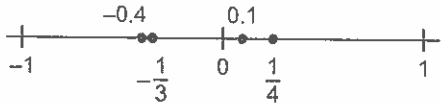
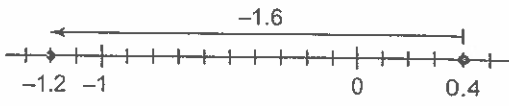


## Unit 3 Study Guide

Skill	Description	Example	
Compare and order rational numbers.	Numbers increase in value from left to right on a number line.	 <p>From least to greatest: <math>-0.4, -\frac{1}{3}, 0.1, \frac{1}{4}</math></p>	
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.	 <p><math>0.4 + (-1.6) = -1.2</math></p>	
	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.	$3\frac{1}{3} - (-1\frac{2}{5}) = 3\frac{1}{3} + (+1\frac{2}{5})$ $= 3 + 1 + \frac{5}{15} + \frac{6}{15}$ $= 4\frac{11}{15}$ $-18.7 - 13.5 = -18.7 + (-13.5)$ $= -32.2$	
Multiply and divide rational numbers.	Use the same rules for signs as with integers. Then determine the numerical value.	$\left(-\frac{2}{3}\right) \times \frac{9}{8} = \frac{(-2)^1 \times 9^1}{3^1 \times 8^1}$ $= -\frac{3}{4}$ $(-6.3) \times 7 = -44.1$	
		$\left(-2\frac{1}{5}\right) \div \left(-3\frac{3}{10}\right) = \left(-\frac{11}{5}\right) \div \left(-\frac{33}{10}\right)$ $= \left(\frac{11^1}{5^1}\right) \times \left(\frac{10^2}{33^2}\right)$ $= \frac{2}{3}$ $(-5.6) \div 0.7 = -8.0$	
Use order of operations to evaluate expressions.	<b>B</b>	Do the operations in brackets first.	$(-2.50 + 1.75) \div (0.1 - (-0.4))^2$ $= -0.75 \div (0.1 + (+0.4))^2$ $= -0.75 \div (0.5)^2$ $= -0.75 \div 0.25$ $= -3$
	<b>E</b>	Next, evaluate any exponents.	
	<b>D</b>	Then, divide and multiply in order from left to right.	
	<b>M</b>	Finally, add and subtract in order from left to right.	
	<b>A</b>		
	<b>S</b>		

8. Which of the following expressions have the same sum as  $-\frac{3}{4} + \frac{7}{8}$ ? Use a number line to show how you know.

a)  $-\frac{3}{4} + \left(-\frac{7}{8}\right)$       b)  $-\frac{7}{8} + \frac{3}{4}$   
 c)  $\frac{7}{8} + \left(-\frac{3}{4}\right)$       d)  $\frac{7}{8} + \frac{3}{4}$

### Apply

9. Use integers to estimate each sum. Then, determine each sum.

a)  $-5.6 + 3.2$   
 b)  $7.95 + (-4.51)$   
 c)  $-0.325 + (-32.5)$   
 d)  $-123.5 + 27.45$   
 e)  $82.001 + 100.28$   
 f)  $-17.84 + (-0.098)$

10. Is it possible to add 2 rational numbers and get a sum that is less than both the numbers you added? Explain your reasoning.

11. Determine each sum.

a)  $-\frac{2}{3} + \frac{1}{2}$       b)  $\frac{4}{5} + \left(-\frac{1}{3}\right)$   
 c)  $-\frac{11}{4} + \left(-\frac{6}{5}\right)$       d)  $\frac{13}{5} + \frac{9}{2}$   
 e)  $-2\frac{1}{3} + \left(-1\frac{3}{4}\right)$       f)  $\frac{9}{5} + \left(-\frac{17}{6}\right)$   
 g)  $-3\frac{3}{4} + 4\frac{5}{8}$       h)  $1\frac{5}{6} + \left(-5\frac{2}{3}\right)$   
 i)  $-3\frac{1}{4} + \left(-2\frac{1}{6}\right)$       j)  $2\frac{3}{5} + \left(-1\frac{7}{8}\right)$

12. **Assessment Focus** What can you say about the sign of the sum of 2 rational numbers in each case? Include examples and explain your reasoning.

- a) Both rational numbers are positive.  
 b) Both rational numbers are negative.  
 c) One rational number is positive and one rational number is negative.

13. Zoe owes her mother \$36.25, then Zoe borrows another \$25.35.
- Write each amount as a rational number.
  - Use the numbers in part a.
    - Write an expression for the amount Zoe owes.
    - How much does Zoe owe?
  - Zoe pays back \$14.75.
    - Write an expression for the amount Zoe now owes.
    - How much does Zoe now owe?

14. Estimate whether each sum is greater than or less than 0. Explain how you know. Calculate to check your prediction.

a)  $-0.61 + 0.23$       b)  $12.94 + (-12.56)$   
 c)  $-\frac{7}{3} + \left(\frac{17}{5}\right)$       d)  $\frac{7}{4} + \left(-\frac{6}{5}\right)$

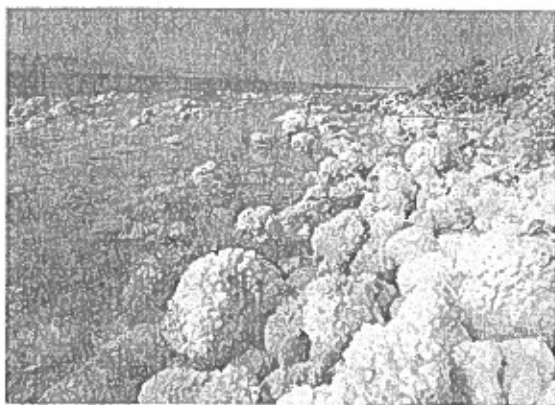
15. On Tuesday, December 23rd, the lowest temperature in Winnipeg was  $-13.4^{\circ}\text{C}$ . By noon the next day, the temperature had increased by  $5.7^{\circ}\text{C}$ .
- What was the temperature at noon?
  - On Wednesday, December 24th, the lowest temperature was  $3.7^{\circ}\text{C}$  less than the lowest the previous day. What was the lowest temperature on Wednesday?
  - Sketch a thermometer to show these changes in temperature.



**10. Assessment Focus** Is it possible to subtract 2 rational numbers and get a difference that is greater than both the numbers you subtracted? Explain your reasoning. Include examples of rational numbers in decimal form and in fraction form.

**11.** In Asia, the lowest point on land is the shore of the Dead Sea, which is 417.5 m below sea level. The highest point is the peak of Mount Everest, which 8844.43 m above sea level.

- Write each measurement above as a rational number.
- Write a subtraction statement that represents the distance between the highest point and the lowest point. What is this distance?



**12.** Predict whether each answer is positive or negative. Explain how you know. Calculate to check your prediction.

- $-3.86 - 41.12$
- $1.32 - (-5.79)$
- $-\frac{5}{4} - \left(-\frac{7}{2}\right)$
- $-\frac{23}{5} - \frac{5}{3}$

## Reflect

How is subtracting 2 rational numbers similar to adding 2 rational numbers? How is it different? Include examples of rational numbers in your explanation.

**13.** Evaluate each expression.

- $\frac{3}{5} - \left(-\frac{1}{2}\right) + \frac{2}{3}$
- $-2.34 + 8.6 + (-5.71)$
- $-\frac{16}{5} - \left(-\frac{14}{3}\right) + \frac{13}{4}$
- $23.5 + (-12.61) - 3.2$

**14.** Determine a rational number that makes each statement true. Use a calculator to check your answer.

- $-1.2 - \square \leq 3.7$
- $4.3 - \square \geq 8.9$
- $\square - 2.9 \geq 5.3$
- $\square - 7.2 \leq -10.9$

## Take It Further

**15.** Determine the missing number in each subtraction statement.

- $\square - 28.4 = 37.3$
- $\frac{9}{10} - \square = \frac{3}{5}$
- $\square - 0.05 = -2.08$
- $\frac{11}{6} - \square = -\frac{7}{3}$
- $-1.25 - \square = 3.75$
- $-3\frac{1}{2} - \square = 5\frac{1}{4}$

**16.** Find two pairs of rational numbers that make each equation true.

- $-7.4 + \square - \square = -10.9$
- $\square - (-12.8) + \square = -1.1$
- $-21.6 - \square - \square = -15.4$

**17.** Determine the range of numbers that makes each sentence true. Explain your thinking.

- $-11.8 - \square \leq 5.7$
- $6.3 - \square \geq 9.4$

## Mid-Unit Review

- 3.1** 1. a) Sketch a number line. On the line, place each rational number below.

$$-1.3, 2\frac{3}{4}, 1.51, -\frac{8}{5}, -\frac{9}{3}$$

- b) Which numbers in part a are less than  $-1.5$ ? Explain how you know.

2. Order the following rational numbers from least to greatest. Place each number on a number line to support your answer.

$$-\frac{6}{5}, 1.2, -1.1, -\frac{1}{4}, 0.2, -1\frac{3}{8}$$

3. Replace each  $\square$  with  $<$  or  $>$ .

How could you check your answers?

a)  $-\frac{2}{3} \square -\frac{3}{4}$       b)  $-\frac{8}{3} \square -\frac{9}{4}$   
 c)  $-2.5 \square 0.5$       d)  $-\frac{4}{5} \square -0.9$

4. Identify a rational number between each pair of numbers. Sketch a number line to illustrate each answer.

a) 1.2, 1.4      b)  $-\frac{3}{4}, \frac{5}{8}$   
 c)  $0.4, \frac{1}{3}$       d)  $-1.05, -\frac{9}{10}$

- 3.2** 5. a) How can you determine the sign of the sum of two numbers before you add them?

- b) Determine the sign of each sum, then check by using a calculator.

i)  $2.35 + 3.47$

ii)  $-5.783 + (-0.247)$

iii)  $-\frac{2}{3} + \left(-1\frac{1}{8}\right)$

iv)  $-5.27 + 6.58$

v)  $-\frac{17}{5} + \frac{1}{9}$

vi)  $0.085 + (-0.125)$

6. Determine each sum.

a)  $8.37 + 0.58$       b)  $-21.25 + (-36.57)$

c)  $-157.4 + 32.7$       d)  $\frac{5}{8} + \left(-\frac{1}{9}\right)$

e)  $-8\frac{1}{4} + 5\frac{1}{5}$       f)  $-\frac{5}{3} + \left(-\frac{23}{7}\right)$

- 3.3** 7. The temperature of a freezer changed from  $-16.1^\circ\text{C}$  to  $-14.7^\circ\text{C}$ .

- a) i) By how much did the temperature change?

- ii) Is this an increase or a decrease in temperature? Explain how you know.

- b) By how much does the temperature need to change again before it is at  $-3.8^\circ\text{C}$ ?

8. Determine each difference.

a)  $40.25 - 63.10$       b)  $-112.2 - (-14.8)$

c)  $\frac{2}{5} - \frac{9}{10}$       d)  $-4\frac{4}{9} - 3\frac{5}{6}$

e)  $-1.8 - 4.3$       f)  $\frac{23}{8} - \left(-\frac{7}{2}\right)$

9. The lowest point on land in North America is Death Valley at 86 m below sea level.

The highest point is the peak of

Mt. McKinley at 6193.7 m above sea level.

How can you use rational numbers to calculate the distance between these two points?

10. a) How can you determine the sign of the difference of two numbers before you subtract them?

- b) Determine the sign of each difference, then check by using a calculator.

i)  $62.4 - 53.7$       ii)  $-0.54 - 1.98$

iii)  $\frac{1}{12} - \frac{9}{10}$       iv)  $5\frac{2}{3} - \left(-7\frac{1}{2}\right)$

b)  $(-1.25)(-2.84)$

When there are more than 2 digits in both numbers being multiplied, use a calculator.

The rational numbers have the same sign, so their product is positive.

Key in  $1.25 \times 2.84$  to display: 3.55



$$(-1.25)(-2.84) = 3.55$$

### Discuss the ideas

1. Why does it help to predict the sign of a product before you multiply 2 rational numbers?
2. Why does it make sense that the rules for signs when you multiply integers must apply when you multiply rational numbers?

### Practice

#### Check

3. Predict which products are greater than 0, then multiply to determine each product. Explain the strategy you used to predict.

- a)  $3 \times (-5.2)$
- b)  $2.6 \times (-4)$
- c)  $(-1.3) \times 5$
- d)  $(-0.9) \times (-7.1)$

4. Predict which products are less than 0, then multiply to determine each product. Explain the strategy you used to predict.

- a)  $(-3) \times \frac{2}{3}$
- b)  $(-\frac{1}{4}) \times (-5)$
- c)  $(\frac{4}{5}) \times (-2)$
- d)  $(-\frac{1}{2}) \times \frac{7}{8}$

5. Determine each product. Estimate to place the decimal point.

- a)  $(-0.64)(0.2)$
- b)  $(-0.5)(-5.71)$
- c)  $(-4.13)(-0.8)$
- d)  $(0.7)(8.5)$

6. Which of the following expressions have the same product as  $(-\frac{3}{4})(\frac{5}{2})$ ?

Explain how you know.

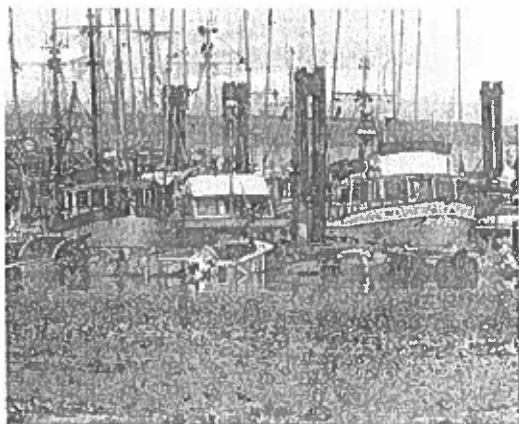
- a)  $(\frac{5}{2})(-\frac{3}{4})$
- b)  $(\frac{3}{4})(-\frac{5}{2})$
- c)  $(-\frac{3}{2})(\frac{5}{4})$
- d)  $(\frac{3}{4})(\frac{5}{2})$
- e)  $(\frac{3}{2})(-\frac{5}{4})$
- f)  $(-\frac{3}{4})(-\frac{5}{2})$

7. Determine each product.

- a)  $(-\frac{1}{3})(\frac{2}{5})$
- b)  $(\frac{1}{4})(-\frac{3}{5})$
- c)  $(\frac{4}{5})(\frac{1}{2})$
- d)  $(-\frac{5}{6})(-\frac{2}{3})$

## Apply

6. At a sea port, the effect of the tide changed the water level by  $-5.6$  m in 3.5 h. What was the mean change in water level per hour?



7. Determine each quotient without a calculator. Estimate to place the decimal point in the quotient.
- a)  $0.32 \div 0.4$
  - b)  $(-1.17) \div 0.8$
  - c)  $0.25 \div (-0.6)$
  - d)  $(-1.02) \div (-0.2)$
  - e)  $3.76 \div (-0.3)$
  - f)  $3.15 \div 0.9$
8. On a winter's day, the temperature at 6 P.M. was  $0^{\circ}\text{C}$ . Suppose the temperature decreased by  $2.5^{\circ}\text{C}$  each hour until it was  $-12.5^{\circ}\text{C}$ . How long did it take to reach this temperature? How do you know?
9. Use a calculator to determine each quotient.
- a)  $20.736 \div (-1.8)$
  - b)  $(-27.94) \div 1.2$
  - c)  $(-84.41) \div (-2.3)$
  - d)  $23.04 \div 4.8$
  - e)  $76.63 \div (-7.5)$
  - f)  $(-0.1081) \div 0.45$

10. **Assessment Focus** Suppose each rational number below is divided by  $-0.5$ . Predict which quotients are greater than  $-10$ . Explain the strategies you used to predict. Then evaluate only those quotients that are greater than  $-10$ .

a)  $-20.5$    b)  $18.8$    c)  $10.7$    d)  $0.6$

11. To pay for a skiing holiday in Whistler, Paige borrowed  $\$1450.50$  from her parents. She pays back  $\$30.75$  each week.
- a) How many weeks will it be until Paige is no longer in debt? Justify your answer.
  - b) How did you use rational numbers to calculate the answer in part a?



12. Determine each quotient.

a)  $\frac{5}{4} \div \left(-\frac{7}{6}\right)$       b)  $\frac{3}{10} \div \frac{12}{5}$   
c)  $\left(-\frac{3}{4}\right) \div \left(-1\frac{1}{8}\right)$       d)  $\left(-4\frac{3}{5}\right) \div \frac{3}{4}$   
e)  $3\frac{2}{3} \div \left(-2\frac{1}{4}\right)$       f)  $3\frac{4}{9} \div 6\frac{1}{3}$

13. A thermometer on a freezer is set at  $-5.5^{\circ}\text{C}$ . Each time the freezer door is opened, the temperature increases by  $0.3^{\circ}\text{C}$ . Suppose there is a power outage. How many times can the door be opened before the temperature of the freezer increases to  $5^{\circ}\text{C}$ ? Justify your solution.

## Discuss

## the ideas

1. What does a fraction bar indicate?
2. As the number of operations increases and the expressions become more complex, it is easy to make mistakes.  
What can you do to prevent yourself making mistakes?

## Practice

### Check

3. Evaluate. Do not use a calculator.
  - a)  $2.3 - (-1.6) \times (0.8)$
  - b)  $(-14.8) \times 0.9 - 3.1$
  - c)  $(-12.8) \div (-0.2) + 4.5 \div 0.5$
  - d)  $(-4.8) \times (-0.4 + 0.6)^2$
4. Evaluate. Do not use a calculator.
  - a)  $\frac{1}{2} + \left(-\frac{3}{4}\right) \times \frac{1}{3}$
  - b)  $\left(-\frac{5}{4}\right) \div \left(-\frac{1}{4} + \frac{3}{2}\right) \left(-\frac{1}{4} + \frac{3}{2}\right)$
  - c)  $\left(-\frac{7}{10}\right) \div \left(-\frac{2}{5}\right) - \left(-\frac{1}{4}\right) \times \frac{1}{2}$
  - d)  $\frac{6}{5} \times \left(-\frac{2}{3} + \frac{8}{3}\right)^2 - \frac{5}{12}$

### Apply

5. a) Use a calculator to evaluate the expression below. Key in the expression as it is written.  
 $-2.8 - 1.4 \times 4.5$ 
  - b) Does the calculator follow the order of operations or does it perform operations from left to right? How did you find out?
6. Estimate which expression has the greatest value. Then use a calculator to evaluate each expression to verify your prediction.
  - a)  $9.1 - 3.5 \times (4.2)^2$
  - b)  $(9.1 - 3.5) \times (4.2)^2$
  - c)  $9.1 - (3.5 \times 4.2)^2$
  - d)  $9.1[(-3.5) \times (4.2)^2]$

### 7. Evaluate.

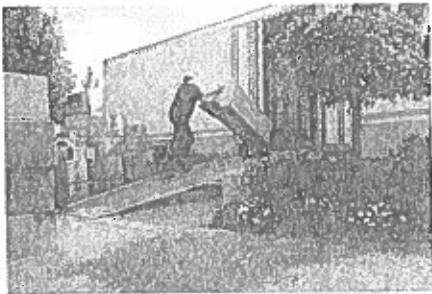
- a)  $\left(-\frac{2}{3}\right) \div \frac{1}{4} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{3}$
- b)  $\left(-\frac{2}{3}\right) \div \left[\frac{1}{4} + \left(-\frac{1}{2}\right)\right] \times \frac{1}{3}$
- c)  $\left(-\frac{2}{3}\right) \div \left[\frac{1}{4} - \left(-\frac{1}{2}\right)\right] \times \frac{1}{3}$
- d)  $\left(-\frac{2}{3}\right) \div \left[\frac{1}{4} + \left(-\frac{1}{2}\right) \times \frac{1}{3}\right]$

### 8. Find the errors in each solution.

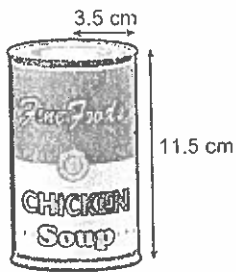
Write the correct solution.

a)	$(-3.7) \times (-2.8 + 1.5) - 4.8 \div (-1.2)$
	$= (-3.7) \times (1.3) - 4.8 \div (-1.2)$
	$= -4.81 - 4.8 \div (-1.2)$
	$= -9.61 \div (-1.2)$
	$= 8.008\bar{3}$
b)	$-\frac{3}{8} - \frac{4}{5} \times \frac{3}{10} \div \left(-\frac{4}{5}\right)$
	$= -\frac{15}{40} - \frac{32}{40} \times \frac{3}{10} \div \left(-\frac{4}{5}\right)$
	$= -\frac{47}{40} \times \frac{3}{10} \div \left(-\frac{4}{5}\right)$
	$= -\frac{141}{400} \div \left(-\frac{4}{5}\right)$
	$= -\frac{141}{400} \times \left(-\frac{5}{4}\right)$
	$= \frac{(-141) \times (-5)}{400 \times 4}$
	$= \frac{705}{1600}$

9. A family moves from Chicago to Saskatoon. A company that rents moving trucks uses this formula,  $C = 1.15[21.95d + 0.035(k - 120)]$ , to determine the cost, including tax, of renting a truck for  $d$  days and  $k$  kilometres, when  $k > 120$ . The distance from Chicago to Saskatoon is 2400 km and the family travels for 4 days. What is the cost to rent the truck?



10. A can of soup is a cylinder with radius 3.5 cm and height 11.5 cm.



Use the formula:

Surface area =  $2\pi r^2 + 2\pi r \times \text{height}$ ,  
where  $r$  is the radius of the can

- a) Determine the area of tin needed to make the can, to the nearest square centimetre.  
b) Explain how you used the order of operations in part a.
11. a) Use this formula to convert each Fahrenheit temperature below to Celsius:  
$$C = \frac{F - 32}{1.8}$$
  
i)  $0^\circ\text{F}$     ii)  $-40^\circ\text{F}$     iii)  $-53^\circ\text{F}$

- b) Here is another way to write the formula in part a:  $C = \frac{5}{9}(F - 32)$   
Use this formula to convert each Fahrenheit temperature below to Celsius:  
i)  $50^\circ\text{F}$     ii)  $-13^\circ\text{F}$     iii)  $32^\circ\text{F}$   
c) Which formula in parts a and b was easier to use? Explain your choice.

12. Evaluate. State the order in which you carried out the operations.

a)  $\left(-4\frac{1}{2}\right) + \left(-\frac{2}{3}\right) \times 2\frac{3}{4}$   
b)  $\left(-3\frac{2}{5}\right) \times \left(-1\frac{5}{6}\right) + \frac{3}{10}$   
c)  $(-3) \div \left(-\frac{4}{5}\right) + \left(-\frac{5}{12}\right) \times 1\frac{1}{2}$   
d)  $\left(1\frac{5}{8}\right) - \left(-2\frac{3}{4} + 2\right)\left(-2\frac{3}{4} + 2\right)$

13. Use a calculator to evaluate.

Write the answers to the nearest hundredth where necessary.

a)  $2.3 + (-11.2) \div (-0.2) - 3.7$   
b)  $(-3.4) \times 0.7 - (-1.8)(-1.8)$   
c)  $\frac{0.67 - 4.2 \div (-0.2)}{(-7.3 + 8.6)^2}$   
d)  $\frac{8.9 \times (-3.1 + 22.7)^2 + 4.7}{(-9.6) \div 0.04 - 0.4}$

14. On one day in Black Lake, Saskatchewan, the maximum temperature was  $-8.1^\circ\text{C}$  and the minimum temperature was  $-16.7^\circ\text{C}$ .  
a) What was the mean temperature that day?  
b) How did you use the order of operations in part a?

