UNIT 3
Rational Numbers

What You'll Learn

How to

- Identify positive and negative decimals and fractions as rational numbers
- Compare and order rational numbers
- Add, subtract, multiply, and divide rational numbers
- Solve problems that involve rational numbers
- Apply the order of operations with rational numbers

Why It's Important

Rational numbers are used by

- building contractors to measure and to estimate costs
- chefs to measure ingredients, plan menus, and estimate costs
- investment professionals to show changes in stock prices

Key Words

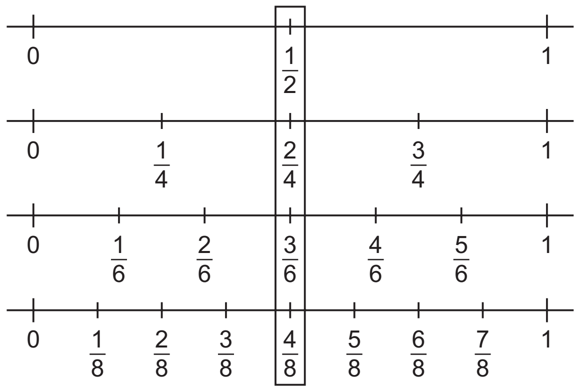
fraction	integer
equivalent fraction	decimal
numerator	repeating decimal
denominator	terminating decimal
common denominator	rational number
multiple	reciprocal
common multiple	

3.1 Skill Builder

Equivalent Fractions

$\frac{1}{2}$, $\frac{2}{4}$, $\frac{3}{6}$, and $\frac{4}{8}$ are **equivalent fractions.**

They represent the same distance on a number line.



Here is one way to find equivalent fractions. Multiply or divide the numerator and denominator by the same number.

$$\frac{1}{2} \overset{\times 3}{\underset{\times 3}{=}} \frac{3}{6} \qquad \frac{4}{8} \overset{\div 2}{\underset{\div 2}{=}} \frac{2}{4}$$

Multiplying or dividing both the numerator and denominator by the same number is like multiplying or dividing by 1. The original quantity is unchanged.

Check

1. Write 2 equivalent fractions.

a) $\frac{7}{10}$ $\qquad \frac{7}{10} \overset{\times 2}{\underset{\times 2}{=}} \frac{\_\_\_}{\_\_\_} \qquad \frac{7}{10} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_}$

b) $\frac{12}{15}$ $\qquad \frac{12}{15} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_} \qquad \frac{12}{15} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_}$

2. Write an equivalent fraction with the given denominator.

a) $\frac{3}{5} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{20}$ $\quad$ 5 × 4 = 20, so multiply the numerator and denominator by 4.

b) $\frac{1}{4} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{12}$ $\quad$ 4 × ______ = 12, so __________ the numerator and denominator by ______.

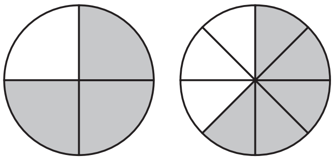
c) $\frac{\_\_\_}{15} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{2}{3}$ $\quad$ 15 ÷ ______ = 3, so divide the numerator and denominator by ______.

d) $\frac{\_\_\_}{24} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{5}{6}$ $\quad$ 24 ÷ ______ = 6, so ________ the numerator and denominator by ______.

Comparing Fractions

Here are 3 ways to compare $\frac{3}{4}$ and $\frac{5}{8}$.

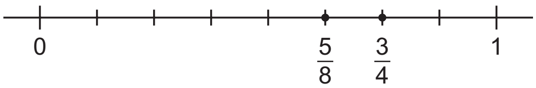
- Using area models:



$\frac{3}{4}$ $\frac{5}{8}$

Compare the shaded areas: $\frac{3}{4} > \frac{5}{8}$

- Using number lines:



Numbers increase from left to right on a number line.

From the number line: $\frac{5}{8} < \frac{3}{4}$

- Writing equivalent fractions:

$$\frac{3}{4} \underset{\times 2}{\overset{\times 2}{=}} \frac{6}{8}$$

$\frac{5}{8} < \frac{6}{8}$; so, $\frac{5}{8} < \frac{3}{4}$

Check

Compare the fractions in each pair. Write $>$, $<$, or $=$.

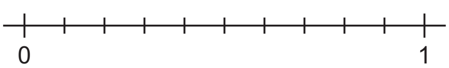
1. a) $\frac{7}{8}$ — $\frac{3}{4}$

b) $\frac{3}{5}$ — $\frac{7}{10}$

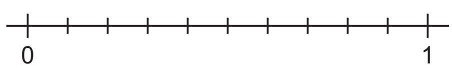
c) $\frac{7}{12}$ — $\frac{2}{3}$

d) $\frac{6}{7}$ — $\frac{6}{8}$

2. a) $\frac{2}{5}$ — $\frac{3}{10}$



b) $\frac{3}{5}$ — $\frac{9}{10}$



Common Denominators

To find a common denominator of $\frac{1}{2}$ and $\frac{2}{3}$:
Look for equivalent fractions with the same denominator.

List the multiples of 2: 2, 4, **6**, 8, 10, 12, 14, …

List the multiples of 3: 3, **6**, 9, 12, 15, …

6 is the least common multiple of 2 and 3. It is the simplest common denominator to work with.

Rewrite $\frac{1}{2}$ and $\frac{2}{3}$ with denominator 6.

$\frac{1}{2} \overset{\times 3}{=} \frac{3}{6}$ $\quad$ $\frac{2}{3} \overset{\times 2}{=} \frac{4}{6}$

Equivalent fractions help us compare, add, or subtract fractions.

Check

1. Write equivalent fraction pairs with a common denominator.

a) $\frac{1}{2}$ and $\frac{3}{8}$

Multiples of 2: 2, 4, 6, 8, 10, …

Multiples of 8: 8, 16, …

A common denominator is ___.

So, $\frac{1}{2} = \_\_\_$ and $\frac{3}{8} = \_\_\_$

b) $\frac{3}{4}$ and $\frac{5}{6}$

Multiples of 4: ____________

Multiples of 6: ____________

____

So, $\frac{3}{4} = \_\_\_$ and $\frac{5}{6} = \_\_\_$

c) $\frac{3}{5}$ and $\frac{2}{3}$

Multiples of ___: ____________

Multiples of ___: ____________

____

So, $\frac{3}{5} = \_\_\_$ and $\frac{2}{3} = \_\_\_$

2. Compare each pair of fractions from question 1.

a) $\frac{1}{2}$ and $\frac{3}{8}$. Since ___ > ___, $\frac{1}{2}$ ___ $\frac{3}{8}$

b) $\frac{3}{4}$ and $\frac{5}{6}$. Since ___ < ___, $\frac{3}{4}$ ___ $\frac{5}{6}$

c) $\frac{3}{5}$ and $\frac{2}{3}$. Since ___ < ___, $\frac{3}{5}$ ___ $\frac{2}{3}$

Converting between Fractions and Decimals

- Fractions to decimals

  The fraction bar represents division. For example:

$\frac{1}{6}$ means $1 \div 6$

Use a calculator:

$1 \div 6 = 0.166\,666\ldots$

$= 0.1\overline{6}$

So, $\frac{1}{6} = 0.1\overline{6}$

The bar over the 6 means that 6 repeats.

$0.1\overline{6}$ is a **repeating decimal.**

$\frac{7}{8}$ means $7 \div 8$

Use a calculator:

$7 \div 8 = 0.875$

So, $\frac{7}{8} = 0.875$

0.875 is a **terminating decimal.**

- Decimals to fractions

  Use place value. For example:

0.7 means 7 tenths.

So, $0.7 = \frac{7}{10}$

0.23 means 23 hundredths

So, $0.23 = \frac{23}{100}$

Check

1. Write each fraction as a decimal.

a) $\frac{3}{4} = 3 \div 4$

$=$ ____________

b) $\frac{2}{3} =$ ____________

$=$ ____________

c) $\frac{5}{8} =$ ____________

$=$ ____________

d) $\frac{5}{9} = 5 \div 9$

$=$ ____________

e) $4\frac{1}{5} = 4 + \frac{1}{5}$

$= 4 +$ ____________

$= 4 +$ ____________

$=$ ____________

f) $2\frac{1}{3} = 2 +$ ____________

$= 2 +$ ____________

$= 2 +$ ____________

$=$ ____________

2. Which numbers in question 1 are:

a) repeating decimals? ____________

b) terminating decimals? ____________

3. Write each decimal as a fraction.

a) 0.3 = ____________

b) 0.9 = ____________

c) 0.11 = ____________

d) 0.87 = ____________

e) 1.5 = ____________

f) 5.7 = ____________

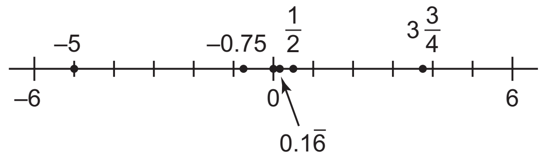
3.1 What Is a Rational Number?

FOCUS **Compare and order rational numbers.**

Rational numbers include:

- integers
- positive and negative fractions
- positive and negative mixed numbers
- repeating and terminating decimals

Here is a number line that displays some rational numbers.

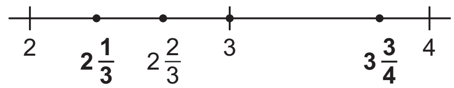


Example 1 Finding a Rational Number between Two Given Numbers

Find 2 rational numbers between $2\frac{1}{3}$ and $3\frac{3}{4}$.

Solution

Label a number line from 2 to 4.



$2\frac{1}{3}$ is one-third of the way from 2 to 3.

$3\frac{3}{4}$ is three-quarters of the way from 3 to 4.

From the number line, 2 rational numbers between $2\frac{1}{3}$ and $3\frac{3}{4}$ are: $2\frac{2}{3}$ and 3

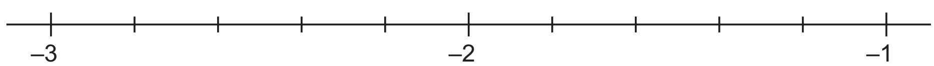
There are many correct solutions. Which ones can you name?

Check

1. Find 2 rational numbers between each pair of numbers.

Plot points to show $-1\frac{2}{5}$ and $-2\frac{1}{3}$.

a) $-2\frac{1}{3}$ and $-1\frac{2}{5}$



From the number line, 2 values between $-2\frac{1}{3}$ and $-1\frac{2}{5}$ are: _____ and _____

b) -0.3 and 0.6

From the number line, 2 values between -0.3 and 0.6 are: _____ and _____

Example 2 Comparing Rational Numbers on a Number Line

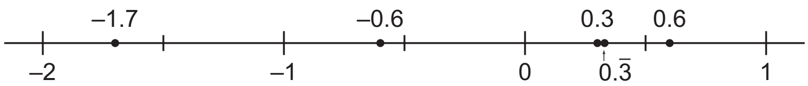
Order each set of rational numbers from least to greatest.

a) $0.3, 0.\overline{3}, -1.7, 0.6, -0.6$

b) $3\frac{1}{4}, -\frac{3}{4}, -\frac{4}{8}, 1\frac{3}{4}, -2\frac{3}{8}$

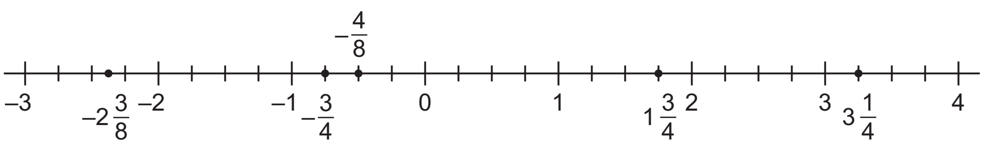
Solution

a) Plot the numbers on a number line.
To plot 0.3 and $0.\overline{3}$, think: $0.\overline{3} = 0.3333\ldots$
So, $0.\overline{3}$ is slightly greater than 0.3.



From the number line, the order from least to greatest is: $-1.7, -0.6, 0.3, 0.\overline{3}, 0.6$

b) Plot the numbers on a number line.

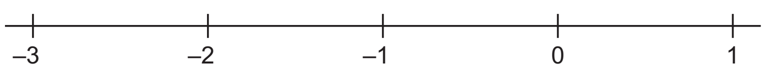


From the number line, the order from least to greatest is: $-2\frac{3}{8}, -\frac{3}{4}, -\frac{4}{8}, 1\frac{3}{4}, 3\frac{1}{4}$

Check

1. Order each set of numbers from least to greatest.

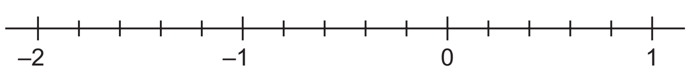
a) $-1.\overline{8}, 0.7, -2, -2.1, -0.3$



From the number line, the order from least to greatest is: ______________________________

b) $-1\frac{9}{10}, -2, -1\frac{4}{5}, \frac{4}{5}, -1\frac{1}{5}$

The number line is divided in fifths to help you plot the numbers.



From the number line, the order from least to greatest is: __________________________

Practice

1. Write each rational number as a decimal.

a) $\frac{3}{5} = \underline{\quad} \div \underline{\quad}$

$= \underline{\qquad\qquad}$

b) $\frac{5}{3} = \underline{\qquad\qquad}$

$= \underline{\qquad\qquad}$

c) $-\frac{3}{5} = -(\underline{\quad} \div \underline{\quad})$

$= \underline{\qquad\qquad}$

d) $\frac{-3}{5} = (\underline{\quad}) \div \underline{\quad}$

$= \underline{\qquad\qquad}$

e) $\frac{-5}{3} = (\underline{\quad}) \div \underline{\quad}$

$= \underline{\qquad\qquad}$

f) $\frac{3}{-5} = \underline{\qquad\qquad}$

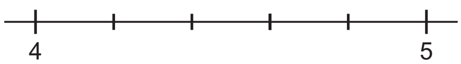
$= \underline{\qquad\qquad}$

Look for matching answers. What conclusion can you make?

____

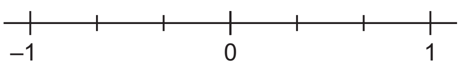
2. Plot and compare each pair of rational numbers.

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



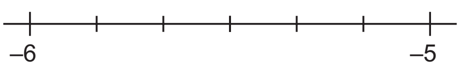
From the number line, $4\frac{2}{5}$ __ $4\frac{3}{5}$

b) $\frac{2}{3}$ and $-\frac{1}{3}$



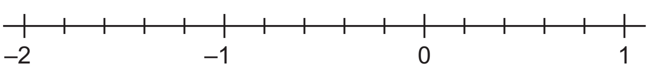
From the number line, ________

c) $-5\frac{5}{6}$ and $-5\frac{1}{6}$



____

3. a) Write a decimal to match each point on the number line.

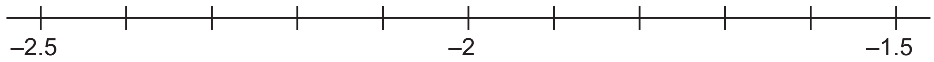


b) Write the numbers in part a from least to greatest.

____

4. Find 2 rational numbers between each pair of numbers.

a) -2.1 and -1.7



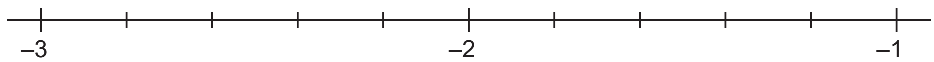
Two possible numbers are: ______________

b) 4.1 and 4.4

Start by plotting the given values on the number line.

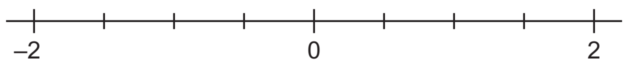
Two possible numbers are: ______________

c) $-1\frac{3}{5}$ and $-2\frac{1}{5}$



____

5. Order these rational numbers from least to greatest.
$-1\frac{1}{2}, \frac{3}{2}, -1.7, -2, \frac{3}{4}$



Estimate to place numbers where necessary.

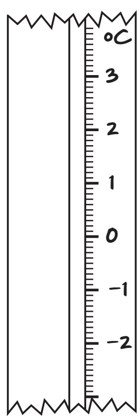
From least to greatest: ____________________

6. Kiki recorded the temperatures at the same time each day over a 5-day period.

-0.8°C, -1.3°C, 2.4°C, -1.5°C, 0.9°C

Order the temperatures from lowest to highest:

____

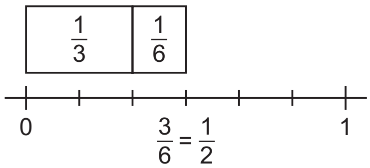


3.2 Skill Builder

Adding Fractions

Here are 2 ways to add $\frac{1}{3}$ and $\frac{1}{6}$.

- Using fraction strips on a number line:
  Place the fraction strips end to end, starting at 0.



  From the number line: $\frac{1}{3} + \frac{1}{6} = \frac{3}{6}$, or $\frac{1}{2}$

- Using common denominators:
  $\frac{1}{3}$ is the same as $\frac{2}{6}$.
  So, $\frac{1}{3} + \frac{1}{6} = \frac{2}{6} + \frac{1}{6}$
  $= \frac{3}{6}$, or $\frac{1}{2}$

Some additions give answers that are greater than 1.

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

$= \frac{7}{6}$ ⟵ improper fraction

$= 1\frac{1}{6}$ ⟵ mixed number

Rewrite the improper fraction as a mixed number: divide 6 into 7 to see that there is 1 whole, and 1 sixth left over.

Check

1. Find each sum. Use diagrams to show your thinking.

a) $\frac{1}{6} + \frac{4}{6} =$ _____

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

2. Find each sum. Use the method you like best.

a) $\frac{2}{5} + \frac{4}{5} =$ _____, or _____

b) $\frac{2}{4} + \frac{5}{8} =$ _______

$=$ _____, or _____

Adding Mixed Numbers

Mixed numbers combine whole numbers and fractions.

We can add numbers in any order without changing the answer.

Add: $1\frac{1}{8} + 3\frac{3}{4}$

Add the whole numbers and add the fractions.

$1\frac{1}{8} + 3\frac{3}{4} = 1 + 3 + \frac{1}{8} + \frac{3}{4}$ A common denominator is 8.

$= 1 + 3 + \frac{1}{8} + \frac{6}{8}$

$= 4 + \frac{7}{8}$

$= 4\frac{7}{8}$

Check

1. Find each sum. Use diagrams to show your thinking.

a) $1\frac{1}{3} + 1\frac{2}{3} =$ ____________

b) $2\frac{1}{6} + \frac{1}{2} =$ ____________

2. Find each sum.
Use the method you like best.

a) $3\frac{2}{7} + 2\frac{3}{7} =$ ________________
= ________________
= ________________

b) $4\frac{1}{9} + 1\frac{2}{3} =$ ________________
= ________________
= ________________
= ________________

3.2 Adding Rational Numbers

FOCUS **Solve problems by adding rational numbers.**

Integers and fractions are rational numbers.
So, you can use strategies for adding integers, and strategies for adding fractions, to add rational numbers.

Example 1 Adding Rational Numbers on a Number Line

a) $-2.3 + (-1.9)$

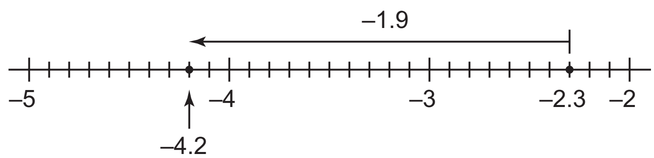
b) $-\frac{1}{2} + \left(-\frac{5}{4}\right)$

Solution

a) $-2.3 + (-1.9)$

Use a number line divided in tenths.

Start at -2.3. To add -1.9, move 1.9 to the left.



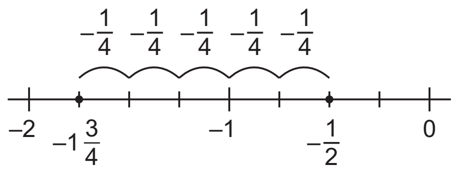
When we add a negative number, we move to the left. When we add a positive number, we move to the right.

So, $-2.3 + (-1.9) = -4.2$.

b) $-\frac{1}{2} + \left(-\frac{5}{4}\right)$

Use a number line divided into fourths.

Start at $-\frac{1}{2}$. To add $-\frac{5}{4}$, move $\frac{5}{4}$ to the left.

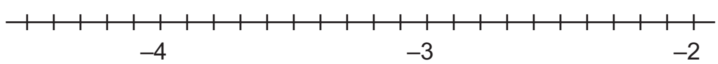


So, $-\frac{1}{2} + \left(-\frac{5}{4}\right) = -1\frac{3}{4}$.

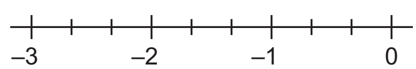
Check

1. Use a number line to add.

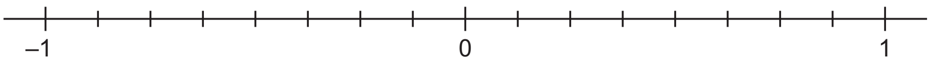
a) $-4.5 + 2.3 =$ _________



b) $-\frac{1}{3} + \left(-\frac{7}{3}\right) =$ _________



c) $\frac{3}{8} + \left(-\frac{3}{4}\right) =$ ____________



Example 2 Adding Fractions without a Number Line

Add: $-\frac{2}{5} + \left(-\frac{1}{2}\right)$

Solution

To find $-\frac{2}{5} + \left(-\frac{1}{2}\right)$, look for a common denominator.

Use a common denominator of 10.

Multiples of 5: 5, 10, 15, …
Multiples of 2: 2, 4, 6, 8, 10, …

$-\frac{2}{5} \overset{\times 2}{\underset{\times 2}{=}} -\frac{4}{10}$ and $-\frac{1}{2} \overset{\times 5}{\underset{\times 5}{=}} -\frac{5}{10}$

So, $-\frac{2}{5} + \left(-\frac{1}{2}\right) = -\frac{4}{10} + \left(-\frac{5}{10}\right)$

$= -\frac{9}{10}$

Think of integer addition: $(-4) + (-5) = -9$

Check

1. Add.

a) $-\frac{7}{12} + \frac{1}{6}$ Use a common denominator of _____.

$\frac{1}{6} \overset{\_\_\_}{\underset{\_\_\_}{=}} \_\_\_\_$

$= -\frac{7}{12} + \_\_\_\_$

$= \_\_\_\_\_$

b) $\frac{3}{5} + \left(-\frac{2}{3}\right)$ Use a common denominator of _____.

$\frac{3}{5} \overset{\_\_\_}{\underset{\_\_\_}{=}} \_\_\_\_$ and $-\frac{2}{3} \overset{\_\_\_}{\underset{\_\_\_}{=}} \_\_\_\_$

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

$= \_\_\_\_\_$

Example 3 Adding Mixed Numbers

Calculate: $-2\frac{1}{8} + 3\frac{1}{3}$

Solution

Estimate first to predict the answer:

$-2\frac{1}{8} + 3\frac{1}{3}$ is about $-2 + 3$, or 1.

We expect an answer close to 1.

To calculate, add the whole numbers and add the fractions.
Keep the signs with each part of the mixed number.

$-2\frac{1}{8} + 3\frac{1}{3} = (-2) + 3 + \left(-\frac{1}{8}\right) + \frac{1}{3}$ Use a common denominator of 24.

$-\frac{1}{8} \overset{\times 3}{=} -\frac{3}{24}$ and $\frac{1}{3} \overset{\times 8}{=} \frac{8}{24}$

$$\text{So, } -2\frac{1}{8} + 3\frac{1}{3} = \underbrace{(-2) + 3}_{} + \underbrace{\left(-\frac{3}{24}\right) + \frac{8}{24}}_{}$$

$$= 1 + \frac{5}{24}$$

$$= 1\frac{5}{24}$$

Check: the answer is reasonably close to the original estimate of 1.

Check

1. Find each sum.

a) $-1\frac{5}{16} + 3\frac{3}{8}$ = ____ + ____ + ____ + ____ Use a common denominator of ____.

= ____ + ____ + ____ + ____

= ____ + ____

= ____

$\frac{3}{8} = \frac{\_\_}{\_\_}$

Estimate to check if your answer is reasonable.

b) $2\frac{3}{5} + 1\frac{1}{4} =$ ____ + ____ + ____ + ____

$=$ ____ + ____ + ____ + ____

$=$ ____ + ____

$=$ ____

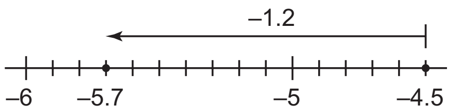
Use a common denominator of ____.

$\frac{3}{5} = \frac{\_\_\_\_}{\_\_\_\_}$ and $\frac{1}{4} = \frac{\_\_\_\_}{\_\_\_\_}$

Practice

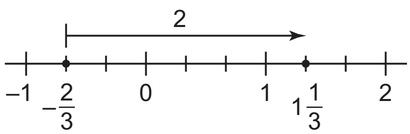
1. Write the addition statement shown by each number line.

a)



______ + (____) = _______

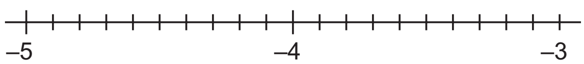
b)



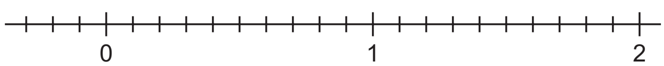
____

2. Use the number line to add.

a) $-4.5 + (1.2) =$ _______



b) $1.7 + (-1.9) =$ _______



3. Add.

a) i) $4 + 6 =$ ______ **ii)** $4.1 + 6.4 =$ ______ **iii)** $\frac{4}{11} + \frac{6}{11} =$ ______

b) i) $4 + (-6) =$ ______ **ii)** $4.1 + (-6.4) =$ ______ **iii)** $\frac{4}{11} + \left(-\frac{6}{11}\right) =$ ______

c) i) $-4 + 6 =$ ______ **ii)** $-4.1 + 6.4 =$ ______ **iii)** $-\frac{4}{11} + \frac{6}{11} =$ ______

d) i) $-4 + (-6) =$ ______ **ii)** $-4.1 + (-6.4) =$ ______ **iii)** $-\frac{4}{11} + \left(-\frac{6}{11}\right) =$ ______

4. Find each sum.

a) $-4.6 + 5.8 = $ _____

b) $2.3 + (-4.6) = $ _______

c) $-0.3 + (-6.2) = $ ______

d) $(-26.5) + (-18.1) = $ ________

5. Find each sum.

a) $-\frac{1}{3} + \frac{5}{9}$

$= \frac{\_\_\_\_}{\_\_\_\_} + \frac{5}{9}$

$= \frac{\_\_\_\_}{\_\_\_\_}$

b) $\frac{1}{3} + \left(-\frac{2}{5}\right)$

$= $ ______________

$= \frac{\_\_\_\_}{\_\_\_\_}$

c) $-\frac{3}{8} + \left(-\frac{1}{3}\right)$

$= $ ______________

$= \frac{\_\_\_\_}{\_\_\_\_}$

6. Find each sum.

Look for a common denominator first.

a) $-2\frac{2}{5} + 6\frac{1}{2}$

____

____

____

____

b) $-1\frac{1}{6} + \left(-3\frac{1}{4}\right)$

____

____

____

____

c) $\left(-3\frac{1}{3}\right) + \left(-5\frac{1}{7}\right)$

____

____

____

____

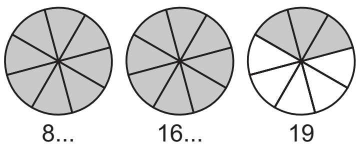
3.3 Skill Builder

Converting Mixed Numbers to Improper Fractions

Here are 2 ways to write $2\frac{3}{8}$ as an improper fraction.

- Make a diagram to show $2\frac{3}{8}$.

  Count individual parts.



  Think of the diagram above:

2	$\times$	8	+	3
↑		↑		↑
2 whole circles shaded		8 pieces in each circle		plus another 3 pieces

- Use calculation.

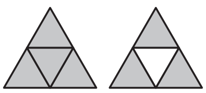
$$2\frac{3}{8} = \frac{2 \times 8 + 3}{8}$$
$$= \frac{19}{8}$$

$$2\,\frac{3}{8} = 2 + \frac{3}{8}$$
$$= \frac{16}{8} + \frac{3}{8}$$
$$= \frac{19}{8}$$

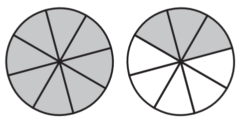
Check

1. Write a mixed number and an improper fraction to show each shaded quantity.

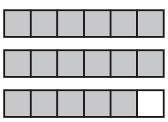
a) ____ or ____



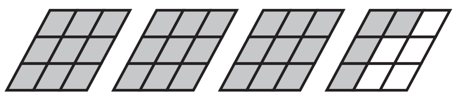
b) ____ or ____



c) ____ or ____



d) ____ or ____



2. Write each mixed number as an improper fraction.

a) $1\frac{2}{5} = \underline{\quad} + \frac{2}{5}$

$= \frac{\underline{\quad}}{5} + \frac{2}{5}$

$= \frac{\underline{\quad}}{5}$

b) $2\frac{2}{3} = \underline{\quad} + \underline{\quad}$

$= \frac{\underline{\quad}}{3} + \underline{\quad}$

$= \underline{\quad}$

c) $5\frac{3}{4} = \underline{\quad} + \underline{\quad}$

$= \frac{\underline{\quad}}{4} + \underline{\quad}$

$= \underline{\quad}$

3.3 Subtracting Rational Numbers

FOCUS **Solve problems by subtracting rational numbers.**

To subtract an integer, we add its opposite.

- $-5 - 2$ is the same as $-5 + (-2)$.

  So, $-5 - 2 = -5 + (-2)$
  $= -7$

- $-5 - (-2)$ is the same as $-5 + (+2)$

  So, $-5 - (-2) = -5 + (+2)$
  $= -3$

We can use the same strategy to subtract rational numbers.

Subtracting Rational Numbers
To subtract a rational number, add its opposite.

Example 1 Subtracting Rational Numbers in Fraction Form

Subtract: $\frac{1}{3} - \frac{5}{6}$

Solution

$\frac{1}{3} - \frac{5}{6}$	Add the opposite.
$= \frac{1}{3} + \left(-\frac{5}{6}\right)$	Use 6 as a common denominator.
$= \frac{2}{6} + \left(-\frac{5}{6}\right)$	Think of integer addition: $2 + (-5) = -3$
$= -\frac{3}{6}$	Write the answer in simplest form.
$= -\frac{1}{2}$	

Check

1. Subtract.

a) $-\frac{1}{2} - \frac{7}{8} = -\frac{1}{2} + \left(-\frac{7}{8}\right)$
$= \_\_\_\_ + \left(-\frac{7}{8}\right)$
$= \_\_\_\_$
$= \_\_\_\_$

b) $\frac{4}{5} - \left(-\frac{2}{3}\right) = \_\_\_\_ + \_\_\_\_$
$= \_\_\_\_ + \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

Example 2 Subtracting Rational Numbers in Mixed Number Form

Subtract: $\frac{3}{4} - 2\frac{5}{8}$

Solution

$\frac{3}{4} - 2\frac{5}{8}$	Write $2\frac{5}{8}$ as an improper fraction.
$= \frac{3}{4} - \frac{21}{8}$	Use 8 as a common denominator.
$= \frac{6}{8} - \frac{21}{8}$	Add the opposite.
$= \frac{6}{8} + \left(-\frac{21}{8}\right)$	
$= -\frac{15}{8}$, or $-1\frac{7}{8}$	

Check

1. Find the difference.

a)

$-\frac{13}{15} - 1\frac{1}{5}$	Write $1\frac{1}{5}$ as an improper fraction.
$= -\frac{13}{15} - \frac{}{\underline{}}$	Use _____ as a common denominator.
$= -\frac{13}{15} - \frac{\underline{}}{15}$	Add the opposite.
$= -\frac{13}{15} + \left(-\frac{\underline{}}{15}\right)$	
$= \frac{}{\underline{}}$	Write the answer as a mixed number.
$=$ ________	

b)

$-2\frac{3}{8} - 3\frac{1}{2}$	Rewrite $-2\frac{3}{8}$ and $3\frac{1}{2}$ as improper fractions.
$= \frac{}{\underline{}} - \frac{}{\underline{}}$	Use ___ as a common denominator.
$= \frac{}{\underline{}} - \frac{}{\underline{}}$	Add the opposite.
$= \frac{}{\underline{}} + \frac{}{\underline{}}$	
$= \frac{}{\underline{}}$	Write the answer as a mixed number.
$=$ ________	

Example 3 Solving a Problem by Subtracting Rational Numbers

In Alberta:

- The lowest temperature ever recorded was -61.1°C at Fort Vermilion in 1911.
- The highest temperature was 43.3°C at Bassano Dams in 1931.

What is the difference between these temperatures?

Solution

Subtract to find the difference between the temperatures.

$43.3 - (-61.1)$ Add the opposite.

$= 43.3 + (61.1)$

$= 104.4$

The difference between the temperatures is 104.4°C.

Use mental math to check.
$40 + 60 = 100$
$3.3 + 1.1 = 4.4$
$100 + 4.4 = 104.4$

Check

1. The lowest temperature ever recorded on Earth was -89.2°C in Antarctica.
The highest temperature ever recorded is 57.8°C in Libya.
What is the difference between these temperatures?

______ − (______) = ______ + (______)

= ______

The difference between the temperatures is _____°C.

Practice

1. Subtract.

a) $1.6 - 3.9 =$ _______ **b)** $1.6 - (-3.9) =$ _______

c) $-2.4 - 4.5 =$ _______ **d)** $2.4 - (-4.5) =$ _______

2. Draw lines to join matching subtraction sentences, addition sentences, and answers.

Subtraction sentence	Addition sentence	Answer
$2.7 - 9.7$	$2.7 + 9.7$	-12.4
$-2.7 - 9.7$	$2.7 + (-9.7)$	-7
$-2.7 - (-9.7)$	$-2.7 + (-9.7)$	7
$2.7 - (-9.7)$	$-2.7 + 9.7$	12.4

3. Find each difference.

Estimate to check if your answers are reasonable.

a) $7.1 - 4.7 =$ ______ **b)** $-3.2 - 1.9 =$ ______

c) $26.2 - (-8.4) =$ ______ **d)** $(-8.6) - (-7.2) =$ ______

4. Subtract.

a) i) $6 - 3 =$ _____ **ii)** $6.3 - 3.1 =$ _____ **iii)** $\frac{6}{7} - \frac{3}{7} =$ _____

b) i) $-6 - 3 =$ _____ **ii)** $-6.3 - 3.1 =$ _______ **iii)** $-\frac{6}{7} - \frac{3}{7} =$ ______________

c) i) $6 - (-3) =$ ____ **ii)** $6.3 - (-3.1) =$ _____ **iii)** $\frac{6}{7} - \left(-\frac{3}{7}\right) =$ __________

d) i) $-6 - (-3) =$ ____ **ii)** $-6.3 - (-3.1) =$ _______ **iii)** $-\frac{6}{7} - \left(-\frac{3}{7}\right) =$ _____

5. Determine each difference.

a) $\frac{3}{5} - \left(-\frac{1}{3}\right) = \frac{3}{5} + \frac{1}{3}$

$= \underline{\quad} + \underline{\quad}$

$= \underline{\qquad}$

b) $-\frac{17}{20} - \frac{3}{2} = -\frac{17}{20} + \left(-\frac{3}{2}\right)$

$= -\frac{17}{20} + \underline{\qquad}$

$= \underline{\qquad\qquad}$

c) $\frac{9}{5} - \frac{7}{4} =$ ______________

$= \underline{\quad} + \underline{\qquad}$

$= \underline{\qquad}$

6. Calculate.

a) $2\frac{1}{6} - 1\frac{1}{3} = \frac{\quad}{6} - \frac{\quad}{3}$

$= \frac{\quad}{6} + \left(-\frac{\quad}{3}\right)$

$= \underline{\quad} + \underline{\qquad}$

$= \underline{\qquad}$

b) $1\frac{1}{2} - \left(-2\frac{1}{3}\right) = \frac{\quad}{2} - \left(-\frac{\quad}{3}\right)$

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

$= \underline{\quad} + \underline{\qquad}$

$= \underline{\qquad}$

7. Jenny has a gift card with \$24.50 left on it. She makes purchases totaling \$42.35. What amount does Jenny still owe the cashier after using the gift card?

Subtraction sentence: _______ − _______ = _______

Jenny still owes the cashier \$______.

CHECKPOINT

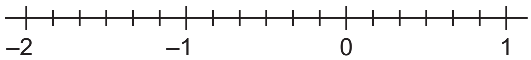
Can you …

- Compare and order rational numbers?
- Add and subtract rational numbers?
- Solve problems by adding and subtracting rational numbers?

3.1 **1.** Find 2 rational numbers between each pair of numbers.

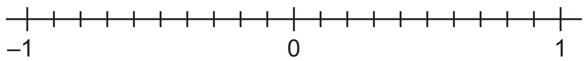
a) $-1\frac{1}{3}$ and $\frac{1}{6}$

Plot each number on the number line.



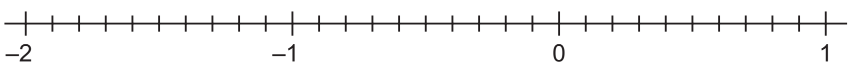
From the number line, 2 values between $-1\frac{1}{3}$ and $\frac{1}{6}$ are: ____ and ____

b) -0.4 and 0.2



From the number line, 2 values between -0.4 and 0.2 are: ______ and _____

2. Use the number line to order the fractions from least to greatest: $-1\frac{2}{3}$, $\frac{7}{10}$, $-\frac{4}{5}$



For least to greatest, read the points from _____ to ______: _____________

3. a) Write each number as a decimal.

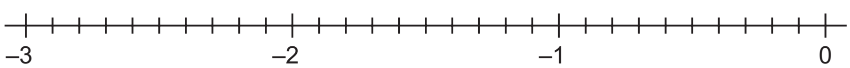
$-\frac{2}{5}$ = ________ $-1\frac{1}{2}$ = ________

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

$-\frac{2}{5}$ means $-(2 \div 5)$.

b) Order the decimals in part a from least to greatest.

Use the number line to help you.



From least to greatest: ____________________________________

3.2 **4.** Find each sum.

a) $6.5 + (-4.2) =$ ______

b) $-13.6 + (-7.9) =$ ________

5. Find each sum. Use equivalent fractions.

a) $-\frac{3}{8} + \frac{1}{4} = -\frac{3}{8} + \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

b) $\frac{3}{8} + \frac{1}{4} = \frac{\quad}{\quad} + \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

c) $-\frac{3}{8} + \left(-\frac{1}{4}\right) = \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

d) $\frac{3}{8} + \left(-\frac{1}{4}\right) = \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

6. Add.

a) $\frac{2}{3} + \left(-1\frac{4}{11}\right) = \frac{2}{3} + \left(-\frac{15}{11}\right)$

$= \frac{\quad}{\quad} + \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

b) $-1\frac{5}{6} + 3\frac{7}{8} = (\_\_ + \_\_) + \left(\frac{\quad}{\quad} + \frac{\quad}{\quad}\right)$

$= \_\_ + \left(\frac{\quad}{\quad} + \frac{\quad}{\quad}\right)$

$= \frac{\quad}{\quad}$

3.3 **7.** Find each difference.

a) $7.6 - 4.2 =$ _____

b) $-3.4 - 5.7 =$ ______

c) $1.7 - (-9.3) =$ _____

d) $-2.3 - (-5.6) =$ _____

Estimate to check if your answers are reasonable.

8. Subtract.

a) $-\frac{5}{12} - \frac{1}{6} = -\frac{5}{12} + \frac{\quad}{\quad}$

$= -\frac{5}{12} + \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

b) $-2\frac{4}{7} - \left(-3\frac{1}{3}\right) = -2\frac{4}{7} + \frac{\quad}{\quad}$

$= -\frac{\quad}{7} + \frac{\quad}{3}$

$= \frac{\quad}{\quad} + \frac{\quad}{\quad}$

$= \frac{\quad}{\quad}$

9. The table shows Lesley's temperature readings at different times one day.

Time	Temperature (°C)
9:00 A.M.	−5.4
12:00 P.M.	1.3
3:00 P.M.	2.7
9:00 P.M.	−4.2

Find the change in temperature between each pair of given times.
Did the temperature rise or fall each time?

a) 9:00 A.M. and 12:00 P.M.

Change in temperature: $1.3 - (-5.4)$

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

$= \_\_\_\_$

The temperature ______ by ____°C.

b) 3:00 P.M. and 9:00 P.M.

Change in temperature: _____ − _____

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

$= \_\_\_\_\_$

The temperature ______ by ____°C.

c) 9:00 A.M. and 9:00 P.M.

Change in temperature: ______________

____

____

____

3.4 Skill Builder

Writing a Fraction in Simplest Form

A fraction is in simplest form when the only common factor of the numerator and denominator is 1. For example, $\frac{5}{6}$ is in simplest form.

Writing a Fraction in Simplest Form
Look for common factors of the numerator and denominator.
Divide the numerator and denominator by common factors until you cannot go any further.

Write $\frac{24}{30}$ in simplest form.

*Factors of 24: 1, 2, 3, 4, **6**, 8, 12, 24*
*Factors of 30: 1, 2, 3, 5, **6**, 10, 15, 30*

Divide the numerator and the denominator by 6.

$$\frac{24}{30} \overset{\div 6}{\underset{\div 6}{=}} \frac{4}{5}$$

$\frac{4}{5}$ is the simplest form of $\frac{24}{30}$.

Check

1. Write each fraction in simplest form.

a) $\frac{10}{15} \overset{\div 5}{\underset{\div 5}{=}} \frac{\_\_\_}{\_\_\_}$ Divide the numerator and the denominator by 5.

b) $\frac{14}{20} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_}$ Divide the numerator and the denominator by _____.

c) $\frac{8}{12} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_}$ Divide the numerator and the denominator by _____.

d) $\frac{12}{18} \overset{\_\_\_}{\underset{\_\_\_}{=}} \frac{\_\_\_}{\_\_\_}$ Divide the numerator and the denominator by _____.

Multiplying Proper Fractions

When multiplying fractions, we multiply the numerators, and we multiply the denominators.

$$\frac{2}{5} \times \frac{3}{8} = \frac{2 \times 3}{5 \times 8}$$
$$= \frac{6}{40}, \text{ or } \frac{3}{20}$$

To simplify, look for common factors *before* multiplying.

$$\frac{5}{12} \times \frac{8}{15} = \frac{5 \times 8}{12 \times 15}$$
$$= \frac{\cancel{5}^{1} \times \cancel{8}^{2}}{\cancel{12}^{3} \times \cancel{15}^{3}}$$
$$= \frac{1 \times 2}{3 \times 3}$$
$$= \frac{2}{9}$$

A common factor of 5 and 15 is 5.
A common factor of 8 and 12 is 4.
5 ÷ 5 = 1 *8 ÷ 4 = 2*
12 ÷ 4 = 3 *15 ÷ 5 = 3*

Check

1. Find each product.

a) $\frac{3}{4} \times \frac{2}{5}$ Multiply the numerators and multiply the denominators.

$= \frac{3 \times 2}{4 \times 5}$ A common factor of 2 and 4 is ____.

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

$= \frac{\_\_ \times \_\_}{\_\_ \times \_\_} =$ ________

b) $\frac{9}{14} \times \frac{7}{3}$ Multiply the numerators and multiply the denominators.

= ________ A common factor of 9 and 3 is ____.
A common factor of 7 and 14 is ____.

= ________

$= \frac{\_\_ \times \_\_}{\_\_ \times \_\_} =$ ________

2. Multiply.

a) $\frac{6}{7} \times \frac{3}{4} = \frac{\_\_ \times \_\_}{\_\_ \times \_\_}$
= ________
$= \frac{\_\_ \times \_\_}{\_\_ \times \_\_}$
= ________

b) $\frac{4}{5} \times \frac{15}{14} =$ ________
= ________
= ________
= ________

c) $\frac{12}{5} \times \frac{5}{18} =$ ________
= ________
= ________
= ________

Multiplying Mixed Numbers

Mixed numbers combine whole numbers with fraction parts.
To multiply, write the mixed numbers in fraction form.

Multiply: $2\frac{1}{4} \times \frac{2}{3}$

Rewrite $2\frac{1}{4}$ as an improper fraction: $2\frac{1}{4} = \frac{2 \times 4 + 1}{4}$

$= \frac{9}{4}$

So, $2\frac{1}{4} \times \frac{2}{3} = \frac{9}{4} \times \frac{2}{3}$ — Multiply the numerators and multiply the denominators.

$= \frac{9 \times 2}{4 \times 3}$ — Look for common factors in numerator and denominator.

$= \frac{\cancel{9}^{3} \times \cancel{2}^{1}}{\cancel{4}^{2} \times \cancel{3}^{1}}$

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

Check

1. Write each mixed number as an improper fraction.

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

= ______

= ______

b) $3\frac{2}{7}$

= ______

= ______

c) $1\frac{5}{12}$

= ______

= ______

2. Multiply.

a) $3\frac{2}{5} \times \frac{1}{4}$ — Rewrite $3\frac{2}{5}$ as an improper fraction: $3\frac{2}{5} = \frac{17}{5}$

$= \frac{17}{5} \times \frac{1}{4}$ — Multiply the numerators and multiply the denominators.

$= \frac{\_\_ \times \_\_}{\_\_ \times \_\_}$

= ______

b) $1\frac{1}{2} \times 1\frac{1}{3}$ — Rewrite ______ and ______ as improper fractions.

= ______ — Multiply the numerators and multiply the denominators.

= ______ — Look for common factors in numerator and denominator.

= ______

= ______

3.4 Multiplying Rational Numbers

FOCUS **Multiply rational numbers.**

To predict the sign of the product of two rational numbers, use the sign rules for multiplying integers:

×	(−)	(+)
(−)	(+)	(−)
(+)	(−)	(+)

- *If the signs are the same, the answer is positive.*
- *If the signs are different, the answer is negative.*

Example 1 Multiplying Rational Numbers in Fraction Form

Multiply: $\left(-\frac{2}{3}\right)\left(-\frac{6}{7}\right)$

Solution

Predict the sign of the product:
Since the fractions have the same sign, their product is positive.

$$\left(-\frac{2}{3}\right)\left(-\frac{6}{7}\right) = \frac{(-2) \times (\cancel{-6})^{-2}}{\cancel{3}^{1} \times 7}$$

$$= \frac{(-2) \times (-2)}{1 \times 7}$$

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

So, $\left(-\frac{2}{3}\right)\left(-\frac{6}{7}\right) = \frac{4}{7}$

Check

1. Find each product.

a) $\frac{1}{5} \times \left(-\frac{3}{5}\right)$

The fractions have ______________,
so their product is ______________.

$= \frac{\_\_ \times (-3)}{\_\_ \times \_\_}$

$= \_\_\_\_$

b) $\left(-\frac{9}{11}\right)\left(-\frac{7}{12}\right)$

The fractions have ________________, so their product is ________________.

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times 12}$

A common factor of ______ and 12 is ______.

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{}{\_\_\_\_}$

Example 2 Multiplying Rational Numbers in Mixed Number Form

Multiply: $\left(-2\frac{1}{5}\right)\left(-1\frac{3}{4}\right)$

Solution

$\left(-2\frac{1}{5}\right)\left(-1\frac{3}{4}\right)$

Write each mixed number as an improper fraction.

$2\frac{1}{5} = \frac{10}{5} + \frac{1}{5} = \frac{11}{5}$ $\quad$ $1\frac{3}{4} = \frac{4}{4} + \frac{3}{4} = \frac{7}{4}$

So, $\left(-2\frac{1}{5}\right)\left(-1\frac{3}{4}\right) = \left(-\frac{11}{5}\right)\left(-\frac{7}{4}\right)$

The numbers have the same sign: the product is positive.

$= \frac{(-11)\times(-7)}{5 \times 4}$

$= \frac{77}{20}$, or $3\frac{17}{20}$

$\frac{77}{20} = \frac{60}{20} + \frac{17}{20} = 3\frac{17}{20}$

Check

1. Find each product.

a) $\left(-1\frac{1}{4}\right) \times \frac{6}{7}$

$= \left(-\frac{\_\_}{4}\right) \times \frac{6}{7}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{}{\_\_\_\_}$, or ________

b) $\left(-2\frac{4}{5}\right)\left(-2\frac{3}{4}\right)$

$= \left(-\frac{\_\_}{5}\right)\left(-\frac{\_\_}{4}\right)$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{}{\_\_\_\_\_\_\_\_}$

$= \frac{}{\_\_\_\_\_\_\_\_}$

To multiply rational numbers in decimal form:

- Use the sign rules for integers to find the sign of the product.
- Multiply as you would with whole numbers; estimate to place the decimal point.

Example 3 Multiplying Rational Numbers to Solve a Problem

On March 6, 2009, the price of a share in Bank of Montreal changed by −\$3.05. Joanne owns 50 shares. By how much did the shares change in value that day?

Solution

The change in value is: $50 \times (-3.05)$

Multiply the integers, then estimate to place the decimal point.
$50 \times (-305) = -15\ 250$

The product is negative.

Estimate to place the decimal point.
Since -3.05 is close to -3,
$50 \times (-3.05)$ is close to $50 \times (-3)$, or -150.
So, $50 \times (-3.05) = -152.50$

The shares changed in value by −\$152.50 that day.

Check

1. On March 13, 2009, the price of a share in Research in Motion changed by −\$1.13. Tania owns 80 shares. By how much did those shares change in value that day?

The change in value is: $80 \times (-1.13)$
The product is __________.
To find $80 \times (-1.13)$, multiply: ________ $\times$ ________
$80 \times$ ________ $=$ ____________
Estimate: $80 \times (-1.13)$ is about ________ $\times$ ________ $=$ ________
So, $80 \times (-1.13) =$ ____________
The shares changed in value by __________ that day.

Practice

1. Is the product positive or negative?

a) $(-2.5) \times 3.6$ different signs; the product is ________________.

b) $(-4.1) \times (-6.8)$ the same sign; the product is ________________.

c) $\left(-\frac{3}{4}\right)\left(-\frac{7}{9}\right)$ ________________; the product is ________________.

d) $\left(-2\frac{1}{3}\right) \times 6\frac{1}{2}$ ________________; the product is ________________.

2. Which of these expressions have the same product as $\frac{5}{8} \times \left(-\frac{7}{3}\right)$? Why?

a) $\left(-\frac{7}{3}\right) \times \frac{5}{8}$ _____, since ____

____

b) $\left(-\frac{5}{8}\right)\left(-\frac{7}{3}\right)$ _____, since ____

____

c) $\frac{7}{3} \times \frac{5}{8}$ _____, since ____

____

d) $\frac{7}{3} \times \left(-\frac{5}{8}\right)$ _____, since ____

____

3. Find each product.

Think: Is the product positive or negative?

a) $\frac{2}{7} \times \left(-\frac{5}{6}\right)$

$\frac{2}{7} \times \left(-\frac{5}{6}\right) =$ ____________

$=$ ____________

$=$ ____________

$=$ ____________

b) $\left(-\frac{4}{5}\right)\left(-\frac{11}{12}\right)$

$\left(-\frac{4}{5}\right)\left(-\frac{11}{12}\right) =$ ____________

$=$ ____________

$=$ ____________

$=$ ____________

4. Find each product.

a) $\left(-\frac{8}{9}\right) \times 1\frac{1}{2}$

$\left(-\frac{8}{9}\right) \times 1\frac{1}{2} = \left(-\frac{8}{9}\right) \times \frac{\_\_}{2}$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

b) $\left(-2\frac{5}{6}\right)\left(-1\frac{1}{5}\right)$

$\left(-2\frac{5}{6}\right)\left(-1\frac{1}{5}\right) = \left(-\frac{\_\_}{6}\right)\left(-\frac{\_\_}{5}\right)$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_\_\_\_\_$

5. Multiply.

a) $0.4 \times (-3.2)$

To find $0.4 \times (-3.2)$, multiply: $4 \times (-32) =$ ___________
$0.4 \times (-3.2)$ is about ________ $\times$ ________ $=$ ________
So, $0.4 \times (-3.2) =$ ___________.

b) $(-3.03) \times (-0.7)$

To find $(-3.03) \times (-0.7)$, multiply: ___________ $\times$ ___________ $=$ ___________
$(-3.03) \times (-0.7)$ is about (____) $\times$ (____) $=$ ____
So, $(-3.03) \times (-0.7) =$ ___________.

6. On a certain day, the temperature changed by an average of -2.2°C/h. What was the total temperature change in 8 h?

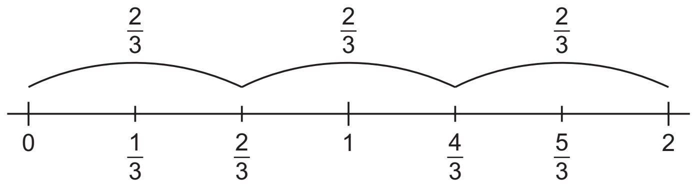
The total change in temperature is: _______ $\times$ _________
The product is _______________.
To find ______________, multiply: _______ $\times$ _______ $=$ _______
$8 \times (-2.2)$ is about _______ $\times$ _______ $=$ _______.
So, $8 \times (-2.2) =$ _______
The temperature_____ by _______°C in 8 h.

3.5 Skill Builder

Dividing Fractions

Here are two ways to divide $2 \div \frac{2}{3}$.

- Use a number line.



How many groups of two-thirds are there in 2?

There are 3 groups of two-thirds in 2. So, $2 \div \frac{2}{3} = 3$

- Multiply by the reciprocal of $\frac{2}{3}$.

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

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

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

$= \frac{2^1 \times 3}{1 \times 2^1}$ Look for common factors.

$= 3$

Check

1. Find each quotient. Use any method.

a) $2 \div \frac{1}{6} =$ ______

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

c) $\frac{1}{3} \div \frac{5}{3} = \frac{1}{3} \times$ ______

= ______

= ______

d) $4 \div \frac{2}{3} = 4 \times$ ______

= ______

= ______

3.5 Dividing Rational Numbers

FOCUS **Divide rational numbers.**

Division is the opposite of multiplication.
So, the sign rules for dividing rational numbers
are the same as those for multiplying rational numbers.

÷	**(−)**	**(+)**
(−)	(+)	(−)
(+)	(−)	(+)

Example 1 Dividing Rational Numbers in Fraction Form

Divide: $\frac{3}{4} \div \left(-\frac{9}{8}\right)$

Solution

$\frac{3}{4} \div \left(-\frac{9}{8}\right)$

The fractions have different signs, so the quotient is negative.

$\frac{3}{4} \div \left(-\frac{9}{8}\right) = \frac{3}{4} \times \left(-\frac{8}{9}\right)$ Multiply by the reciprocal.

$= \frac{\cancel{3}^{1} \times (-\cancel{8})^{-2}}{\cancel{4}^{1} \times \cancel{9}^{3}}$ Look for common factors.

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

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

So, $\frac{3}{4} \div \left(-\frac{9}{8}\right) = -\frac{2}{3}$

Dividing by $-\frac{9}{8}$ is the same as multiplying by $-\frac{8}{9}$.

Check

1. Divide.

Think: Is the quotient positive or negative?

a) $\frac{2}{5} \div \left(-\frac{3}{4}\right)$

$= \frac{2}{5} \times$ _____

$= \frac{2 \times \_\_\_}{5 \times \_\_\_}$

$=$ _____

b) $\left(-\frac{2}{9}\right) \div \left(-\frac{4}{7}\right)$

$=$ _____ $\times$ _____

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$=$ __________

$=$ _____

Example 2 Dividing Rational Numbers in Decimal Form

Divide:
$(-5.1) \div 3$

Solution

$(-5.1) \div 3$

Since the signs are different, the quotient is negative.

Divide integers: $(-51) \div 3 = -17$

Estimate to place the decimal point.
-5.1 is close to -6, so $(-5.1) \div 3$ is close to $(-6) \div 3 = -2$
So, $(-5.1) \div 3 = -1.7$

Check

1. Divide: $(-7.5) \div 5$

$(-7.5) \div 5$

Divide integers: _______ ÷ ___ = ________

Estimate to place the decimal point.

$(-7.5) \div 5$ is about _____ ÷ ___ = ______

So, $-7.5 \div 5 =$ _______

Think: Is the quotient positive or negative?

Practice

1. Is the quotient positive or negative?

a) $(-7.5) \div (-3)$ Same sign; the quotient is _________________.

b) $8.42 \div (-2)$ _________________; the quotient is _________________.

c) $\left(-\frac{9}{10}\right) \div \frac{3}{5}$ _________________; the quotient is _________________.

d) $(-16) \div \left(-\frac{4}{5}\right)$ _____________; the quotient is _____________.

2. Which of these expressions have the same answer as $\left(-\frac{3}{10}\right) \div \frac{2}{5}$?

a) $-\frac{3}{10} \times \frac{5}{2}$

____, since ____

____

b) $-\frac{3}{10} \div \left(-\frac{2}{5}\right)$

___, since ____

____

c) $\frac{2}{5} \div \left(-\frac{3}{10}\right)$

___, since ____

____

d) $\frac{3}{10} \div \left(-\frac{2}{5}\right)$

____, since ____

____

3. Find each quotient.

a) $\left(-\frac{2}{3}\right) \div \frac{7}{6}$

$= \left(-\frac{2}{3}\right) \times$ _____

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$=$ _____

b) $\left(-\frac{15}{16}\right) \div \left(-\frac{5}{8}\right)$

$= \left(-\frac{15}{16}\right) \times$ _____

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$=$ _______

4. Divide.

a) $\left(-\frac{8}{9}\right) \div \frac{1}{3}$

$= \left(-\frac{8}{9}\right) \times$ ____

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$=$ __________

Think: Is the quotient positive or negative?

b) $\left(-\frac{2}{5}\right) \div \left(-\frac{3}{7}\right)$

$=$ ____ $\times$ ____

$= \frac{\_\_\_\_ \times \_\_\_\_}{\_\_\_\_ \times \_\_\_\_}$

$=$ ________

5. Use integers to determine each quotient.
Estimate to place the decimal point in the answer.

a) $(-2.94) \div 0.7$

$(-2.94) \div 0.7$
The quotient is __________.
To find $(-2.94) \div 0.7$, divide: ________ $\div$ _____ $=$ ________
$(-2.94) \div 0.7$ is about ______ $\div$ _____ $=$ ________.
So, $(-2.94) \div 0.7 =$ ________

b) $(-5.52) \div (-0.8)$

$(-5.52) \div (-0.8)$
The quotient is __________.
To find $(-5.52) \div (-0.8)$, divide: ________ $\div$ _____ $=$ _____
$(-5.52) \div (-0.8)$ is about ______ $\div$ ______ $=$ ____.
So, $(-5.52) \div (-0.8) =$ ______

3.6 Order of Operations with Rational Numbers

The order of operations for rational numbers is the same as for integers and fractions.
Think BEDMAS to remember the correct order of operations.
We use this order of operations to evaluate expressions with more than one operation.

B Do the operations in brackets first.
E Next, evaluate any exponents.
D
M Then, divide and multiply in order from left to right.
A
S Finally, add and subtract in order from left to right.

Example 1 Using the Order of Operations with Decimals

Evaluate.

a) $(-2.4) \div 1.2 - 7 \times 0.2$

b) $(-3.4 + 0.6) + 4^2 \times 0.2$

Solution

a) $\mathbf{(-2.4) \div 1.2} - 7 \times 0.2$ Divide first.
$= -2 - \mathbf{7 \times 0.2}$ Then multiply.
$= -2 - 1.4$ To subtract, add the opposite.
$= -2 + (-1.4)$
$= -3.4$

b) $\mathbf{(-3.4 + 0.6)} + 4^2 \times 0.2$ Brackets first.
$= -2.8 + \mathbf{4^2} \times 0.2$ Then evaluate the power.
$= -2.8 + \mathbf{16 \times 0.2}$ Then multiply.
$= -2.8 + 3.2$ Add.
$= 0.4$

Check

1. Evaluate.

a) $3.8 + 0.8 \div (-0.2)$
$= 3.8 + (\_\_\_)$
$= \_\_\_\_$

b) $4.6 - 3^2 + 3.9 \div (-1.3)$
$= 4.6 - \_\_\_ + 3.9 \div (-1.3)$
$= 4.6 - \_\_\_ + (\_\_\_)$
$= -4.4 + (\_\_\_)$
$= \_\_\_\_$

Example 2 Using the Order of Operations with Fractions

Evaluate:

a) $\left(\frac{3}{4}-\frac{7}{8}\right) \div \left(-\frac{5}{16}\right)$ **b)** $\left(-\frac{2}{3}\right) \times \frac{1}{6} + \frac{1}{2}$

Solution

a) $\left(\frac{3}{4}-\frac{7}{8}\right) \div \left(-\frac{5}{16}\right)$ Subtract in the brackets first. Use a common denominator of 8.

$= \left(\frac{\mathbf{6}}{\mathbf{8}}-\frac{\mathbf{7}}{\mathbf{8}}\right) \div \left(-\frac{5}{16}\right)$

$= \left(-\frac{1}{8}\right) \div \left(-\frac{5}{16}\right)$ To divide, multiply by the reciprocal of $-\frac{5}{16}$.

$= \left(-\frac{1}{8}\right) \times \left(-\frac{16}{5}\right)$

$= \left(-\frac{1}{\cancel{8}^{1}}\right) \times \left(-\frac{\cancel{16}^{2}}{5}\right)$ Look for common factors.

$= \frac{2}{5}$ Both factors are negative, so the product is positive.

b) $\left(-\frac{2}{3}\right) \times \frac{1}{6} + \frac{1}{2}$ Multiply first.

$= \left(-\frac{\mathbf{\cancel{2}^{1}}}{\mathbf{3}}\right) \times \frac{\mathbf{1}}{\mathbf{\cancel{6}^{3}}} + \frac{1}{2}$ Look for common factors.

$= \left(-\frac{1}{9}\right) + \frac{1}{2}$ Add. Use a common denominator of 18.

$= -\frac{2}{18} + \frac{9}{18} = \frac{7}{18}$

Check

1. Evaluate.

a) $\frac{3}{4} - \left(-\frac{2}{3}\right)\left(-\frac{1}{4}\right)$ Multiply first.

$= \frac{3}{4} -$ ______________ Look for common factors.

$= \frac{3}{4} -$ ______________

$= \frac{3}{4} -$ ______________ Subtract. Use a common denominator of 12.

$=$ ______ $-$ ______

$=$ ______

b) $\left(-\frac{1}{6}\right) \div \frac{1}{5} + \left(-\frac{3}{2}\right)$ Divide first. Multiply by the reciprocal of ____.

$= -\frac{1}{6} \times \frac{}{\_\_\_} + \left(-\frac{3}{2}\right)$

$= \frac{}{\_\_\_\_\_\_\_\_} + \left(-\frac{3}{2}\right)$

$= \frac{}{\_\_\_\_} + \left(-\frac{3}{2}\right)$ Add. Use a common denominator of ___.

$= \frac{}{\_\_\_\_} + \frac{}{\_\_\_\_}$

$= \frac{}{\_\_\_\_\_}$

Example 3 Applying the Order of Operations

The formula $C = (F - 32) \div 1.8$ converts temperatures in degrees Fahrenheit, F, to degrees Celsius, C.
What is 28.4°F in degrees Celsius?

Solution

Substitute $F = 28.4$ in the formula $C = (F - 32) \div 1.8$

$C = (28.4 - 32) \div 1.8$ Subtract in the brackets first. Add the opposite.
$= (28.4 + (-32)) \div 1.8$
$= (-3.6) \div 1.8$ Divide.
$= -2$

28.4°F is equivalent to −2°C.

Check

1. The expression $F = 32 + 9 \times C \div 5$ converts temperatures in degrees Celsius, C, to degrees Fahrenheit, F.

What is −12.5°C in degrees Fahrenheit?

$F = 32 + 9 \times (\_\_\_\_\_\_) \div 5$ Multiply first.
= ______________________ ________________
= ______________________ ________________
= ______________________

−12.5°C is equivalent to _______°F.

Practice

1. In each expression, which operation will you do first?

a) $(-8.6) \times 2.4 - (-6 + 2.5)$

____

b) $2.5 - 6.4 \times 2.1 + 3.5$

____

c) $\frac{4}{3} \times \frac{5}{6} + \frac{2}{7} \div \frac{5}{14}$

____

d) $\frac{5}{3} + \frac{2}{7} \div \left(-\frac{1}{4}\right) - \frac{3}{5}$

____

2. Evaluate each expression.

a) $(-3.6) \div 1.8 + (1.2 - 1.5)$

= ______________________________

= ______________________________

= ______________________________

b) $\left(-\frac{1}{4}\right) \div \frac{3}{8} + \left(-\frac{1}{2}\right)^2$

= ______________________________

= ______________________________

= ______________________________

= ______________________________

= ______________________________

3. Evaluate each expression.

a) $(5.6 + 4.4) \div (-2.5)$
= ____ $\div (-2.5)$
= ______

b) $(-4.2) + 6 \times (-1.7)$
= $(-4.2) +$ (_______)
= __________

c) $9.2 \div 4 - 3.6 \times 2$
= ____________________
= ____________________
= ____________________

d) $7.5 \times [-0.7 + (-0.3) \times 3]$
= ________________________
= ________________________
= ________________________

4. Evaluate each expression.

a) $\frac{1}{5} + \left(-\frac{1}{4}\right) \times \frac{8}{15}$

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

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

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

$=$ ______

$=$ ______

b) $\left(-\frac{7}{4}\right) \div \frac{2}{3} + \frac{1}{4}$

$=$ ______

$=$ ______

$=$ ______

$=$ ______

$=$ ______

c) $\left(\frac{1}{3}\right)^2 \times \frac{3}{2} - \frac{5}{4}$

$=$ ______

$=$ ______

$=$ ______

$=$ ______

$=$ ______

5. A mistake was made in each solution.
Identify the line in which the mistake was made, and give the correct solution.

a) $(-3.2 \div 1.6)^2 - (-4.1)$ ______

$= (-2)^2 - (-4.1)$ ______

$= 4 + (-4.1)$ ______

$= -0.1$ ______

b) $\frac{1}{3} + \frac{4}{3} \times \left(-\frac{1}{2}\right)$ ______

$= \frac{5}{3} \times \left(-\frac{1}{2}\right)$ ______

$= \frac{5 \times (-1)}{3 \times 2}$ ______

$= -\frac{5}{6}$ ______

6. The formula for the area of a trapezoid is $A = h \times (a + b) \div 2$.
In the formula, h is the height and a and b are the lengths of the parallel sides. Find the area of a trapezoid with height 3.5 cm and parallel sides of length 8 cm and 12 cm.

Substitute $h =$ ______, $a =$ ____, and $b =$ ______ in the formula $A = h \times (a + b) \div 2$.

$A =$ ______

$=$ ______

$=$ ______

$=$ ______

The trapezoid has area ____ cm^2.

Unit 3 Puzzle

Rational Numbers Bingo

Evaluate each expression and circle the answer on the Bingo cards. Which card is the winning card?

On the winning card, the answers form a horizontal, vertical, or diagonal line.

Questions

Evaluate as a decimal.

1. $(-8.2) - (-2.4) =$ ___________

2. $3.65 \div (-0.5) =$ ___________

3. $(-1.9) \times 2 =$ ___________

4. $(-3.48) + 5.06 =$ ___________

5. $(-0.80) - 0.64 =$ ___________

Evaluate as a fraction.

6. $\left(-\frac{7}{10}\right) + \frac{6}{5} =$ ___________

7. $\left(-\frac{6}{7}\right)\left(-\frac{14}{15}\right) =$ ___________

8. $\left(-\frac{1}{4}\right) \times \frac{1}{3} =$ ___________

9. $\left(-\frac{4}{5}\right) - \left(-\frac{3}{4}\right) =$ ___________

10. $\frac{1}{9} \div \left(-\frac{2}{3}\right) =$ ___________

$-1\frac{11}{20}$	–0.16	$2\frac{1}{15}$	–5.8	$-2\frac{1}{12}$
7.3	–1	–1.44	$-\frac{4}{5}$	3.99
–3.8	$1\frac{2}{5}$	FREE SPACE	$1\frac{9}{10}$	$-\frac{1}{12}$
3	$-2\frac{1}{15}$	–10.6	$-\frac{1}{6}$	–1.58
1.58	$\frac{4}{5}$	$-\frac{1}{20}$	–7.3	$\frac{1}{2}$

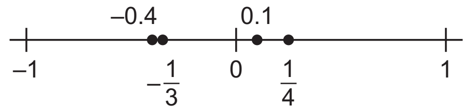
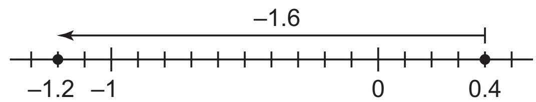
Card A

3	–5.8	–10.6	$1\frac{9}{10}$	$-2\frac{1}{15}$
$2\frac{1}{15}$	$-\frac{4}{5}$	–3.99	$1\frac{2}{5}$	–7.3
–1.44	1.58	FREE SPACE	$-\frac{1}{6}$	–1
7.3	$7\frac{11}{20}$	$\frac{1}{2}$	–1.58	$-2\frac{1}{12}$
$-\frac{1}{20}$	3.99	$\frac{4}{5}$	$-\frac{1}{12}$	–0.16

Card B

The winning card is ___________________.

Unit 3 Study Guide

Skill	Description	Example
Compare and order rational numbers.	Numbers increase in value from left to right on a number line.	 From least to greatest: $-0.4, -\frac{1}{3}, 0.1, \frac{1}{4}$
Add rational numbers.	Model on a number line: Start at the first number. Move right to add a positive number; move left to add a negative number.	 $0.4 + (-1.6) = -1.2$
	Look for common denominators to add fractions. With decimals, add digits with the same place value.	$-\frac{2}{5} + \frac{1}{2} = -\frac{4}{10} + \frac{5}{10} = \frac{1}{10}$ $(-18.7) + 13.5 = -5.2$
Subtract rational numbers.	Add the opposite.	$3\frac{1}{3} - \left(-1\frac{2}{5}\right) = 3\frac{1}{3} + \left(+1\frac{2}{5}\right)$ $= 3 + 1 + \frac{5}{15} + \frac{6}{15}$ $= 4\frac{11}{15}$ $-18.7 - 13.5 = -18.7 + (-13.5)$ $= -32.2$
Multiply and divide rational numbers.	Use the same rules for signs as with integers. Then determine the numerical value.	$\left(-\frac{2}{3}\right) \times \frac{9}{8} = \frac{(\cancel{-2})^{-1} \times \cancel{9}^{3}}{\cancel{3}^{1} \times \cancel{8}^{4}}$ $= -\frac{3}{4}$ $(-6.3) \times 7 = -44.1$
		$\left(-2\frac{1}{5}\right) \div \left(-3\frac{3}{10}\right) = \left(-\frac{11}{5}\right) \div \left(-\frac{33}{10}\right)$ $= \left(-\frac{\cancel{11}^{1}}{\cancel{5}^{1}}\right) \times \left(-\frac{\cancel{10}^{2}}{\cancel{33}^{3}}\right)$ $= \frac{2}{3}$ $(-5.6) \div 0.7 = -8.0$
Use order of operations to evaluate expressions.	**B** Do the operations in brackets first. **E** Next, evaluate any exponents. **D M** Then, divide and multiply in order from left to right. **A S** Finally, add and subtract in order from left to right.	$(-2.50 + 1.75) \div (0.1 - (-0.4))^2$ $= -0.75 \div (0.1 + (+0.4))^2$ $= -0.75 \div (0.5)^2$ $= -0.75 \div 0.25$ $= -3$

Unit 3 Review

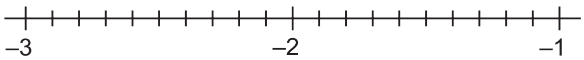
3.1 **1. a)** Write each number as a decimal.

i) $-\frac{16}{9} = $ ____________
$= $ ____________

ii) $-\frac{7}{3} = $ ____________
$= $ ____________

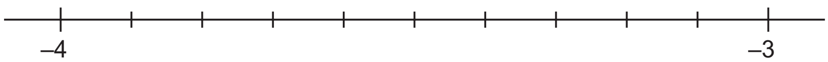
iii) $-2\frac{1}{5} = -\frac{\_\_}{\_\_}$
$= $ ______________
$= $ ______________

b) Find two rational numbers between $-\frac{16}{9}$ and $-\frac{7}{3}$:



Two rational numbers between $-\frac{16}{9}$ and $-\frac{7}{3}$ are: ____ and ______

2. Order these numbers from least to greatest: -3.9, $-3\frac{4}{5}$, -3.3, $-\frac{7}{2}$



From least to greatest: ____________________________

3.2 **3.** Calculate each sum.

a) $(-2.1) + 4.8 = $ _______

b) $25.6 + (-18.9) = $ _______

c) $(-6.4) + (-3.8) = $ _______

4. Add.

a) $-\frac{1}{8} + \left(-\frac{3}{4}\right)$
$= -\frac{1}{8} + $ _____
$= $ _____

b) $-\frac{4}{3} + \frac{11}{12}$
$= $ _____ $+ \frac{11}{12}$
$= $ _____

c) $\left(-1\frac{2}{3}\right) + 2\frac{8}{9} = (-1 + 2) + \left(\_\_ + \_\_\right)$
$= (-1 + 2) + \left(\_\_ + \_\_\right)$
$= $ ________
$= $ ________

3.3 **5.** Subtract.

a) $\left(-\frac{7}{12}\right) - \left(-\frac{2}{3}\right) = -\frac{7}{12} + \frac{2}{3}$

$= -\frac{7}{12} + \_\_\_$

$= \_\_\_$

b) $\frac{3}{5} - 2\frac{1}{7} = \frac{3}{5} + \left(-\frac{\_\_}{7}\right)$

$= \_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_$

c) $-3\frac{1}{10} - 1\frac{3}{5} = -\frac{\_\_}{10} + \left(-\frac{\_\_}{5}\right)$

$= \_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_$

6. The table shows the elevations of several places on Earth.

Place	**Elevation (m)**
Mt. Everest	8849.7
Mt. Logan	5959.1
Death Valley	−410.9
Dead Sea	−417.3

Write a subtraction sentence that represents the difference in the elevations of the given locations. Then calculate the difference.

a) Mt. Logan and the Dead Sea

______ − (______) = ______ + ______

= ________

The difference in elevations is ______ m.

b) Death Valley and the Dead Sea

______ − (______) = ______ + ______

= ________

The difference in elevations is ____ m.

c) Mt. Everest and Mt. Logan

______ − ______ = ______ + _______

= ________

The difference in elevations is ______ m.

3.4 **7.** What is the sign of each product?

a) $(-3.8) \times (-1.2)$ ________

b) $0.75 \times (-8.6)$ ________

c) $\left(-\frac{1}{3}\right)\left(-\frac{4}{9}\right)$ ________

d) $\left(-1\frac{2}{5}\right) \times \frac{7}{10}$ ________

8. Find each product.

a) $\left(-\frac{2}{5}\right)\left(-\frac{11}{20}\right)$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \_\_\_\_\_\_$

b) $\left(-\frac{4}{5}\right) \times \frac{25}{12}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \_\_\_\_\_\_$

c) $-\frac{15}{16} \times 1\frac{1}{3}$

$= -\frac{15}{16} \times \frac{\_\_}{3}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \_\_\_\_\_\_$

d) $-3\frac{2}{3} \times \left(-2\frac{3}{11}\right)$

$= -\frac{\_\_}{3} \times \left(-\frac{\_\_}{11}\right)$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \frac{\_\_\_ \times \_\_\_}{\_\_\_ \times \_\_\_}$

$= \_\_\_\_\_\_$

9. Circle the most reasonable answer.

	Question	Most reasonable answer		
a)	29.5 × 4.8	1.416	14.16	141.6
b)	5.4 × 0.7	0.378	3.78	37.8
c)	305.8 × 3.2	97.856	978.56	9785.6
d)	37.5 × 1.6	0.6	6	60

10. A diver descends at a speed of 0.8 m/min.
How far does the diver descend in 3.5 min?
The distance the diver descends is: ______ × ______

The product is ____________. Multiply the whole numbers: ______ × ______ = ______

Estimate: ______ × ______ is about ______ × ______ = ______.

The exact answer is ______ × ______ = ______

The diver descends ______ m in 3.5 min.

3.5 **11.** Divide.

a) $\frac{1}{5} \div \left(-\frac{7}{10}\right)$

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

$=$ ______

$=$ ______

$=$ ______

b) $\left(-\frac{3}{5}\right) \div \left(-\frac{12}{7}\right)$

$=$ ______

$=$ ______

$=$ ______

$=$ ______

3.6 **12.** Evaluate each expression.

a) $1.1 - 3.1 \times 7$

$= 1.1 -$ ______

$= 1.1 + ($______$)$

$=$ ______

b) $-1.8 \div (-0.3) + [5.1 - (-2.9)]$

$= -1.8 \div (-0.3) + [5.1 +$ ______$]$

$= -1.8 \div (-0.3) +$ ______

$=$ ______ $+$ ______

$=$ ______

c) $\left(-\frac{5}{6}\right) \times \frac{1}{4} + \frac{5}{12}$

$=$ ______ $+ \frac{5}{12}$

$=$ ______ $+ \frac{5}{12}$

$=$ ______ $+$ ______

$=$ ______

d) $1\frac{3}{4} + \frac{2}{3} \div \left(-\frac{8}{9}\right)$

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

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

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

$= \frac{\_\_}{4} +$ ______

$=$ ______