{1}{6}=$ _____

c) $4\frac{1}{9}-2\frac{2}{3}=4\frac{1}{9}-2\frac{\square}{9}$
$=3\frac{\square}{9}-$ _____
$=$ _____

d) $7\frac{1}{4}-3\frac{5}{6}=$ _____

3.1 Using Models to Multiply Fractions and Whole Numbers

Quick Review

➤ Repeated addition can be written as multiplication.

$\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=5\times\frac{1}{3}$

$=\frac{5}{3}$

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

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

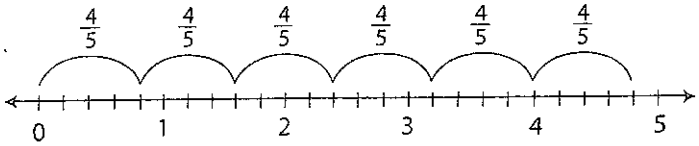
$\frac{4}{5}+\frac{4}{5}+\frac{4}{5}+\frac{4}{5}+\frac{4}{5}=6\times\frac{4}{5}$

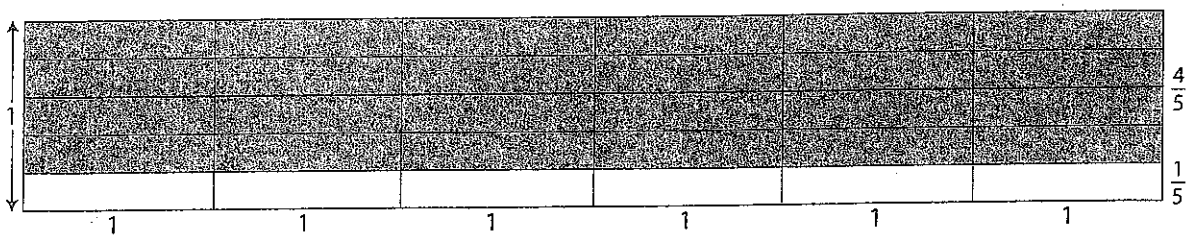
$=\frac{24}{5}$

$=\frac{20}{5}+\frac{4}{5}$

$=4\frac{4}{5}$

$6\times\frac{4}{5}=4\frac{4}{5}$ can also be shown on a number line or using a rectangle.





Practice

1. Write each addition statement as a multiplication statement and determine the product.

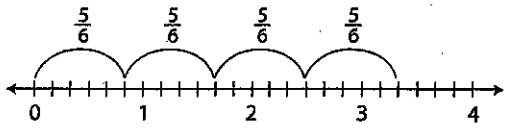
a) $\frac{5}{7}+\frac{5}{7}+\frac{5}{7}+\frac{5}{7}=$ _____ $\times\frac{5}{7}$

$=\frac{\square}{7}$

$=\square\frac{\square}{7}$

b) $\frac{7}{8}+\frac{7}{8}+\frac{7}{8}+\frac{7}{8}+\frac{7}{8}=$ _____ c) $\frac{2}{3}+\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=$ _____ d) $\frac{7}{12}+\frac{7}{12}+\frac{7}{12}+\frac{7}{12}+\frac{7}{12}+\frac{7}{12}=$ _____

2. Write the multiplication sentence represented by each number line.

a) 

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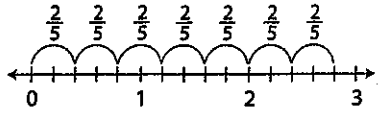
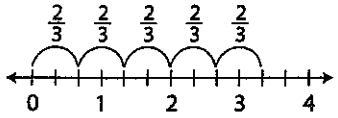
b) 

_____

c) 

_____

3. Multiply. Use a model to help.

a) $3 \times \frac{7}{12} =$ _____ b) $20 \times \frac{3}{4} =$ _____ c) $\frac{2}{3} \times 18 =$ _____

d) $\frac{4}{9} \times 10 =$ _____ e) $6 \times \frac{3}{4} =$ _____ f) $\frac{5}{8} \times 9 =$ _____

4. Match each multiplication to the correct product.

a) $2 \times \frac{4}{5}$	i) $7\frac{1}{2}$
b) $\frac{3}{8}$ of 13	ii) $4\frac{2}{3}$
c) $5 \times \frac{3}{4}$	iii) $1\frac{3}{5}$
d) $9 \times \frac{5}{6}$	iv) $3\frac{3}{4}$
e) $\frac{2}{3} \times 7$	v) $4\frac{7}{8}$

5. It takes $\frac{3}{4}$ h to frame a picture. How long will it take to frame 13 pictures?

It will take _____ h to frame 13 pictures.

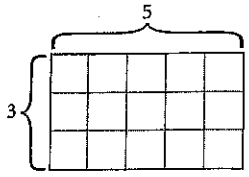
3.2 Using Models to Multiply Fractions

Quick Review

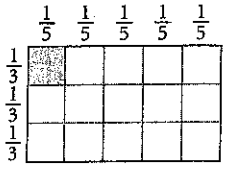
At Home / At School

Area models are useful for visualizing multiplication.

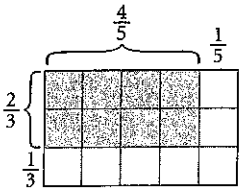
- The area of a rectangle is length multiplied by width.
  A 5 by 3 rectangle covers 15 unit squares.
  So, $5 \times 3 = 15$.



- To model $\frac{1}{5} \times \frac{1}{3}$, draw a 5 by 3 rectangle.
  The rectangle has 15 equal parts.
  A horizontal row of 5 squares represents $\frac{1}{3}$ of the rectangle.
  $\frac{1}{5}$ of this row of $\frac{1}{3}$ covers 1 of the 15 parts.
  So, $\frac{1}{5} \times \frac{1}{3} = \frac{1}{15}$.



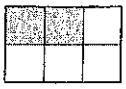
- 2 horizontal rows of 5 squares represent $\frac{2}{3}$ of the rectangle.
  $\frac{4}{5}$ of these 2 horizontal rows of 5 covers 8 of the 15 parts.
  So, $\frac{4}{5} \times \frac{2}{3} = \frac{8}{15}$.



Practice

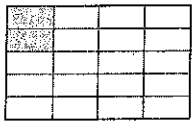
1. Write the multiplication sentence modelled by the shaded region in each rectangle.

a)



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

b)



$\frac{1}{4} \times$ _____ = _____

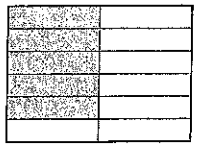
Tip

Write all fractions in simplest form.

c)

_____

d)

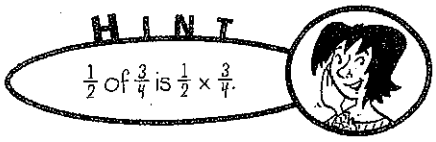


_____

2. Draw an area model for each product. Then find the product.
Write all fractions in simplest form.
Models may vary.

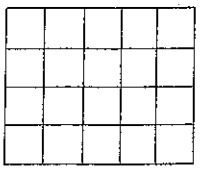
a) $\frac{1}{4} \times \frac{3}{4} =$ _____ b) $\frac{1}{2} \times \frac{2}{3} =$ _____

3. Tom took $\frac{3}{4}$ of a pie. He could only eat $\frac{1}{2}$ of what he took. What fraction of the pie did Tom eat?



_____

4. Use the area model below to calculate each product.



$\frac{1}{5} \times \frac{1}{4} =$ _____ $\frac{2}{5} \times \frac{3}{4} =$ _____ $\frac{3}{5} \times \frac{1}{4} =$ _____ $\frac{1}{5} \times \frac{1}{2} =$ _____ $\frac{3}{5} \times \frac{1}{2} =$ _____

Look for a pattern in the numbers. Describe a relationship between the numerator and the denominator of each answer fraction and those of the fractions being multiplied.

_____

_____

_____

_____

5. Determine each product.

a) $\frac{3}{4} \times \frac{2}{5} =$ _____ b) $\frac{5}{8} \times \frac{2}{3} =$ _____ c) $\frac{4}{7} \times \frac{2}{3} =$ _____ d) $\frac{2}{3} \times \frac{7}{10} =$ _____

3.3 Multiplying Fractions

Quick Review

At Home / At School

➢ To multiply fractions without using a model, multiply the numerators and multiply the denominators.

$\frac{3}{4} \times \frac{2}{5} = \frac{3 \times 2}{4 \times 5} = \frac{6}{20} = \frac{3}{10}$

➢ If the numerators and denominators have common factors, divide by the common factors before multiplying.

$\frac{5}{12} \times \frac{8}{12} = \frac{5 \times 8}{12 \times 15}$

$= \frac{\cancel{5}^{1} \times \cancel{8}^{2}}{\cancel{12}^{3} \times \cancel{15}^{3}}$

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

$= \frac{2}{9}$

$5 \div 5 = 1$	$8 \div 4 = 2$
$12 \div 4 = 3$	$15 \div 5 = 3$

Practice

1. Multiply.

a) $\frac{3}{8} \times \frac{4}{15} = \frac{3 \times 4}{8 \times 15}$

_____ is the greatest common factor for 3 and 15.

_____ is the greatest common factor for 4 and 8.

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

$=$ _____

b) $\frac{3}{5} \times \frac{5}{6} =$ _____ c) $\frac{3}{4} \times \frac{7}{9} =$ _____ d) $\frac{8}{9} \times \frac{3}{10} =$ _____ d) $\frac{13}{9} \times \frac{3}{26} =$ _____

2. Simplify before multiplying. Express products as proper fractions.

a) $\frac{7}{3} \times \frac{9}{14} =$ _____ b) $\frac{15}{8} \times \frac{10}{9} =$ _____ c) $\frac{15}{4} \times \frac{2}{9} =$ _____ d) $\frac{12}{5} \times \frac{10}{9} =$ _____

3. Multiply.

a) $\frac{15}{8} \times \frac{3}{5} =$ _____ b) $\frac{6}{7} \times \frac{2}{3} =$ _____ c) $\frac{5}{6} \times \frac{3}{10} =$ _____ d) $\frac{7}{15} \times \frac{10}{21} =$ _____

4. Multiply. Estimate to check that each product is reasonable.

a) $\frac{44}{35} \times \frac{7}{33} =$ _____ b) $\frac{34}{33} \times \frac{22}{17} =$ _____ c) $\frac{57}{91} \times \frac{14}{19} =$ _____ d) $\frac{39}{64} \times \frac{24}{13} =$ _____

5. Match each multiplication to the correct product.

a) $\frac{5}{6} \times \frac{2}{7}$	i) $\frac{1}{4}$
b) $\frac{3}{2} \times \frac{1}{6}$	ii) $\frac{1}{6}$
c) $\frac{8}{9} \times \frac{9}{8}$	iii) $\frac{5}{21}$
d) $\frac{3}{4} \times \frac{2}{9}$	iv) 1

6. In the school band, $\frac{3}{5}$ of the students play the trumpet. Of these, $\frac{1}{6}$ also play the trombone. What fraction of the students in the band play both trumpet and trombone?

_____ of the students in the band play both trumpet and trombone.

7. Jeremy ate $\frac{1}{3}$ of an apple pie. Sara ate $\frac{1}{4}$ of the remainder. What fraction of the pie did Sara eat?

_____ of the pie was left after Jeremy had his share. So, Sara ate ____ × ____ = ____ of the pie.

8. Leona spent $\frac{5}{8}$ of $\frac{2}{3}$ of her allowance on magazines. What fraction of her total allowance did she spend on magazines? What fraction did she have left?

Leona spent ____ of her allowance on magazines. She had 1 − ____ = ____ of her allowance left.

3.4 Multiplying Mixed Numbers

Quick Review

At Home

➤ An area model is often useful for visualizing a multiplication.

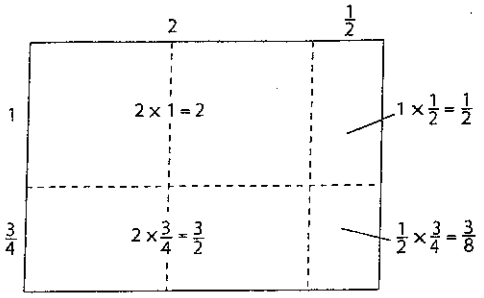
$$2\tfrac{1}{2} \times 1\tfrac{3}{4} = (2\times1)+\left(\tfrac{1}{2}\times1\right)+\left(2\times\tfrac{3}{4}\right)+\left(\tfrac{1}{2}\times\tfrac{3}{4}\right)$$

$$= 2 + \tfrac{1}{2} + \tfrac{3}{2} + \tfrac{3}{8}$$

$$= \tfrac{16}{8} + \tfrac{4}{8} + \tfrac{12}{8} + \tfrac{3}{8}$$

$$= \tfrac{35}{8}$$

$$= 4\tfrac{3}{8}$$



➤ Another way to multiply mixed numbers is to first convert to improper fractions.

Multiply: $1\tfrac{1}{5} \times 3\tfrac{1}{8}$

$$1\tfrac{1}{5} \times 3\tfrac{1}{8} = \tfrac{6}{5} \times \tfrac{25}{8}$$

$$= \frac{\cancel{6}^{3} \times \cancel{25}^{5}}{\cancel{5}^{1} \times \cancel{8}^{4}}$$

$$= \tfrac{15}{4}$$

$$= 3\tfrac{3}{4}$$

$6 \div 2 = 3$ $\quad$ $25 \div 5 = 5$
$5 \div 5 = 1$ $\quad$ $8 \div 2 = 4$

Practice

1. Write each mixed number as an improper fraction.

a) $2\tfrac{3}{5} =$ _____ b) $4\tfrac{3}{4} =$ _____ c) $3\tfrac{1}{6} =$ _____ d) $1\tfrac{7}{12} =$ _____

2. Write each improper fraction as a mixed number.

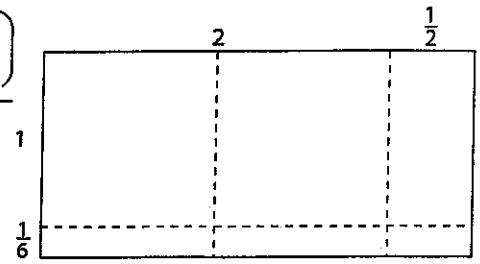
a) $\tfrac{43}{8} =$ _____ b) $\tfrac{19}{6} =$ _____ c) $\tfrac{17}{3} =$ _____ d) $\tfrac{27}{4} =$ _____

3. a) Show the product $1\frac{1}{6} \times 1\frac{1}{2}$ on the rectangle. State the product.

$1\frac{1}{6} \times 2\frac{1}{2} = (\_\_\_\_) + (\_\_\_\_) + (\_\_\_\_) + (\_\_\_\_)$

$= 2 + \_\_\_\_$

$= \_\_\_\_$



b) Draw an area model to show the product $2\frac{1}{4} \times 1\frac{1}{3}$. Determine the product.

$2\frac{1}{4} \times 1\frac{1}{3} = \_\_\_\_$

4. Multiply. Express answers as proper fractions.

a) $2\frac{5}{8} \times 1\frac{5}{7} = \_\_\_\_$

$= \_\_\_\_$

$= \_\_\_\_$

b) $2\frac{1}{10} \times 2\frac{2}{3} = \_\_\_\_$

c) $1\frac{1}{8} \times 3\frac{1}{3} = \_\_\_\_$

d) $2\frac{1}{4} \times 2\frac{2}{3} = \_\_\_\_$

e) $4\frac{2}{5} \times 2\frac{1}{7} = \_\_\_\_$

f) $4\frac{4}{5} \times 2\frac{1}{4} = \_\_\_\_$

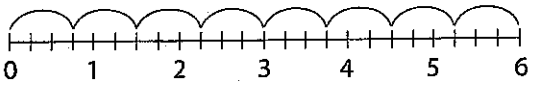
5. George practises his guitar for $1\frac{1}{5}$ h per day on school days. On Saturdays, he increases his practice time to $2\frac{1}{2}$ times his normal time. How many hours does he practise on Saturdays?

3.5 Dividing Whole Numbers and Fractions

Quick Review

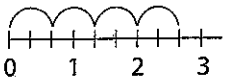
A number line can be used to help divide a whole number by a fraction.

➤ To determine how many three-quarters there are in 6, divide 6 into quarters.
Arrange 24 quarters into groups of three.
There are 8 groups of three-quarters.



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

➤ To determine how many two-thirds there are in 3, divide 6 into thirds.
Arrange 18 thirds into groups of two-thirds.
There are 4 groups of two-thirds and one-third left over.



$\frac{1}{3}$ is $\frac{1}{2}$ of $\frac{2}{3}$.

So, $3 \div \frac{2}{3} = 4\frac{1}{2}$

To find $\frac{4}{5} \div 3$, think of sharing $\frac{4}{5}$ into 3 equal parts.

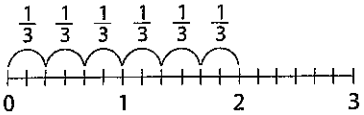
Each part is $\frac{1}{3}$ of $\frac{4}{5}$, or $\frac{1}{3} \times \frac{4}{5} = \frac{4}{15}$

So, $\frac{4}{5} \div 3 = \frac{4}{15}$

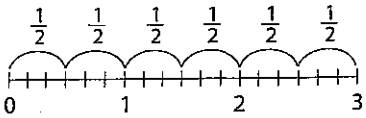
Practice

1. Use the number line to determine each quotient.

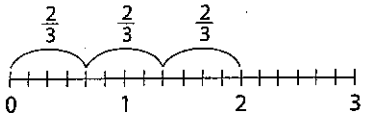
a) $2 \div \frac{1}{3} =$ ____



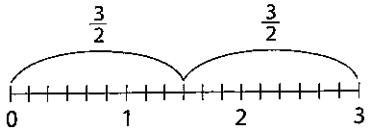
b) $3 \div \frac{1}{2} =$ ____



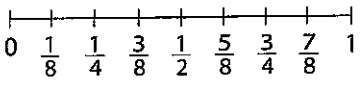
c) $2 \div \frac{2}{3} =$ ____



d) $3 \div \frac{3}{2} =$ ____



2. Use the number line to determine each quotient.



a) $\frac{1}{2} \div 4 =$ ____

b) $\frac{1}{4} \div 2 =$ ____

c) $\frac{3}{4} \div 2 =$ ____

d) $\frac{7}{8} \div 2 =$ ____

3. Use fraction circles, a number line, or a picture to determine each quotient.

a) $2 \div \frac{1}{7} =$ _____ b) $3 \div \frac{1}{3} =$ _____ c) $5 \div \frac{5}{6} =$ _____ d) $6 \div \frac{3}{5} =$ _____

4. Determine each quotient.

a) $2 \div \frac{3}{4} =$ _____ b) $3 \div \frac{2}{3} =$ _____ c) $2 \div \frac{3}{8} =$ _____ d) $2 \div \frac{3}{5} =$ _____

e) $\frac{3}{5} \div 2 =$ _____ f) $\frac{3}{4} \div 5 =$ _____ g) $\frac{5}{6} \div 2 =$ _____ h) $\frac{1}{2} \div 2 =$ _____

6. a) Two-thirds of a bag of candies is shared equally among 6 people. What fraction of the candies does each person receive?

Each person receives _____ of the bag of candies.

b) How many two-thirds cup servings are in 12 cups of fruit?

There are _____ two-thirds cup servings in 12 cups of fruit.

7. a) Write the digits 3, 4, and 12 in the boxes to obtain the greatest quotient. Is there more than one answer?

$$\square \div \frac{\square}{\square} = \_\_\_\_\_$$

b) Write the digits 3, 4, and 12 in the boxes to obtain the least quotient. Is there more than one answer?

$$\square \div \frac{\square}{\square} = \_\_\_\_\_$$

3.6 Dividing Fractions

Quick Review

At Home / At School

There are at least two ways to divide fractions.

➢ Use common denominators

To divide: $\frac{3}{4} \div \frac{1}{6}$

Write the fractions with common denominator 12:

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

How many two-twelfths are in nine-twelfths?

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

So, $\frac{3}{4} \div \frac{1}{6} = 4\frac{1}{2}$

➢ You can also divide by a fraction by multiplying by the reciprocal.

To divide: $\frac{4}{5} \div \frac{2}{3}$

The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

$\frac{4}{5} \div \frac{2}{3} = \frac{4}{5} \times \frac{3}{2}$

$= \frac{6}{5}$

$= 1\frac{1}{5}$

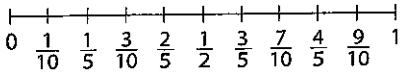
Practice

1. Write the reciprocal of each fraction.

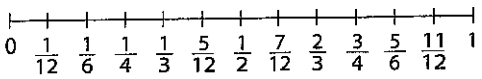
a) $\frac{4}{7}$ _____ b) $\frac{3}{8}$ _____ c) $\frac{11}{15}$ _____ d) $\frac{7}{8}$ _____

2. Use the number line to determine each quotient.

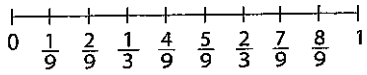
a) $\frac{9}{10} \div \frac{2}{5} =$ _____



b) $\frac{2}{3} \div \frac{1}{4} =$ _____



c) $\frac{2}{3} \div \frac{4}{9} =$ _____



3. Divide. Estimate to check that each quotient is reasonable.

a) $\frac{6}{7} \div \frac{3}{7}$ There are _____ three-sevenths in six-sevenths. So, $\frac{6}{7} \div \frac{3}{7} =$ _____

b) $\frac{8}{9} \div \frac{5}{9} =$_____ **c)** $\frac{4}{5} \div \frac{3}{5} =$_____ **d)** $\frac{7}{8} \div \frac{3}{8} =$_____

4. Use common denominators to determine each quotient.

a) $\frac{7}{8} \div \frac{1}{4} = \frac{7}{8} \div \frac{\square}{8}$ There are _____-eighths in seven-eighths. So, $\frac{7}{8} \div \frac{1}{4} =$_____

b) $\frac{4}{5} \div \frac{1}{10} =$ _____ **c)** $\frac{3}{4} \div \frac{2}{5} =$_____ **d)** $\frac{6}{7} \div \frac{1}{3} =$ _____

5. Divide by multiplying by the reciprocal.

a) $\frac{9}{4} \div \frac{2}{3} = \frac{9}{4} \times$_____ **b)** $\frac{7}{3} \div \frac{4}{5} =$_____ **c)** $\frac{5}{2} \div \frac{3}{8} =$_____ **d)** $\frac{3}{4} \div \frac{9}{2} =$_____

$=$ _____

$=$ _____

6. Suppose you have $\frac{3}{4}$ of a cake. How many servings of each size can you make?

a) $\frac{1}{4}$ of the cake _____ **b)** $\frac{1}{6}$ of the cake _____

c) $\frac{1}{3}$ of the cake _____ **d)** $\frac{1}{2}$ of the cake _____

7. How many pieces of ribbon, each $\frac{1}{6}$ m long, can be cut from a ribbon $\frac{7}{8}$ m long?

_____ pieces of ribbon can be cut. That is 5 whole pieces of ribbon with _____ of a piece,

or _____ m, left over.

3.7 Dividing Mixed Numbers

Quick Review

At Home / At School

To divide mixed numbers without using a model, use either of the following methods.

Divide: $2\frac{5}{6} \div 1\frac{1}{4}$

➤ Write each mixed number as an improper fraction and then use common denominators.

$2\frac{5}{6} \div 1\frac{1}{4} = \frac{17}{6} \div \frac{5}{4}$

$= \frac{34}{12} \div \frac{15}{12}$

$= 34 \div 15$

$= \frac{34}{15}$, or $2\frac{4}{15}$

➤ Use multiplication.

$2\frac{5}{6} \div 1\frac{1}{4} = \frac{17}{6} \div \frac{5}{4}$

Dividing by $\frac{5}{4}$ is the same as multiplying by $\frac{4}{5}$.

So, $\frac{17}{6} \div \frac{5}{4} = \frac{17}{6} \times \frac{4}{5}$

$= \frac{17 \times \overset{2}{\cancel{4}}}{\underset{3}{\cancel{6}} \times 5}$

$= \frac{34}{15}$, or $2\frac{4}{15}$

Practice

1. Write each mixed number as an improper fraction.

a) $4\frac{5}{8} =$ _____ b) $3\frac{5}{7} =$ _____ c) $2\frac{5}{12} =$ _____ d) $3\frac{4}{9} =$ _____

2. Write each pair of mixed numbers as improper fractions with the same denominator.

a) $2\frac{1}{3}, 4\frac{1}{6}$

Write the fraction part of each mixed number with the same denominator, ____:

$2\frac{1}{3} = 2$____ $4\frac{1}{6} = 4$____

Write each mixed number as an improper fraction: _____

b) $3\frac{3}{5}, 2\frac{1}{10}$ _____ c) $4\frac{1}{5}, 2\frac{1}{2}$ _____ d) $2\frac{1}{4}, 1\frac{2}{3}$ _____

3. Use common denominators to determine each quotient. Estimate to check that the quotients are reasonable.

a) $4\frac{3}{4} \div 2\frac{1}{2} = \frac{\square}{4} \div \frac{\square}{2}$

$= \frac{\square}{4} \div \frac{\square}{4}$

$=$ _____ $\div$ _____

$=$ _____, or _____

b) $5\frac{1}{3} \div 2\frac{2}{9} =$ _____ **c)** $3\frac{1}{2} \div 2\frac{1}{3} =$ _____ **d)** $4\frac{4}{5} \div 1\frac{1}{2} =$ _____

4. Divide by multiplying by the reciprocal. Estimate to check that the quotients are reasonable.

a) $3\frac{1}{2} \div 2\frac{1}{4} = \frac{\square}{2} \div \frac{\square}{4}$

$= \frac{7}{2} \times$ _____

$=$ _____, or _____

b) $5\frac{5}{6} \div 2\frac{7}{9} =$ _____ **c)** $4\frac{1}{4} \div 1\frac{5}{12} =$ _____ **d)** $4\frac{4}{5} \div 2\frac{2}{3} =$ _____

5. Divide. Estimate to check that the quotients are reasonable.

a) $2\frac{3}{4} \div 1\frac{1}{8} =$ _____ **b)** $3\frac{3}{4} \div 2\frac{2}{5} =$ _____ **c)** $5\frac{1}{2} \div 2\frac{1}{3} =$ _____ **d)** $5\frac{1}{5} \div 2\frac{1}{10} =$ _____

6. Paula ran $3\frac{1}{3}$ laps in $13\frac{1}{3}$ min. If she ran at a steady pace, how long did it take her to run one lap?

It took Paula _____ min to run one lap.

7. Jonathon took $7\frac{1}{2}$ h to complete his project. He worked on the project for $1\frac{1}{2}$ h each evening. How many evenings did Jonathon take to complete the project?

Jonathon took _____ evenings to complete the project.

8. Which of the following quotients is the greatest? What is its value?

A $6\frac{2}{7} \div 1\frac{5}{7} =$ _____ **B** $6\frac{3}{10} \div 1\frac{3}{4} =$ _____ **C** $7\frac{1}{5} \div 2\frac{2}{15} =$ _____

The product in part _____ is the greatest. Its value is _____.

3.8 Solving Problems with Fractions

Quick Review

At Home / At School

➤ When solving word problems, it is important to understand the problem. This is best done by explaining in your own words, drawing diagrams, or listing the steps required to obtain a solution. It also helps if you identify key words and related mathematical operations.

Parent-teacher interviews were held on Tuesday. Mr. Smith had 3 interviews that each lasted $\frac{3}{4}$ h, 5 interviews that lasted $\frac{1}{4}$ h each, and 4 that lasted $\frac{1}{3}$ h each. How long did Mr. Smith spend on interviews?

The question is asking for the total time.

3 interviews at $\frac{3}{4}$ h each suggests multiplying: $3 \times \frac{3}{4}\text{ h} = \frac{9}{4}\text{ h}$

5 interviews at $\frac{1}{4}$ h each suggests multiplying: $5 \times \frac{1}{4}\text{ h} = \frac{5}{4}\text{ h}$

4 interviews at $\frac{1}{3}$ h each suggests multiplying: $4 \times \frac{1}{3}\text{ h} = \frac{4}{3}\text{ h}$

Total time suggests adding:

$$\left(\frac{9}{4}+\frac{5}{4}+\frac{4}{3}\right)\text{h} = \left(\frac{27}{12}+\frac{15}{12}+\frac{16}{12}\right)\text{h}$$

$$= \frac{58}{12}\text{ h}$$

$$= \frac{29}{6}\text{ h}$$

$$= 4\frac{5}{6}\text{ h}$$

Mr. Smith spent $4\frac{5}{6}$ h in interviews.

Practice

1. Which operation (addition, subtraction, multiplication, division) would you use to solve each problem?

a) Jon ate one-third of a bag of candies and Monika ate one-quarter of the bag. What fraction of the bag of candies did they eat? _____

b) How many three-quarter cups of milk can be poured from a 6-cup jug of milk? _____

c) There are 186 students in grade 8. Two thirds of them have brown eyes. How many students have brown eyes? _____

2. Solve each problem in question 1.

a) Jon and Monika ate _____ + _____ of the bag of candies.

_____ + _____ = _____ + _____

= _____

Jon and Monika ate _____ of the bag of candies.

b) _____ three-quarter cups of milk can be poured from a 6-cup jug of milk

c) _____ students have brown eyes.

3. Maribeth works in a dog rescue centre. At feeding time, 5 of the dogs each get $\frac{3}{4}$ kg of food and 3 dogs each get $\frac{3}{5}$ kg of food. How much food does Maribeth feed to the dogs?

Maribeth feeds _____ kg of food to the dogs.

4. A recipe calls for $3\frac{3}{4}$ cups of flour and 2 cups of sugar. Teri wants to make $\frac{1}{3}$ of the recipe. How much flour and sugar does she need?

Teri needs _____ cups of flour and _____ cups of sugar.

5. Fiona has $2\frac{4}{7}$ kg of rice that she wants to share equally among 6 people. How much rice does each person get?

Each person gets _____ kg of rice.

6. Vonnie works in an engine repair shop where she replaces the oil after the engines have been repaired. She has $11\frac{2}{3}$ L of oil and each engine requires $1\frac{1}{6}$ L of oil. How many engines can she fill with oil?

Vonnie can fill _____ engines with oil.

7. A jug contains $3\frac{3}{4}$ cups of juice. Halla pours $\frac{5}{8}$ cups of juice into each of three glasses.

a) How much juice does she pour into the glasses? _____ cups

b) How much juice is left in the jug? _____ cups

8. How many $1\frac{5}{8}$-m pieces of ribbon can be cut from a ribbon $9\frac{3}{4}$ m long?

_____ pieces of ribbon

9. Sara spends $\frac{2}{5}$ of her salary on rent and $\frac{1}{3}$ of the remainder on food.

a) What fraction of her salary is left after Sara pays the rent?

_____ of her salary is left after she pays the rent.

b) What fraction of her salary is left after she pays for rent and food?

_____ of her salary is left after she pays for rent and food.

10. Justin spent $\frac{1}{3}$ of his money on clothes and $\frac{1}{4}$ on music videos. He then spent $\frac{3}{5}$ of the remainder on food.

a) What fraction of his money did Justin spend on clothes and videos?

_____ of his money

b) What fraction of his money did Justin spend on food?

_____ of his money

c) What fraction of his money did Justin spend altogether?

_____ of his money

3.9 Order of Operations with Fractions

Quick Review

At Home / At School

➤ The order of operations for fractions is the same as for whole numbers.
Do the operations in brackets first.
Then divide and multiply, in order, from left to right.
Then add and subtract, in order, from left to right.

$\frac{3}{14} \div \left(\frac{5}{8} - \frac{1}{4}\right) + \frac{2}{7} = \frac{3}{14} \div \left(\frac{5}{8} - \frac{2}{8}\right) + \frac{2}{7}$ Write the fractions in the brackets with common denominators.

$= \frac{3}{14} \div \frac{3}{8} + \frac{2}{7}$ Do the operation in the brackets first.

$= \frac{3}{14} \times \frac{8}{3} + \frac{2}{7}$ Divide by multiplying by the reciprocal.

$= \frac{\cancel{3}^{1} \times \cancel{8}^{4}}{\cancel{14}_{7} \times \cancel{3}_{1}} + \frac{2}{7}$

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

$= \frac{6}{7}$ Add.

Practice

1. Which operation would you do first?

a) $\frac{7}{8} \div \left(\frac{3}{4} + \frac{3}{8}\right)$ _____

b) $\frac{7}{9} - \frac{5}{9} \times \frac{1}{4}$ _____

c) $\left(\frac{9}{16} - \frac{3}{4}\right) \times \frac{5}{8}$ _____

d) $\frac{3}{4} \times \left(\frac{3}{4} - \frac{1}{4} \div \frac{1}{2}\right)$ _____

2. Elise was asked to evaluate $1\frac{1}{3} \div \frac{3}{4} \times \frac{2}{3}$. Her work is shown below. Is her answer correct? Explain.

$1\frac{1}{3} \div \frac{3}{4} \times \frac{2}{3} = \frac{4}{3} \div \frac{1}{2}$

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

$= \frac{8}{3}$

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

Her answer *is/is not* correct.

_____

3. Evaluate. Show all steps.

a) $\left(\frac{1}{2}+\frac{2}{3}\right)\times\frac{1}{7}=$

b) $\left(1-\frac{1}{4}\right)\div\left(1+\frac{3}{4}\right)=$

c) $\frac{1}{3}\div\left(\frac{5}{6}\times\frac{1}{4}\right)=$

d) $\frac{4}{7}\times\frac{3}{5}-\frac{1}{5}=$

4. Evaluate.

a) $\frac{7}{9}\times\frac{3}{5}-\frac{1}{6}\div\frac{5}{2}=$ _____

b) $\frac{1}{8}+\frac{3}{4}\div\frac{5}{8}-\frac{4}{5}=$ _____

c) $\frac{6}{7}\div\frac{3}{22}\times\frac{7}{11}\div\frac{8}{9}=$ _____

d) $\frac{11}{12}+\frac{5}{6}\times\frac{3}{4}-\frac{5}{6}=$ _____

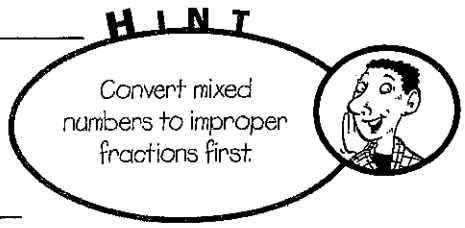
5. Evaluate.

a) $3\frac{1}{3}\div4\frac{1}{6}\times2\frac{1}{4}=$ _____

b) $\frac{4}{5}\times\frac{5}{8}\div\frac{5}{8}\times\frac{3}{4}=$ _____

c) $\frac{5}{12}\div\frac{3}{8}\div\frac{3}{4}\times\frac{9}{10}=$ _____

d) $3\frac{1}{2}\div5\frac{1}{3}\times1\frac{1}{3}\div1\frac{1}{6}=$ _____



6. Evaluate.

a) $\left(\frac{5}{9}+\frac{2}{3}\right)\div\left(\frac{3}{4}+\frac{5}{8}\right)=$ _____

b) $\frac{9}{16}-\left(\frac{3}{4}-\frac{2}{3}\right)\times\frac{3}{4}=$ _____

c) $1\frac{3}{5}\times\left(\frac{5}{8}+\frac{3}{4}-\frac{5}{6}\right)=$ _____

d) $\left(\frac{9}{16}\div\frac{5}{12}\right)-\left(\frac{2}{5}\times\frac{7}{8}\right)=$ _____

e) $2\frac{2}{3}\times1\frac{1}{8}+\left(2\frac{3}{4}+1\frac{3}{8}\right)=$ _____

f) $\left(4\frac{5}{8}-2\frac{3}{4}\right)\div\left(2\frac{1}{3}+1\frac{1}{6}\right)=$ _____

In Your Words

Here are some of the important mathematical words of this unit.
Build your own glossary by recording definitions and examples here. The first one is done for you.

proper and improper fractions

proper fractions have numerator less than denominator; improper fractions have numerator greater than denominator

simplest form of a fraction

reciprocal of a fraction

mixed number

quotient

order of operations

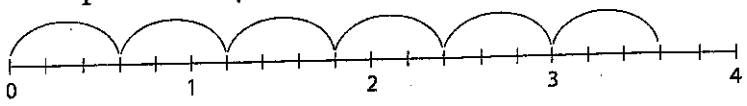
List other mathematical words you need to know.

Unit Review

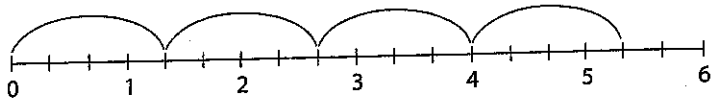
LESSON

3.1 **1.** Write the multiplication sentence represented by each number line.

a) _____

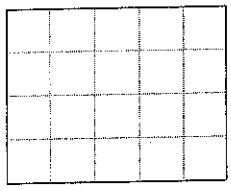


b) _____

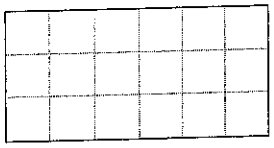


3.2 **2.** Shade each rectangle to show the product.

a) $\frac{3}{4} \times \frac{2}{5}$



b) $\frac{1}{3} \times \frac{5}{6}$



3.3 **3.** Multiply. Estimate to check that the solutions are reasonable.

a) $\frac{3}{4} \times \frac{8}{9} =$ _____

b) $\frac{5}{16} \times \frac{4}{15} =$ _____

c) $\frac{7}{6} \times \frac{8}{21} =$ _____

4. Claude mowed $\frac{1}{4}$ of the lawn before lunch. After lunch he mowed $\frac{2}{3}$ of the uncut lawn. What fraction of the lawn did Claude mow altogether?

Before he started mowing after lunch, Claude had _____ of the lawn left to mow.

Claude mowed _____ of the lawn altogether.

3.4 **5.** Write each mixed number as an improper fraction.

a) $3\frac{3}{5} =$ _____

b) $4\frac{7}{8} =$ _____

c) $1\frac{11}{16} =$ _____

LESSON

6. Multiply.

a) $3\frac{3}{8} \times 3\frac{1}{3} =$ _____ b) $2\frac{2}{5} \times 6\frac{2}{3} =$ _____ c) $1\frac{5}{12} \times 2\frac{5}{8} =$ _____

3.5 **7.** Use a model to determine each quotient.

a) $4 \div \frac{2}{3} =$ _____ b) $5 \div \frac{3}{4} =$ _____ c) $\frac{3}{5} \div \frac{3}{4} =$ _____

3.6 **8.** Divide.

a) $\frac{5}{12} \div \frac{10}{11} =$ _____ b) $\frac{3}{7} \div \frac{9}{14} =$ _____ c) $\frac{3}{5} \div \frac{5}{6} =$ _____

3.7 **9.** Divide. Estimate to check that the quotients are reasonable.

a) $2\frac{1}{4} \div 1\frac{7}{8} =$ _____ b) $1\frac{3}{4} \div 2\frac{4}{5} =$ _____ c) $3\frac{3}{4} \div 2\frac{1}{12} =$ _____

10. A recipe for chocolate cake calls for $1\frac{1}{4}$ cups of chocolate chips. Hasim has $7\frac{1}{2}$ cups of chocolate chips. How many cakes can he make?

Hasim can make _____ cakes.

LESSON

3.8 **11.** On Tuesday, $\frac{5}{12}$ of the grade 8 students attended the computer club meeting and $\frac{3}{8}$ of the grade 8 students attended the science club meeting. The meetings were at the same time. What fraction of the grade 8 students attended one of the meetings? What fraction did not attend either of the meetings?

_____ of the grade 8 students attended one of the meetings.

_____ of the grade 8 students did not attend either of the meetings.

12. Grace has $6\frac{3}{4}$ L of maple syrup that she wants to pour into $\frac{3}{4}$-L containers. How many containers can she fill?

Grace can fill _____ containers.

3.9 **13.** Evaluate.

a) $\frac{3}{5}+\frac{7}{15}\times\frac{9}{14}=$ _____ b) $\left(\frac{3}{5}+\frac{7}{15}\times\frac{9}{14}\right)=$ _____

14. Evaluate: $\frac{4}{7}\times\left(\frac{9}{5}-\frac{3}{4}\right)\div\frac{3}{8}=$ _____