

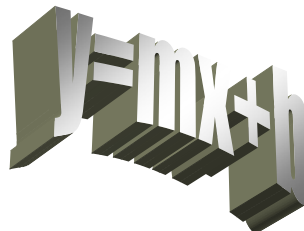
# TIPS4RM

## Targeted Implementation and Planning Supports for Revised Mathematics

*Grades 7, 8, 9 Applied, 10 Applied*

Course: Grade 9 Applied Mathematics (MFM1P)

Unit 6: Multiple Representations: Using Linear Relations  
and their Multiple Representations

A close-up photograph of a table with a grid. The table contains several rows of numbers, some of which are positive values. The numbers are: +2.688, +5.000, +1.500, +1.125, and +1.062. The table has a light blue background and dark blue grid lines.

## Unit 6

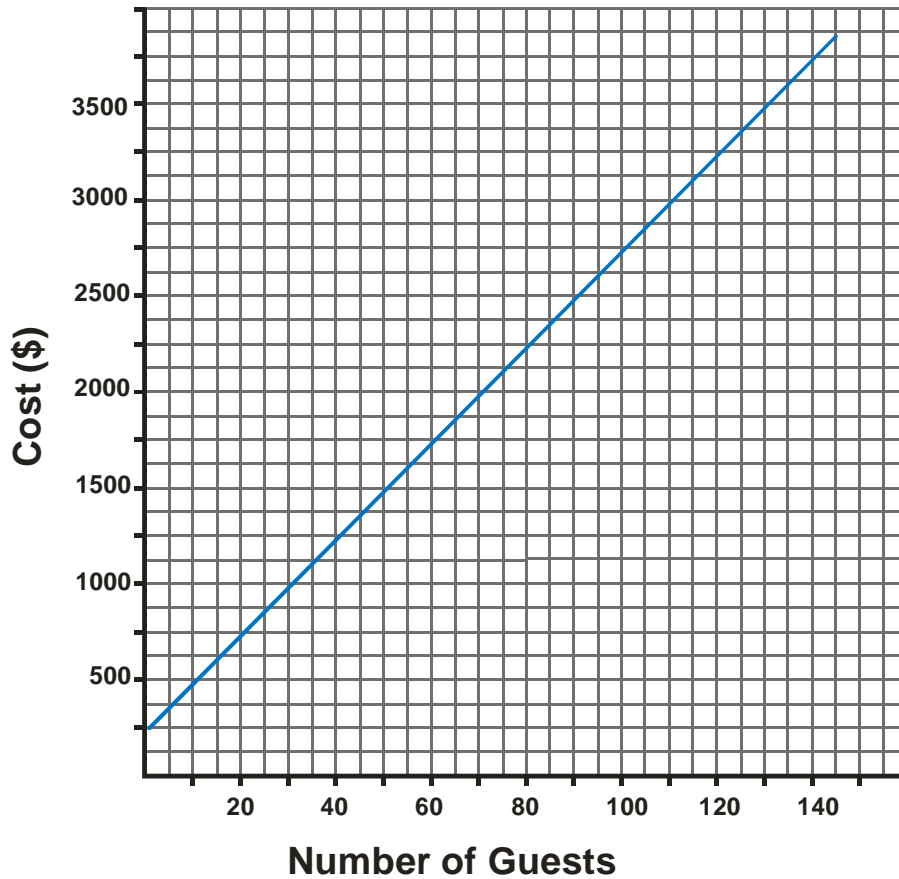
### Multiple Representations: Using Linear Relations and their Multiple Representations

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## 6.1.1: Working with Equations

Jenise has inquired about the cost of renting a facility for her wedding. She used the data she received to draw the graph below.

**Cost of Holding a Wedding at a Facility**



1. Jenise said the graph shows a linear relationship. Justify Jenise's answer.
2. Does this relation represent a direct or partial variation? Explain your answer.
3. State the initial value and calculate the rate of change of this relation.

## 6.1.1: Working with Equations (continued)

4. Use the graph to complete the chart:

	Number of Guests	Cost (\$)
a)	10	
b)		1250
c)	110	
d)		2500
e)	0	
f)		3500
g)	30	

5. Determine an equation for the relationship.

6. Solve the above equation to determine the number of guests Jenise could have for \$1750. Verify your answer using the graph.

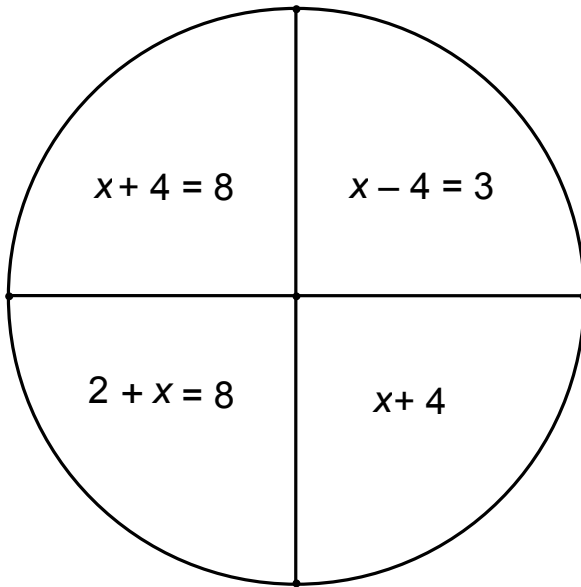
7. Solve the equation to determine the cost for 175 guests. Show your work.

*We will learn how to use algebra to solve this question later in this unit!*

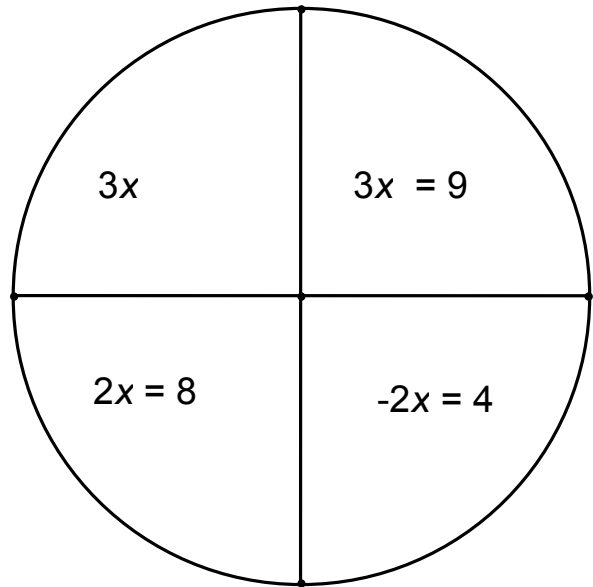
## 6.1.2: Concept Circles – Equations

1. Draw an "X" through the example that does not belong. Justify your answer.

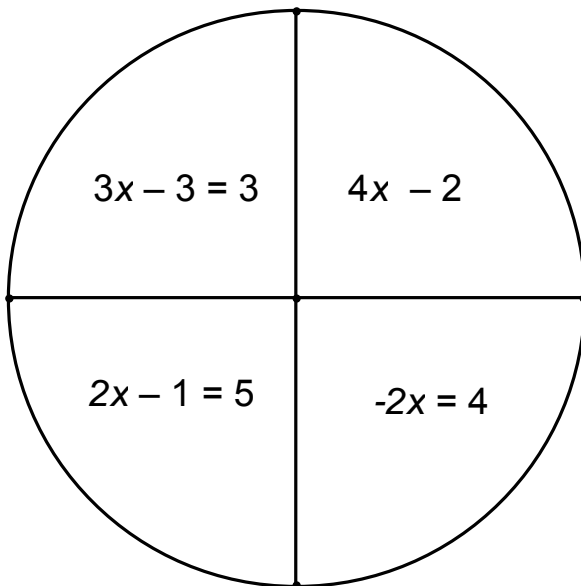
a)



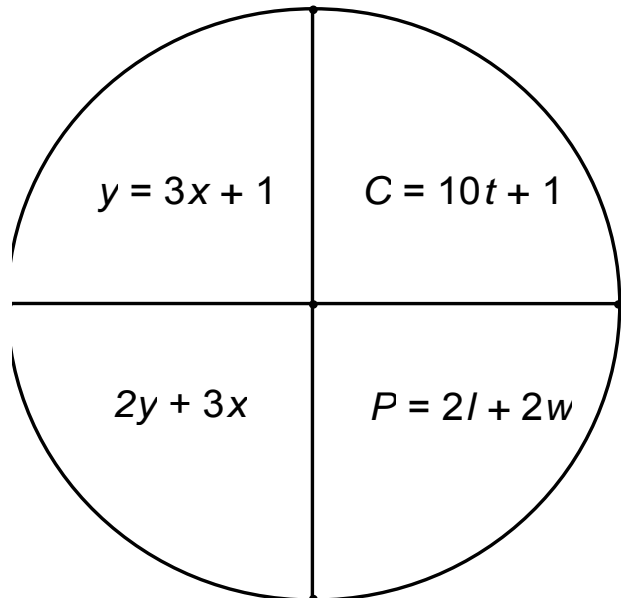
b)



c)



d)



2. Answer True (T) or False (F). Be prepared to justify your answer.

- a) Every equation has exactly two sides. \_\_\_\_
- b) Every equation has one equal sign. \_\_\_\_
- c) Every equation has one variable. \_\_\_\_

### 6.1.3: Equations and Expressions

Complete the following Frayer models.

<b>Definition:</b>	<b>Facts/Characteristics:</b>
<b>Expression</b>	
<b>Examples:</b>	<b>Non-examples:</b>

<b>Definition:</b>	<b>Facts/Characteristics:</b>
<b>Equation</b>	
<b>Examples:</b>	<b>Non-examples:</b>

## 6.1.5: The Equation Game

### One Step Equations

Solve each equation using **algebra tiles**. Have your partner check your answers.

$x - 2 = 4$	$g + 1 = -7$
$-4 = 2 + a$	$3 - b = -2$
$x + 1 = -3$	$t + 6 = 9$

## 6.1.5: The Equation Game (continued)

### One Step Equations

Solve each equation using **algebra**. Have your partner check your answers.

$p - 8 = 10$	$m + 3 = 15$
$-5 = -2 + y$	$k + 6 = 9$
$4 + h = -2$	$9 - w = -2$

## 6.1.6 The Equation Game (continued)

### Two Step Equations

Solve each equation using **algebra tiles**. Have your partner check your answers.

$3x - 2 = 4$	$4n + 1 = -7$
$-4 = 2 + 2a$	$3 - 5b = -2$
$-4x + 1 = -3$	$3t + 6 = 9$

## 6.1.6: The Equation Game (continued)

### Two Step Equations

Solve each equation using **algebra**. Have your partner check your answers.

$3p - 8 = 10$	$-6m + 3 = 15$
$-5 = 2 + 14y$	$3k + 6 = -9$
$4 = -2 + 3h$	$7 - 3w = -2$

## 6.1.P: Practice

Solve the following equations using **algebra**. Check every second equation..

a.  $s + 5 = 14$

b.  $u - 5 = -14$

c.  $-5 = v - 14$

d.  $7x = 14$

e.  $-7 = -14y$

f.  $3m + 1 = 10$

g.  $2h + 7 = 15$

h.  $4 - 2d = -2$

i.  $5y - 3 = 12$

j.  $6 = 4w - 6$

k.  $4 = 3t - 8$

l.  $3c + 12 = 36$

## 6.1.P: Practice (continued)

Solve the following equations using **algebra**. Check every second equation.

a.  $t - 2 = 7$

b.  $4d = -16$

c.  $2m - 4 = 10$

d.  $-3 = 7 - 5p$

e.  $4x + 28 = 16$

f.  $5y - 12 = 13$

g.  $2g - 1 = 7$

h.  $-3 = 4 - 7m$

i.  $-3f - 2 = 7$

j.  $5k - 6 = 24$

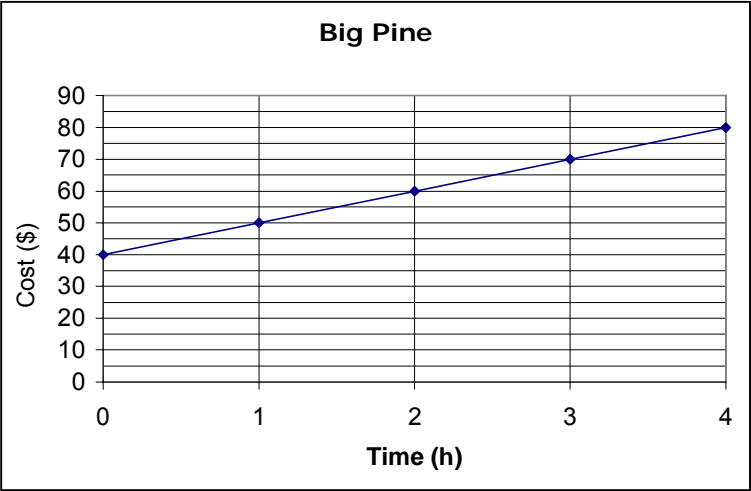
k.  $12 = 12 - 3b$

l.  $-2 - 5b = -12$

## 6.3.1: Mathematical Models

Each situation has a **graphical** model (graph), an **algebraic** model (equation) and a **numerical** model (table of values). Choose either the graphical model or the algebraic model to complete the table of values. Show your work and justify your choice of model.

- Big Pine Outfitters charges a base fee of \$40 and \$10 per hour of use.

<p><math>C</math> represents the total cost (\$) and <math>t</math> represents the numbers of hours the canoe is used.</p>														
<p><b>Algebraic Model:</b></p>	<p><math>C = 40 + 10t</math></p>													
<p><b>Graphical Model:</b></p>														
<p><b>Numerical Model:</b></p>	<table border="1" style="margin: auto;"> <thead> <tr> <th></th> <th><math>t</math> (h)</th> <th><math>C</math> (\$)</th> </tr> </thead> <tbody> <tr> <td>a)</td> <td>0</td> <td></td> </tr> <tr> <td>b)</td> <td></td> <td>70</td> </tr> <tr> <td>c)</td> <td></td> <td>230</td> </tr> </tbody> </table>			$t$ (h)	$C$ (\$)	a)	0		b)		70	c)		230
	$t$ (h)	$C$ (\$)												
a)	0													
b)		70												
c)		230												
<p><b>Solutions:</b></p>														
<p>a)</p>	<p>b)</p>	<p>c)</p>												

## 6.3.1: Mathematical Models (continued)

2. A rental car costs \$50 per day plus \$0.20 for each kilometre it is driven.

C represents the total cost (\$) and $d$ represents the distance (km).														
<b>Algebraic Model:</b>	$C = 50 + 0.2d$													
<b>Graphical Model:</b>														
<b>Numerical Model:</b>	<table border="1"> <thead> <tr> <th></th> <th><math>d</math> (km)</th> <th><math>C</math> (\$)</th> </tr> </thead> <tbody> <tr> <td>a)</td> <td>250</td> <td></td> </tr> <tr> <td>b)</td> <td>1000</td> <td></td> </tr> <tr> <td>c)</td> <td></td> <td>300</td> </tr> </tbody> </table>			$d$ (km)	$C$ (\$)	a)	250		b)	1000		c)		300
	$d$ (km)	$C$ (\$)												
a)	250													
b)	1000													
c)		300												
<b>Solutions:</b>														
a)	b)	c)												

Justify your choice.

### 6.3.1: Mathematical Models (continued)

3.

<b>Algebraic Model:</b>	$y = -3x + 5$ (label the axes)													
<b>Graphical Model:</b>														
<b>Numerical Model:</b>	<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr style="background-color: #e0f0ff;"> <th style="width: 30px;"></th> <th style="width: 40px;"><math>x</math></th> <th style="width: 40px;"><math>y</math></th> </tr> </thead> <tbody> <tr> <td>a)</td> <td style="text-align: center;">0</td> <td></td> </tr> <tr> <td>b)</td> <td style="text-align: center;">6</td> <td></td> </tr> <tr> <td>c)</td> <td></td> <td style="text-align: center;">-55</td> </tr> </tbody> </table>			$x$	$y$	a)	0		b)	6		c)		-55
	$x$	$y$												
a)	0													
b)	6													
c)		-55												
<b>Solutions:</b>														
a)	b)	c)												

Justify your choice.

#### Challenge

Describe a situation that could be modelled with the given graph or equation.

## 6.3.2: Solving Equations Using Substitution

1. Solve the following equations for  $y$  if  $x = 4$ :

a.  $y = 2x - 6$

b.  $2x + y = 3$

c.  $4x = 12 - y$

2. Fiona has 300 m of fencing to surround a vegetable garden. If the width of the garden is 10 m, what is the length?

**Hint:**  $P = 2l + 2w$

3. A carpenter is making a circular tabletop with circumference 4.5 m. What is the radius of the tabletop in centimetres?

**Hint:**  $C = \pi d$

## 6.3.2: Solving Equations Using Substitution (continued)

- 4a. The formula for the final amount,  $A$ , in an investment with principal,  $P$ , and Interest,  $I$ , is  $A = P + I$ .

Determine the principal if  $A$  is \$6000 and  $I$  is \$750.

- 4b. The interest,  $I$ , is calculated by  $I = Prt$ , where  $P$  is the amount of the principal from (a),  $r$  is the interest rate and  $t$  is the number of years the principal was invested.

Determine the number of years the principal was invested if the interest earned is \$750 when the interest rate is 6%.

5. Extend your thinking. Find the missing value:

a.  $A = \pi r^2$

where  $A = 63.585 \text{ cm}^2$

b.  $A = \frac{1}{2}bh$  or  $A = \frac{bh}{2}$

where  $A = 27.3$  and  $b = 6.5$

## 6.3.P: Real World Mathematical Models

1. To fix a car, Joe's Garage charges a base fee of \$25 and \$40/h.
  - a. Make a table of values of the cost of fixing a car for each hour up to 4 hours.

Number of hours (h)	Cost to Fix the Car (C)

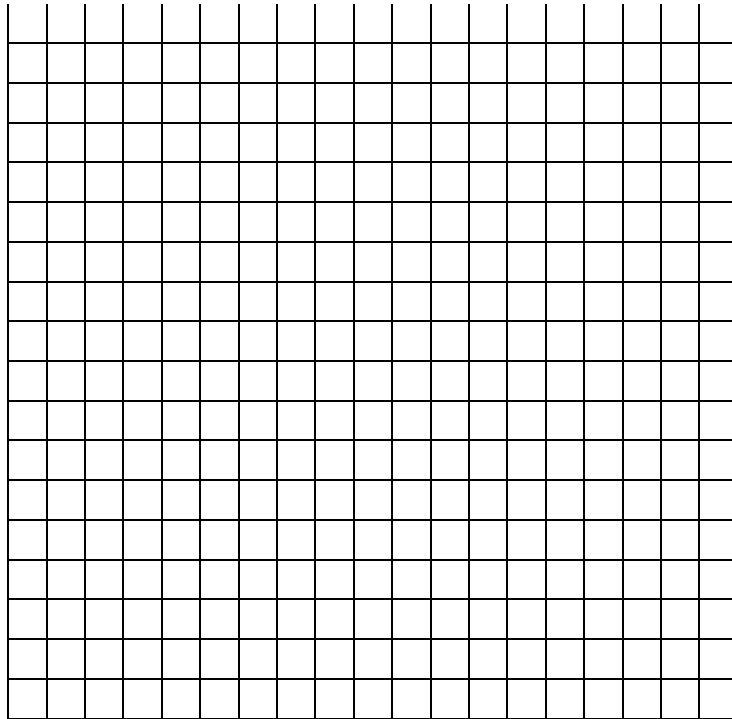
- b. Using your table from (a), calculate the first differences and the rate of change.

Number of hours (h)	Cost to Fix the Car (C)	First Difference

$$\text{Rate of Change} = \frac{\text{Difference in } C}{\text{Difference in } h}$$

### 6.3.P: Real World Mathematical Models (continued)

- c. Graph the cost of fixing a car for up to 4 hours.



- d. Identify the rate of change and the initial value. What do they mean in this problem?
- e. Determine an equation to model the graph.
- f. Determine the cost of a 2.5 hour repair job.  
Show your work using the equation from part (e).  
Check your answer using your graph from part (d).
- g. What does the point (6, 265) represent?
- h. If it costs \$155, how long was spent working on the car?

## 6.4.1: Planning a Special Event

Work through Menu 1 with your teacher as a class.

Maxwell's Catering Company prepares and serves food for large gatherings. They charge a base fee of \$200 for renting the facility, plus a cost per person based on the menu chosen.

**Menu 1** is a buffet that costs \$10 per person.

**Menu 2** is a three-course meal that costs \$14 per person.

**Menu 3** is a five-course meal that costs \$18 per person.

1. Complete the table of values for each relation: [\*Note:  $n$  must go up by equal increments]

**Menu 1:  $C = 10n + 200$**

$n$ No. of people	$C$ Cost (\$)	First Difference
25		
50		
75		
100		
125		

\* $n$  goes up by 25

**Menu 2:  $C = 14n + 200$**

$n$ No. of people	$C$ Cost (\$)	First Difference
0		
50		
100		
150		
200		

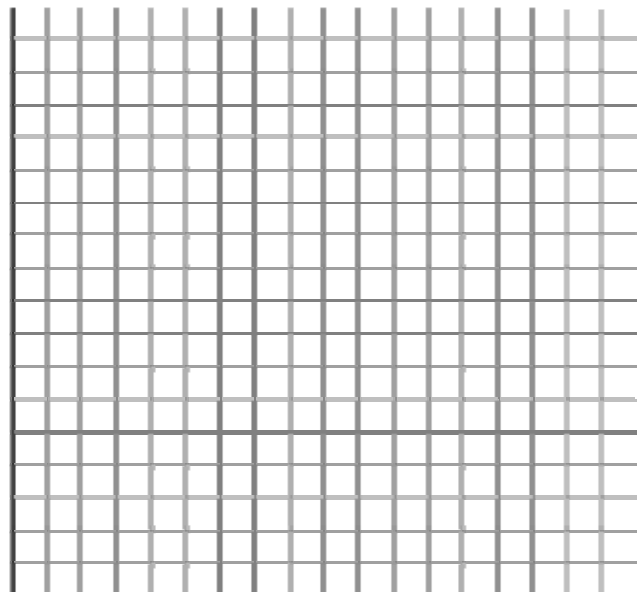
\* $n$  goes up by 50

**Menu 3:  $C = 18n + 200$**

$n$ No. of people	$C$ Cost (\$)	First Difference

\* $n$  goes up by \_\_\_\_

2. a) Graph the 3 relations on the same set of axes. Use an appropriate scale, labels, and title.
- b) Explain whether to use dashed or solid lines to draw these graphs.



## 6.4.1: Planning a Special Event (continued)

3. a) Identify the rate of change and the initial amount of the **Menu 1** line. How do these relate to the total cost?

What does it mean in this problem?	
Rate of change:	
Initial amount:	

- b) Identify the rate of change and the initial amount of the **Menu 2 and 3** lines.

Line	Rate of change	Initial amount
2		
3		

4. a) Examine the first differences and the increment in  $n$ .

Line	Increment in $n$	First Differences	<u>First Differences</u> Increment in $n$
1	25		
2	50		
3			

- b) How do they relate to the graph and the equation?

## 6.4.1: Planning a Special Event (continued)

5. Compare the three graphs. How are the graphs the same? different?

Same	Different

6. a) For **Menu 2**, what does the ordered pair (120, 1780) mean?

- b) For **Menu 3**, what does the ordered pair (80, 1540) mean?

## 6.4.1: Planning a Special Event (continued)

7. Seventy people are expected to attend a school event. How much will it cost for each menu?

Menu	Cost (show your work)
1	
2	
3	

8. Vadim and Sheila are planning a celebration. They have \$3000 to spend on dinner. They would like to have **Menu 3**. What is the greatest number of guests they can have?

9. Logan's Plastics employs 50 people. Each year the company plans a party for its employees.
- Find the cost for **Menu 2** and write your answer as the ordered pair (50, C).
  - Find the cost for **Menu 3** and write your answer as the ordered pair (50, C).
  - How many more dollars will Logan's Plastics have to pay if they choose **Menu 3** instead of **Menu 2**?

## 6.4.2: The Cellular Phone Problem Practice

Two cellular phone companies have a monthly payment plan. They charge a flat fee plus a fee for each minute used.

**Call-A-Lot plan**     $C = 0.50t + 20$     Where  $C$  represents the total monthly cost and

**Talk-More plan**     $C = 0.25t + 25$      $t$  represents the number of minutes.

1. Create a table of values showing the total charges for a month for up to 30 minutes. (Remember to make time go up by the same amount for each interval.)

**Call-A-Lot**

$t$ (time in minutes)	$C$ (cost in \$)	First Difference

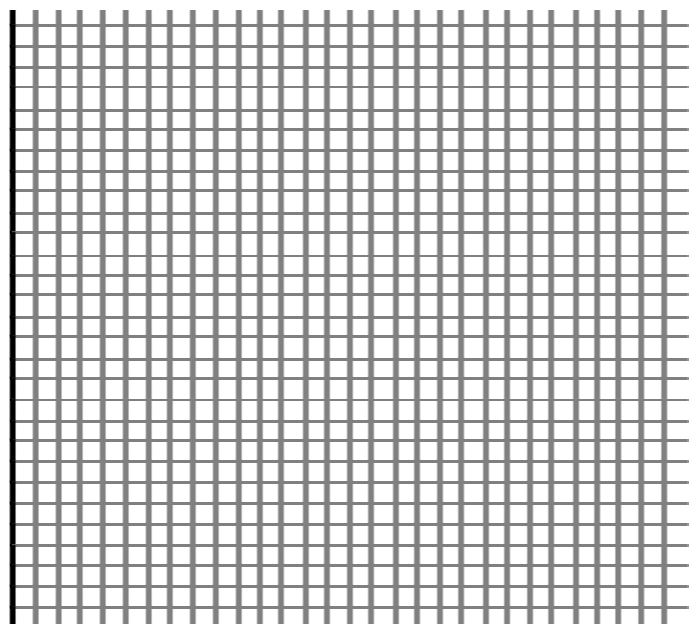
**Talk-More**

$t$ (time in minutes)	$C$ (cost in \$)	First Difference

2. a) Graph the relations on the same set of axes.  
Use an appropriate scale.

b) Independent variable:

Dependent variable:



## 6.4.2: The Cellular Phone Problem Practice (continued)

3. Identify the rate of change and the initial value of the **Call-A-Lot** line. Explain what each means in this problem.

	What does it mean in this problem?
Rate of change:	
Initial value:	

4. Examine the differences. How do they relate to the graph and the equation?  
(Hint: calculate  $\frac{C \text{ differences}}{t \text{ differences}}$ ).
5. Compare the graphs. How are the graphs...
- a) the same?
  
  
  
  
  
  
  
  
  
  
  - b) different?
6. For Talk-More, what does the ordered pair (8, 27) mean?
7. One month, Leslie used 13 minutes on the **Talk-More** plan. How much did it cost her?



## 6.5.1: An Environmental Project

### A coaches B

For a project on the environment, you have decided to gather data on two similar types of vehicles – an SUV and a minivan. Compare the distance that the vehicles can travel on a full tank of gasoline. For each kilometre a vehicle is driven, the gasoline is used at the given rate.

**SUV**  $G = 80 - 0.20d$ , where  $G$  represents the amount of gasoline remaining in litres and  $d$  represents the number of kilometres driven

**Minivan**  $G = 65 - 0.15d$ , where  $G$  represents the amount of gasoline remaining in litres and  $d$  represents the distance travelled in kilometres

1. Create a table of values showing the amount of gasoline remaining for up to 400 km.  
**Note:**  $d$  must go up by the same amount each time.

#### SUV

$d$ (distance in km)	$G$ (gasoline remaining in litres)	First Difference
0		
100		
200		
300		
400		

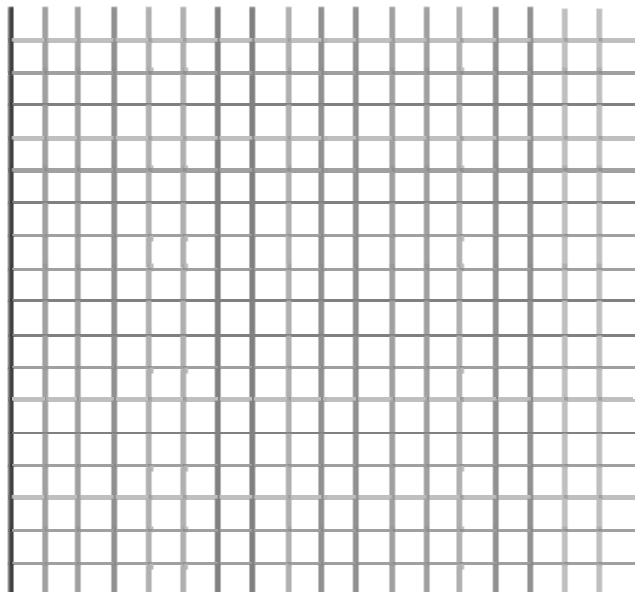
Independent variable:

#### Minivan

$d$ (distance in km)	$G$ (gasoline remaining in litres)	First Difference

Dependent variable:

2. a) Graph the relations on the same set of axes.  
Use an appropriate scale, labels, and a title.  
b) Explain how you know that this data is continuous.



## 6.5.1: An Environmental Project (continued)

### B coaches A

3. Identify the rate of change and the initial value of the SUV.

What does it mean in this problem?	
Rate of change:	
Initial value:	

4. Examine the differences. How do they relate to the graph and the equation?

(Hint: calculate  $\frac{G \text{ differences}}{d \text{ differences}}$ .)

5. Compare the graphs. How are the graphs...

a) the same?

b) different?

6. For the minivan, what does the ordered pair (100, 50) mean?

7. If the SUV is driven 250 km, how much gasoline is left?



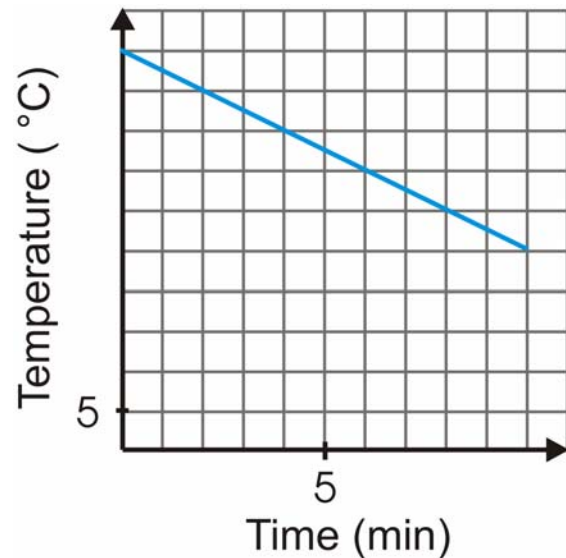
## 6.5.2: Cooling It!

Denis measured the temperature of a cup of hot water as it cooled. He then made the graph on the right. **Complete the scale**, and then answer the following questions about the graph.

- a) One of the points on the graph is (6, 35). Explain the meaning of this point, in the context of Denis' measurements.

- b) Independent variable:

Dependent variable:



- c) Explain why this is continuous data.

- d) Use your graph to determine the temperature after 3.5 minutes.

- e) Identify the rate of change and the initial value and explain what they mean in this problem.

What do they mean in this problem?	
Rate of change:	
Initial value:	

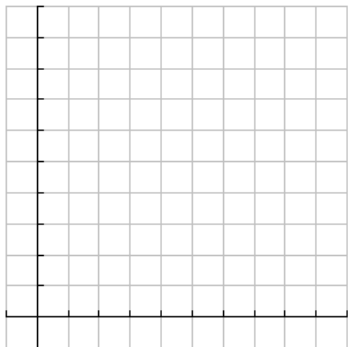
## 6.5.2: Cooling It! (continued)

- f) Write an equation to model Denis' data. Use  $T$  for temperature and  $t$  for time.
- g) Use your equation to determine the temperature of the water after:
- i) 3.5 minutes
  - ii) 20 minutes
- h) Your results for 20 minutes may conflict with what you know about cooling water. Explain. What does this tell you about the limitations of this linear model?
- i) Use your equation to predict when the temperature will be  $39^{\circ}\text{C}$ .



## 6.6.1: Linear and Non-Linear Investigations

**Graphical:** Make a scatter plot and draw the line of best fit.



**Algebraic Model:** (or a description of the relationship in words)

1. How many cubes are required to make model number 10? Show your work.
2. What figure number will have 25 cubes?
3. How would adding two blocks to each end of the cross rather than one affect the graph and the equation?

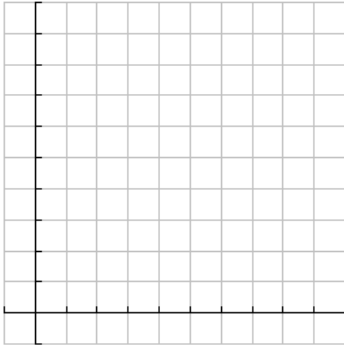
### Conclusion

Make a conclusion. Refer to your hypothesis.



## 6.6.1: Linear and Non-Linear Investigations (continued)

**Graphical:** Make a scatter plot and draw the line of best fit.



**Algebraic Model:** (or a description of the relationship in words)

1. How many pieces of chocolate bar will remain after 6 passes? Show your work.
2. Using this method of eating the chocolate bar, when will it be fully “eaten”? Explain.
3. If the chocolate bar began with 32 pieces instead of 16, how would the graph be different? Include a sketch of the original graph and the new graph on the same set of axes. Give reasons for your answer.

### Conclusion

Make a conclusion. Refer back to your hypothesis.

## 6.6.1: Linear and Non-Linear Investigations (continued)

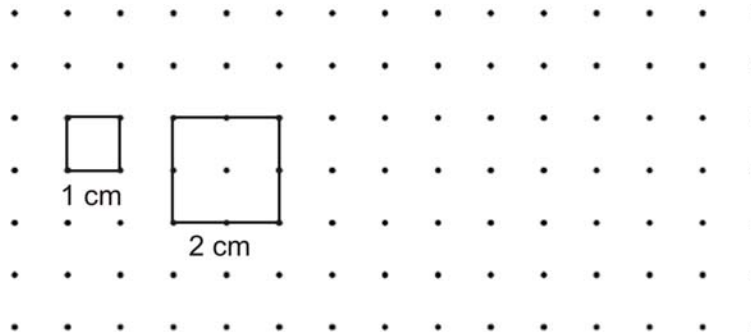
### Investigation 3 – Area vs. Length of a Square

#### Purpose

Find the relationship between the area and the length of a side of a square.

#### Procedure

- On grid paper, draw squares with side lengths of 1 cm, 2 cm, 3 cm, and 4 cm.
- Draw and calculate the area of squares with sides measuring 1 cm, 2 cm, 3 cm, and 4 cm.



#### Hypothesis

Write your hypothesis on the Record Sheet.

- We think that as the side length increases, the area will increase or decrease because \_\_\_\_\_.
- We think that the relationship will be linear or non-linear.
- The data is continuous or discrete.

#### Mathematical Models

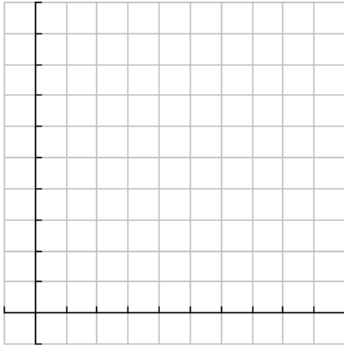
- Record your observations in the table provided and calculate the first differences.
- Make a scatter plot and draw the line (or curve) of best fit.
- Determine the algebraic model or describe the relationship in words.

**Numerical:** Complete the table of values and calculate the differences.

Length	Area	First Differences

## 6.6.1: Linear and Non-Linear Investigations (continued)

**Graphical:** Make a scatter plot and draw the line of best fit.



**Algebraic Model:** (or a description of the relationship in words)

1. What is the area of a square with a side length of 9 cm?
2. What side length does a square with an area of  $100 \text{ cm}^2$  have?
3. Describe the pattern in the first differences.

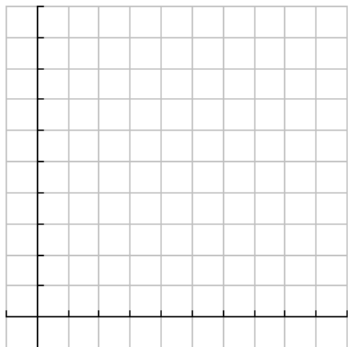
### Conclusion

Make a conclusion. Refer back to your hypothesis.



## 6.6.1: Linear and Non-Linear Investigations (continued)

**Graphical:** Make a scatter plot and draw the line of best fit.



**Algebraic Model:** (or a description of the relationship in words)

1. How many cubes are required to make figure number 7? Show your work.
2. What figure number will have 4 cubes?
3. How would removing 2 blocks from each end of the "candle" rather than 1 affect the graph and the equation?
4. If 5 more blocks were added to the original model, how would that affect the graph and the equation?

### Conclusion

Form a conclusion. Refer back to your hypothesis.

## 6.6.J: Journal Activity

Sally was not in class today. She doesn't know how to use differences to determine if a relationship is linear or non-linear. Use words, pictures, and symbols to explain it to her.

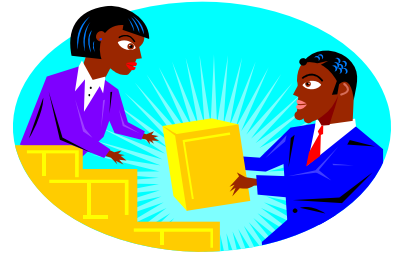
## 6.W: Definition Page

Term	Picture / Sketch	Definition
Expression		
Equation		
Algebra Tiles		
One Step Equations		
Two Step Equations		
Algebraic Model		
Graphical Model		
Numerical Model		
Substitution		
First Difference		
Non-linear Relation		

## 6.S: Unit Summary Page

Unit Name: \_\_\_\_\_

Using a graphic organizer of your choice create a unit summary.



## 6.R Reflecting on My Learning (3, 2, 1)



**3** Things I know well from this unit

**2** Things I need explained more

**1** Question I still have

## 6.RLS: Reflecting on Learning Skills

Students should be aware of the importance that these skills have on your performance. After receiving your marked assessment, answer the following questions. Be honest with yourself. Good Learning Skills will help you now, in other courses and in the future.

- E – Always
- G – Sometimes
- S – Need Improvement
- N – Never

### Organization

- E G S N I came prepared for class with all materials
- E G S N My work is submitted on time
- E G S N I keep my notebook organized.

### Work Habits

- E G S N I attempt all of my homework
- E G S N I use my class time efficiently
- E G S N I limit my talking to the math topic on hand
- E G S N I am on time
- E G S N If I am away, I ask someone what I missed,
- E G S N I complete the work from the day that I missed.

### Team Work

- E G S N I am an active participant in pairs/group work
- E G S N I co-operate with others within my group
- E G S N I respect the opinions of others

### Initiative

- E G S N I participate in class discussion/lessons
- E G S N When I have difficulty I seek extra help
- E G S N After I resolve my difficulties, I reattempt the problem
- E G S N I review the daily lesson/ideas/concepts

### Works Independently

- E G S N I attempt the work on my own
- E G S N I try before seeking help
- E G S N If I have difficulties I ask others but I stay on task
- E G S N I am committed to tasks at hand

Yes No I know all the different ways available in my school, where I can seek extra help.

Yes No I tried my best.

What will I do differently in the next unit to improve?

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