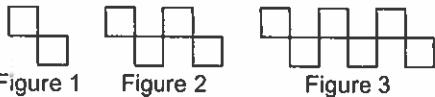
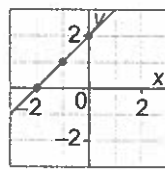
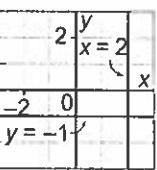
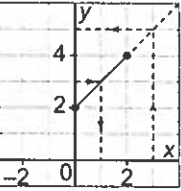


Unit 4 Study Guide

Skill	Description	Example								
Generalize a pattern	Recognize and extend a pattern using a drawing and a table of values. Describe the pattern. Write an equation for the pattern.	 <p>Figure 1 Figure 2 Figure 3</p> <table border="1"> <thead> <tr> <th>Figure Number, n</th> <th>Figure Value, v</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> </tr> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>6</td> </tr> </tbody> </table> <p>As the figure number increases by 1, the figure value increases by 2. The pattern is: multiply the figure number by 2 to get the figure value. An equation is: $v = 2n$</p>	Figure Number, n	Figure Value, v	1	2	2	4	3	6
Figure Number, n	Figure Value, v									
1	2									
2	4									
3	6									
Linear relations	The points on the graph of a linear relation lie on a straight line. To graph a linear relation, create a table of values first. In a linear relation, a constant change in x produces a constant change in y .	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>-2</td> <td>0</td> </tr> <tr> <td>-1</td> <td>1</td> </tr> <tr> <td>0</td> <td>2</td> </tr> </tbody> </table>  <p>As x increases by 1, y increases by 1.</p>	x	y	-2	0	-1	1	0	2
x	y									
-2	0									
-1	1									
0	2									
Horizontal and vertical lines	A vertical line has equation $x = a$ A horizontal line has equation $y = b$	 <p>The graph of $x = 2$ is a vertical line. Every point on the line has x-coordinate 2. The graph of $y = -1$ is a horizontal line. Every point on the line has y-coordinate -1.</p>								
Interpolation and extrapolation	When we estimate values between 2 given points on a graph, we use interpolation. When we estimate values beyond given points on a graph, we use extrapolation.	 <p>When $y = 3$, $x = 1$ Extend the graph to find that, when $x = 3$, $y = 5$</p>								

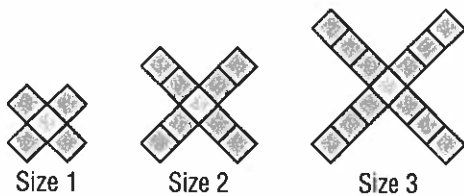
Practice

Check

4. In each equation, determine the value of P when $n = 1$.
 a) $P = 2n$ b) $P = 3n$ c) $P = 4n$ d) $P = 5n$
5. In each equation, determine the value of A when $n = 2$.
 a) $A = 3n + 1$ b) $A = 3n + 2$
 c) $A = 3n + 3$ d) $A = 3n + 4$
6. In a table of values for a pattern, $P = 3$ when $n = 1$; which of the following equations might represent the pattern?
 a) $P = 3n$ b) $P = n + 3$
 c) $P = 2n + 1$ d) $P = 3 - n$
7. The pattern in this table continues. Which expression below represents the number of squares in terms of the figure number?

Figure, f	Number of Squares, s
1	6
2	7
3	8
4	9
5	10

- a) $5f$ b) $2f$ c) $f + 5$ d) $s + 5$
8. This pattern of squares continues. Which equation below relates the number of squares, n , in a picture to the size number, s ?

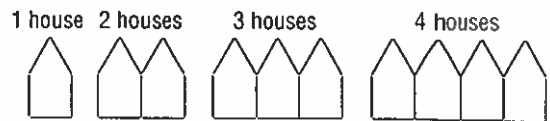


- a) $n = s + 4$ b) $n = 4s$
 c) $n = 4s + 1$ d) $s = 4n$

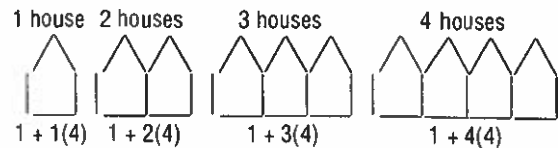
9. The pattern in this table continues. Which equation below relates the number of squares to the figure number?

Figure, f	Number of Squares, s
1	5
2	7
3	9
4	11
5	13

- a) $s = 4f + 1$ b) $s = 2f + 3$
 c) $s = f + 2$ d) $f = 2s + 3$
10. Here is a pattern made with toothpicks. The pattern continues.



Here are the toothpicks rearranged to show what stays the same and what changes in each picture.



- a) Explain how the numbers in the expression below each picture describe the arrangement of toothpicks in the picture.
 b) Let n represent the number of houses in a picture. Write an expression for the number of toothpicks in n houses.
 c) Write an equation that relates the number of toothpicks, t , to n .
 d) Verify the equation by showing that it produces the correct number of toothpicks for the first four pictures in the pattern.

Apply

11. The pattern in each table below continues.

For each table:

- Describe the pattern that relates v to t .
- Write an expression for v in terms of t .
- Write an equation that relates v to t .
- Verify your equation by substituting values from the table.

a)

Term Number, t	Term Value, v
1	11
2	22
3	33
4	44

b)

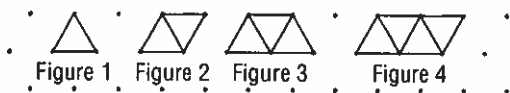
Term Number, t	Term Value, v
1	5
2	8
3	11
4	14

c)

Term Number, t	Term Value, v
1	7
2	6
3	5
4	4

12. Here is a pattern of triangles made with congruent toothpicks.

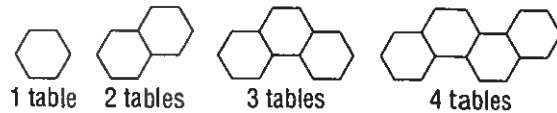
The pattern continues.



- Make a table of values for the figure number and the number of toothpicks in a figure. What patterns do you see?
- Write an expression for the number of toothpicks, t , in figure n .

- Determine the number of toothpicks in figure 45.
- Write an equation that relates t to n .
- Which figure has 17 toothpicks?
How could you check your answer?

13. **Assessment Focus** Hexagonal tables are arranged as shown. The pattern continues. One person sits at each side of a table.



- Determine the number of people who can be seated at each table arrangement. Record your results in a table.
- Describe the patterns in the table.
- What strategies can you use to determine the number of people who could be seated at any table arrangement in the pattern?
- Write an equation that relates the number of people, p , who can be seated at n tables. How can you check that your equation is correct?
- How many tables are needed to seat 41 people? How could you check your answer?
Show your work.

14. The cost to print brochures is the sum of a fixed cost of \$250, plus \$1.25 per brochure.

- Write an equation that relates the total cost, C dollars, to the number of brochures, n .
- What is the cost of printing 2500 brochures?
- How many brochures can be printed for \$625?
Justify your answers.

6. Graph the linear relations you identified in question 5. How does each graph verify your answers to question 5?

7. Copy and complete each table of values.

a) $y = 2x$

x	y
1	
2	
3	
4	

b) $y = x + 2$

x	y
1	
2	
3	
4	

c) $y = -2x$

x	y
2	
4	
6	
8	

d) $y = x - 2$

x	y
4	
5	
6	
7	

8. Here is a partially completed table of values for a linear relation.

x	2	3	4	5	6	7	8
y				15	18		

- Determine the missing values of y . Explain how you found these values.
- Describe the patterns in the table.
- Write an equation that represents the linear relation. How do you know that your equation is correct?
- Graph the data. How are the patterns you described in part b shown in the graph?
- Suppose you want to determine the value of y when $x = -1$. How could you use the table and equation to do this? What is the value of y when $x = -1$?

9. Each table of values represents a linear relation. Copy and complete each table. Explain your reasoning.

a)

x	y
2	11
3	14
4	
5	
6	

b)

x	y
1	
3	8
5	9
7	
9	

c)

x	y
-4	
-2	7
0	3
2	
4	

d)

x	y
4	
6	-7
8	-4
10	
12	

10. Create a table of values for each linear relation, then graph the relation.

Use values of x from -2 to 2 .

a) $y = 3x$

b) $y = x + 3$

c) $y = x - 3$

d) $y = 5 - x$

e) $y = 1 - 4x$

f) $y = -2x - 3$

11. Jin is cycling at an average speed of 4 m/s. He travels a distance, d metres, in t seconds.

- Write an equation that relates d and t .
- Create a table of values for this relation.
- Graph the data. Should you join the points? Explain your reasoning.
- Is the relation between distance and time linear?
 - How do you know from the table of values?
 - How you know from the graph?
- How far does Jin travel in 3.5 h?
- What time does it take Jin to travel 17 km?

15. For each equation below:
- Make a table for the given values of x .
 - Graph the equation.
- $2x + y = 6$; for $x = -3, 0, 3$
 - $3x - y = 2$; for $x = -2, 0, 2$
 - $x + 2y = -6$; for $x = -4, 0, 4$
 - $3x - 2y = -6$; for $x = -2, 0, 2$
16. a) On a grid, draw horizontal and vertical lines to construct a shape that satisfies the following conditions:
- The shape is a square with area 9 square units.
 - One vertex is at the origin.
- b) Write the equations of the lines that form the square.
- c) Is it possible to draw another square that satisfies the conditions in part a? If your answer is yes, draw this square and write the equations of the lines that form it.
17. The difference of two numbers is 6. Let a represent the greater number and b the lesser number.
- Complete a table for 6 different values of a .
 - Graph the data. Should you join the points? Explain.
 - Write an equation that relates b and a .
18. a) Graph these equations on the same grid:
 $x = 2$ $y = 1$ $x + y = 8$
- b) What shape is formed by the lines in part a? How do you know?

Take It Further

19. The sum of two rational numbers is $2\frac{1}{2}$.
- Choose two variables to represent these rational numbers. Make a table to show 5 possible pairs of numbers that satisfy this relation.
 - Graph the data. Describe your graph.
 - Write an equation for the relation.
20. The difference of two rational numbers is -7.5 .
- Choose two variables to represent these rational numbers. Make a table to show 5 possible pairs of numbers that satisfy this relation.
 - Graph the data. Describe your graph.
 - Write an equation for the relation.
21. For each equation below:
- Make a table for 3 values of x .
 - Graph the equation.
- $\frac{1}{2}x + y = 4$
 - $\frac{1}{3}x - y = 2$
 - $\frac{1}{2}x + \frac{1}{3}y = 6$
 - $\frac{1}{3}x - \frac{1}{2}y = -1$
 - $\frac{1}{3}x + \frac{1}{2}y = -3$
 - $\frac{1}{4}x - \frac{1}{2}y = 1$

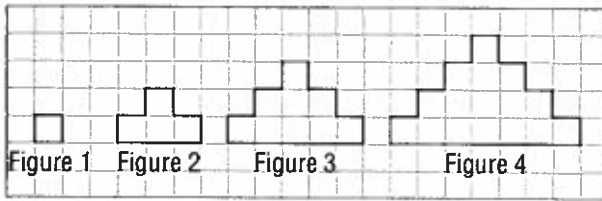
Reflect

How are the equations of horizontal and vertical lines alike?
 How are they different?
 How can you recognize the equation of each line?

Mid-Unit Review

4.1

1. This pattern of squares continues.



- Make a table that shows the figure number, n , and the perimeter of a figure, P . What patterns do you see?
- Write an expression for the perimeter of figure n .
- What is the perimeter of figure 40?
- Write an equation that relates P to n .
- Which figure has a perimeter of 136 units? How do you know?

2. A phone company charges a fixed cost of \$10 per month, plus \$0.25 per minute for long distance calling.

- Write an equation that relates the monthly cost, C dollars, to t , the time in minutes.
- In one month, the time for the long distance calls was 55 minutes. What was the monthly cost?
- For one month, the cost was \$22.50. How many minutes of long distance calls were made?

4.2

3. Create a table of values for each linear relation, then graph the relation.

Use values of x from -3 to 3 .

- $y = -3x$
 - $y = 2x$
 - $y = 2 - 4x$
 - $y = -2x + 4$
 - $y = -3 + x$
 - $y = -x + 3$
4. Alicia buys a \$300-jacket on lay away. She made a down payment of \$30 and is paying \$15 per week. The total paid, P dollars, after n weeks can be represented by the equation $P = 15n + 30$.

- Create a table of values to show the total paid in each of the first 5 weeks.
- Graph the data. Should you join the points on the graph? Explain.
- How do the patterns in the graph relate to the patterns in the table?

5. Each table of values represents a linear relation. Copy and complete each table. Explain your reasoning.

x	y
1	10
2	14
3	
4	
5	

x	y
1	
3	-10
5	-14
7	
9	

x	y
-2	
-1	
0	-3
1	3
2	

x	y
2	
4	-2
6	-5
8	
10	

4.3

6. a) Graph each equation.

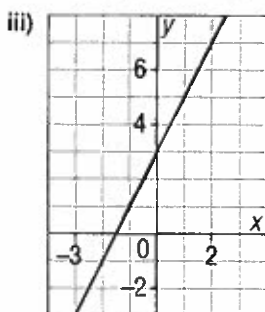
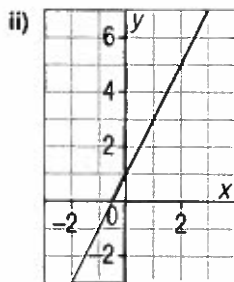
- $y = 1$
- $x = -4$
- $x + y = 8$
- $2x - y = 12$

b) For which equations in part a did you *not* need to make a table of values? Explain why.

7. The difference of two numbers is 1.

Let g represent the greater number and n the lesser number.

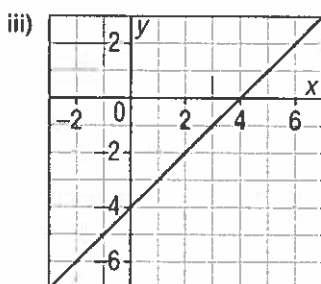
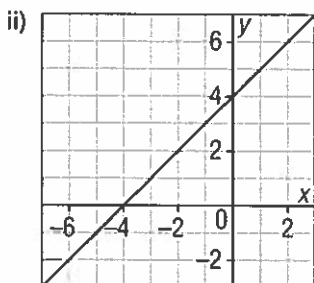
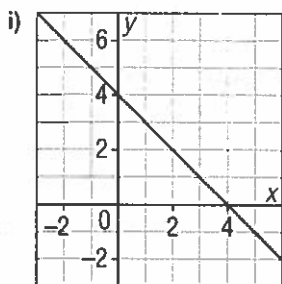
- Complete a table for 4 different values of n .
- Graph the data. Should you join the points? Explain.
- Write an equation that relates n and g .



6. Match each equation with a graph below.

Justify your answers.

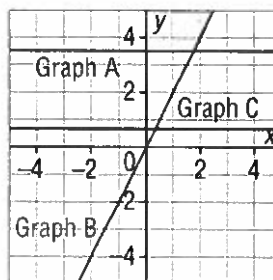
a) $x + y = 4$ b) $x - y = 4$ c) $x - y = -4$



7. Match each equation with its graph below.

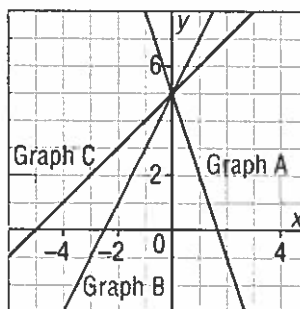
Explain your strategy.

a) $y = 2x$ b) $2y = 7$ c) $3y = 2$



8. Which graph on this grid has equation

$y = 2x + 5$? Justify your answer.

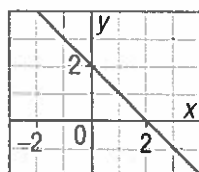


9. Which equation describes each graph?

Justify your answers.

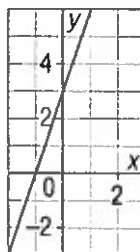
a) i) $y = 2x + 1$ ii) $y = 2x + 3$

iii) $y = x - 2$ iv) $y = -x + 2$



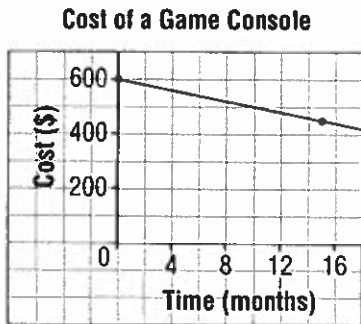
b) i) $x + 3y = 1$ ii) $3x - y = -3$

iii) $3x + y = 1$ iv) $3x - y = 3$



Apply

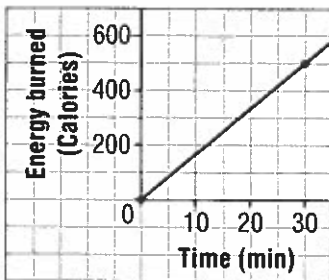
8. This graph shows how the price of a new game console changes with time.



Use the graph.

- Estimate the cost of the game console 5 months after it is released.
 - How many months is it until the console costs \$500?
 - Estimate the price of the console one year after it was released.
9. This graph shows the energy in Calories that Kendall burns when he works out on an elliptical machine.

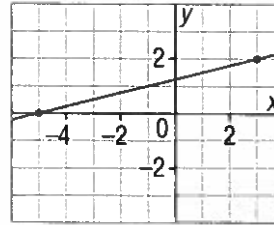
Energy Burned on an Elliptical Machine



Use the graph.

- Estimate how many Calories Kendall burns in 20 min.
- Estimate for how long Kendall must exercise to burn 400 Calories.
- Estimate how many Calories Kendall burns in 6 min.

10. This graph represents a linear relation.



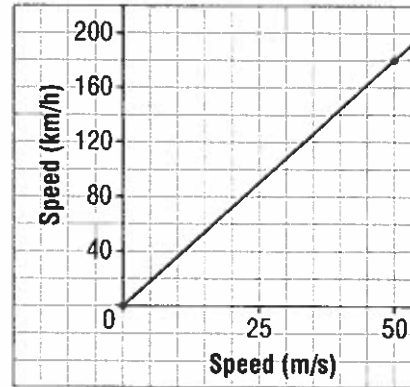
Estimate the value of y when:

- a) $x = -3$ b) $x = 0$ c) $x = 1$

Explain how you estimated.

11. **Assessment Focus** This graph shows how a speed in metres per second relates to a speed in kilometres per hour.

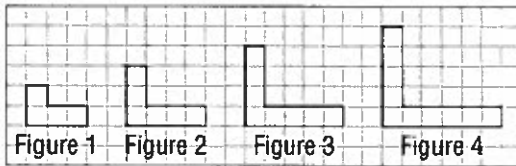
Graph for Converting Speeds



- Estimate the speed, in metres per second, of:
 - a car that is travelling at 70 km/h
 - a train that is travelling at 110 km/h
- Estimate the speed, in kilometres per hour, of:
 - a racing car that is travelling at 60 m/s
 - a bicycle that is travelling at 8 m/s
- For which of parts a and b did you use:
 - interpolation?
 - extrapolation?
 Explain how you know.
- Explain why your answers are estimates and not exact.

Review

4.1 1. This pattern continues.



- Determine the perimeter of each figure.
- Draw the next 3 figures on grid paper.
- Make a table to show the number of each figure and its perimeter.
- Write an expression for the perimeter in terms of the figure number, n .
- Write an equation that relates the perimeter P to n .
- Determine the perimeter of figure 30.
- Determine the figure number that has perimeter 90 units.

2. The pattern in this table continues.

Term Number, n	Term Value, v
1	-5
2	-2
3	1
4	4

- Describe the patterns in the table.
 - Use n to write an expression for the term value.
 - Write an equation that relates v and n .
 - Verify the equation by substituting a pair of values from the table.
 - Determine the value of the 21st term.
 - Which term number has a value of 106? How do you know?
3. The first number in a pattern has the value 75. As the term number increases by 1, its value decreases by 4.
- Create a table for this pattern.
 - Write an expression for the value of the term in terms of the term number n .

- 4.2** 4. Norman has \$140 in his savings account. Each month he deposits \$20 into this account. Let t represent the time in months and A the account balance in dollars.
- Create a table to show several values of t and A .
 - Graph the data. Will you join the points? Explain.
 - Is this relation linear? Justify your answer.
 - Describe the pattern in the table. How are these patterns shown in the graph?
 - Write an equation that relates A and t .

5. Copy and complete each table of values. Describe the patterns in the table.

a) $y = 4x$ b) $y = 10 - 2x$ c) $y = 3x + 4$

x	y	x	y	x	y
1		0			-3
2		1			-2
3		2			-1

6. Graph the data from each table in question 5. For each graph, explain how the patterns in the graph match the patterns in the table.

- 4.3** 7. A piece of string is 25-cm long. The string is cut into 2 pieces.
- Make a table that shows 6 possible lengths for the two pieces of string.
 - Graph the data.
 - Is the relation linear? How do you know?
 - Should you join the dots? Explain.
 - Choose 2 variables to represent the lengths of the longer and shorter pieces.
 - Write an equation that relates the variables.
 - How could you check your equation?

8. Graph each equation. Do you need to make a table of values each time? Explain.

- a) $x = -2$ b) $y = 3$
 c) $x = 5$ d) $y = -1$

9. For each equation below:

- Make a table for the given values of x .
- Graph the equation.

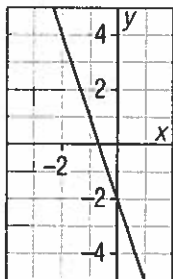
- a) $3x + y = 9$; for $x = -3, 0, 3$
 b) $2x - y = 4$; for $x = -2, 0, 2$
 c) $2x + y = -6$; for $x = -4, 0, 4$
 d) $x - 2y = -6$; for $x = -2, 0, 2$

10. Does each equation represent a vertical line, a horizontal line, or an oblique line? How can you tell without graphing?

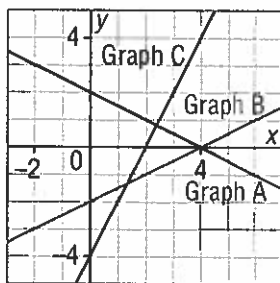
- a) $x = 6$ b) $x - y = 3$
 c) $y + 8 = 0$ d) $2x + 9 = 0$

4.4 11. Which equation describes the graph below? Justify your answer.

- a) $y = -2x + 3$ b) $y = 2x - 3$
 c) $y = 3x - 2$ d) $y = -3x - 2$

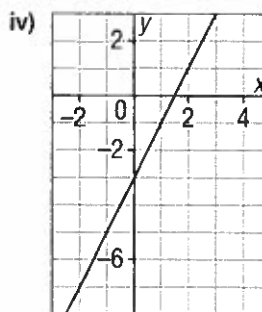
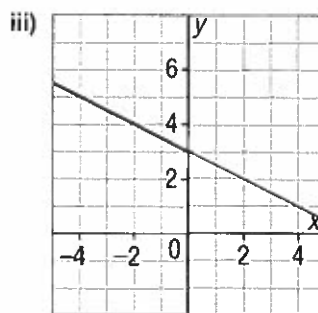
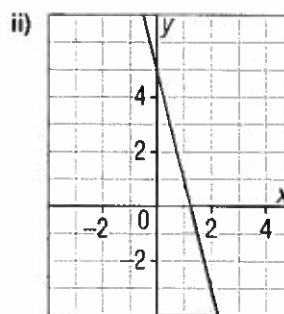
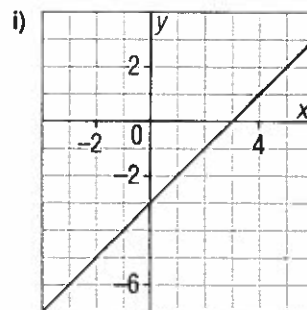


12. Which graph represents the equation $x - 2y = 4$? How do you know?



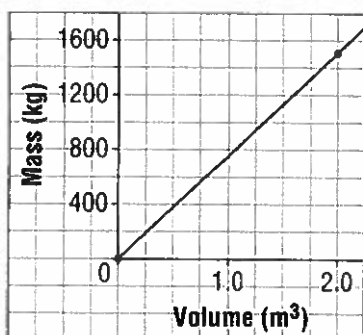
13. Match each equation with its graph below. Explain your strategy.

- a) $x + 2y = 6$
 b) $y = x - 3$
 c) $y = 2x - 3$
 d) $y = -4x + 5$



14. This graph shows how the mass of wheat changes with its volume.

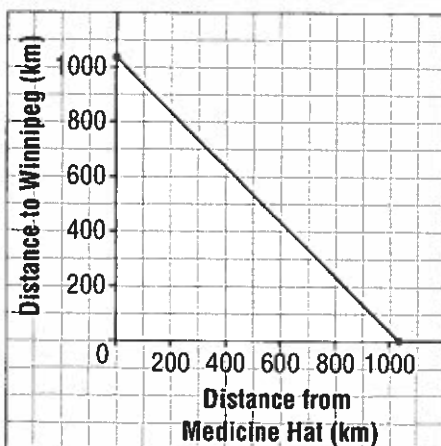
Mass against Volume for Wheat



Use the graph.

- Estimate the volume of 2000 kg of wheat.
 - Estimate the mass of 2.5 m^3 of wheat.
15. Harold and Jenny are driving from Medicine Hat to Winnipeg. The graph shows the distance travelled and the distance yet to go.

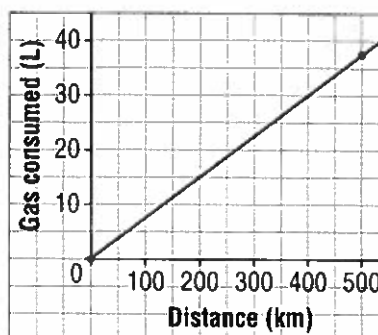
Journey from Medicine Hat to Winnipeg



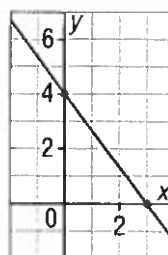
- About how far is it from Medicine Hat to Winnipeg? How can you tell from the graph?
- When Jenny and Harold have travelled 450 km, about how far do they still have to go?

16. The Dubois family lives in Regina. The family is planning a family holiday to the West Coast. This graph shows the gas consumption of the family's car.

Gas Consumption



- The distance from Regina to Vancouver is 1720 km. Estimate the volume of gasoline needed to travel from Regina to Vancouver. Explain how you did this.
 - To travel from Regina to Prince Albert, the car used about 30 L of gasoline. About how far is it between these two towns?
17. This graph represents a linear relation.



- Estimate the value of y when:
 - $x = -4$
 - $x = 2$
 - $x = 5$
- Estimate the value of x when:
 - $y = 7$
 - $y = 2$
 - $y = -3$

Explain how you estimated.