Foundations of Mathematics and Pre-calculus 10

Module 3 Blackline Masters

This blackline master package, which includes all section assignments, as well as selected worksheets, activities, and other materials for teachers to make their own overhead transparencies or photocopies, is designed to accompany Open School BC's Foundations of Mathematics and Pre-calculus (FMP) 10 course. BC teachers, instructional designers, graphic artists, and multimedia experts developed the course and blackline masters .

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Module 3, Section 1—Lesson A: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How do you know whether a variable is dependent or independent?			
How can a graph be used to describe a situation?			
If you're given a situation, how can you graph it?			

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Module 3, Section 1—Lesson B: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
Why is it appropriate to connect the points on some graphs but not others?			
What are some ways that you can express the domain and range of a graph, set of ordered pairs, or table of values?			
How can you determine any limitations on the domain and range of a relation?			

My Notes

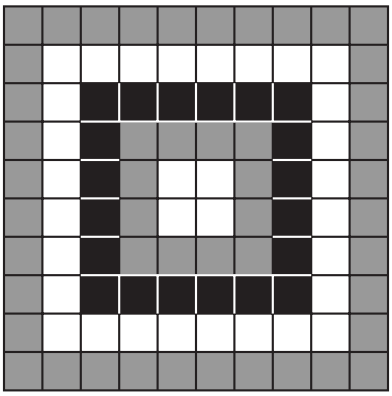
Discover

In the following lab, you'll examine the difference between graphs that have their points joined by lines, and those that don't. You'll also learn how to distinguish between the independent and dependent variables.

Activity 2

Math Lab: Types of Variables and Graphs

Part 1



Observe the pattern in the tiles in the image above. Pay attention to the number of tiles in the border of each square.

Figure 1 is composed of four white squares arranged in a 2 × 2 array.

Figure 1

Figure 2 has a ring of gray tiles around the white 2 × 2 square.

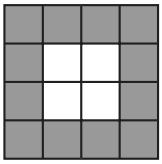


Figure 2

My Notes

This pattern continues. Each figure is surrounded by a border of tiles to result in the next figure.

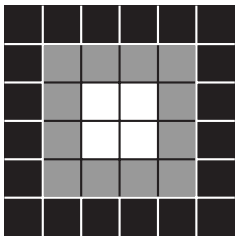


Figure 3

Complete the following.

1. Fill in the table below by writing the figure number and the corresponding number of tiles in the border of the figure.

Figure	Number of Tiles in the Border
1	4
2	12
3	
4	
5	
6	

2. Prepare to construct a graph by answering the questions below:
   a. What are the smallest and largest values that you will use for plotting the figure number?

   b. What are the smallest and largest values that you will use for plotting the number of squares in the border?

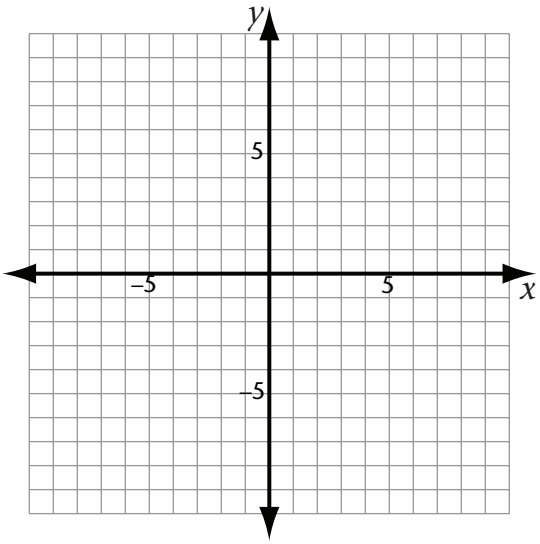
My Notes

c. Which of the following statements makes more sense? Place a check beside the correct one.

- ☐ The figure number depends on the number of squares in the border.
- ☐ The number of squares in the border depends on the figure number.

3. Construct a graph from the data table.

- Plot the data in the first column on the horizontal axis and the data in the second column on the vertical axis.
- Choose an appropriate scale for each axis.
- Label each axis.



4. Describe the relationship between the figure number and the number of squares in the border.

5. Suppose that you are required to extend the table to complete Figures 7 through 10. Show how you can use the description from the previous question to determine the number of squares in the border to create Figure 7 to Figure 10.

My Notes

6. a. Identify the independent and dependent variables in this scenario. How do you know?

   b. Identify all possible values for the independent variable.

   c. Identify all possible values for the dependent variable.

Part 2

Consider the data shown in the table below. The data shows the temperature of juice over time when an insulated glass of juice at a temperature of 22.10°C was placed in a refrigerator.

Time (h)	0	1	2	3	4
Juice temperature (°C)	22.10	18.70	15.90	13.51	11.48

1. Prepare to construct a graph by answering the questions below:
   a. What are the smallest and largest values that you will use for plotting the time?

   b. What are the smallest and largest values that you will use for plotting the juice temperature?

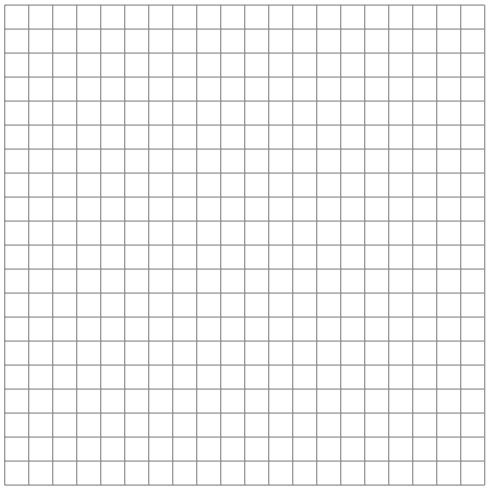
My Notes

c. Which of the following statements makes more sense? Place a check beside the correct one.

☐ The elapsed time depends on the juice temperature.

☐ The juice temperature depends on the elapsed time.

2. Use your answers from the previous question to construct a graph from the data table.
   - Plot the data in the first row on the horizontal axis and the data in the second row on the vertical axis.
   - Choose an appropriate scale for each axis.
   - Label each axis.



3. Describe the relationship between the elapsed time and the juice temperature.

4. Describe how you could determine the following.
   a. the juice temperature after 2.5 hours

   b. the elapsed time when the juice temperature is 10°C

My Notes

5. a. Identify the independent and dependent variables in this scenario. How do you know?

   b. Identify all possible values for the independent variable.

   c. Identify all possible values for the dependent variable.

Part 3

Compare the graphs in Part A and Part B. For one of the graphs, it is appropriate to join the points with a line. For the other one, it is not. For which graph do you think it is appropriate to join the points? Provide reasons to support your answer.

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

My Notes

Going Beyond

This part is optional. Check with your teacher to see if you should complete it.

Create a rule that relates any numerical input value to a corresponding output value.

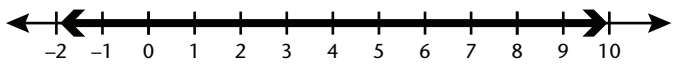
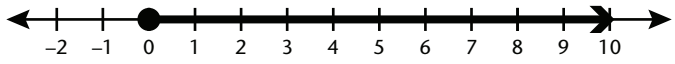
Represent your relation in one of the following forms:

- table of values
- arrow diagram
- a set of ordered pairs
- graph

Share your representation with a friend, and challenge him or her to discover the rule.

Lesson Summary

To express the domain and range, you could use five different methods.

Method	Explanation
Words	The domain is all real numbers. The range is all real numbers larger than or equal to 0.
Number Line	Domain:  Range: 
Interval Notation	Domain: $(-\infty, \infty)$ Range: $[0, \infty)$
Set Notation	Domain: $\{x \mid -\infty < x < \infty, x \in R\}$ or $\{x \mid x \in R\}$ Range: $\{y \mid 0 \leq y < \infty, y \in R\}$ or $\{y \mid y \geq 0, y \in R\}$
List	This is continuous data, not discrete, so for this example, a list does not make sense as a way to express the domain and range.

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Module 3, Section 1—Lesson C: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
Why is it that some relations are not functions?			
How can you tell if a relation is a function?			

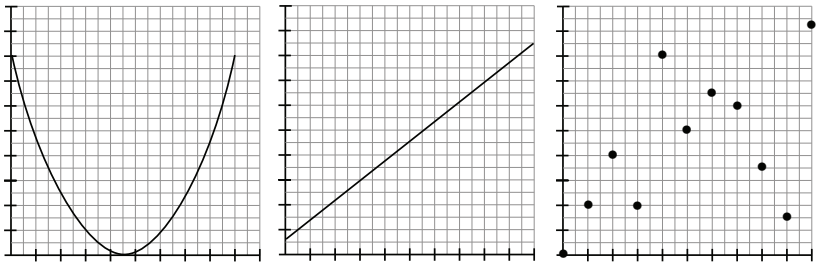
My Notes

Activity 2
Math Lab: Identifying Functions

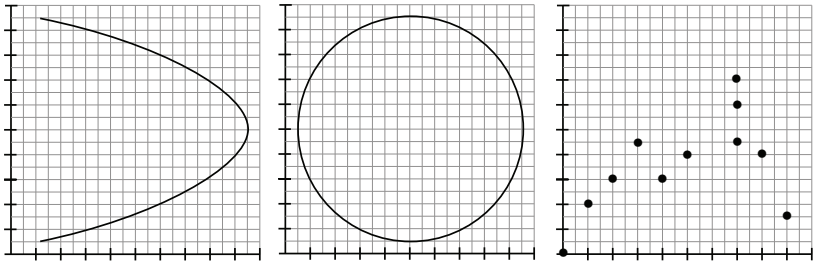
Try the analysis exercise below to see if you can identify the condition that separates functions from non-functions.

Purpose
Analyze data shown in graphs to investigate functions and relations.

Part A: Graph Comparison
The first set of graphs shows relations called functions.



The second set of graphs shows relations that are not functions.

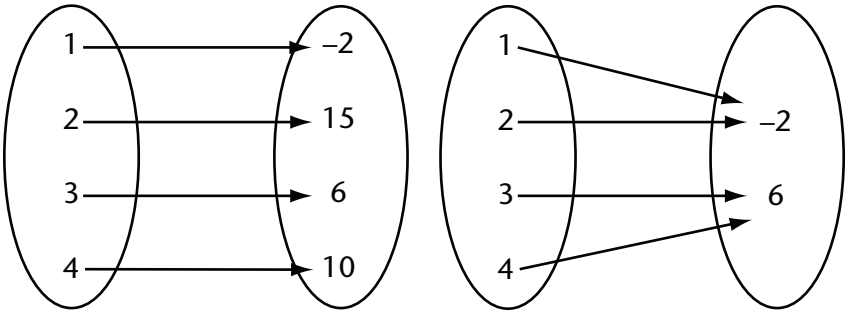


Study each set of graphs. Record the similarities and differences between the graphs in the two sets.

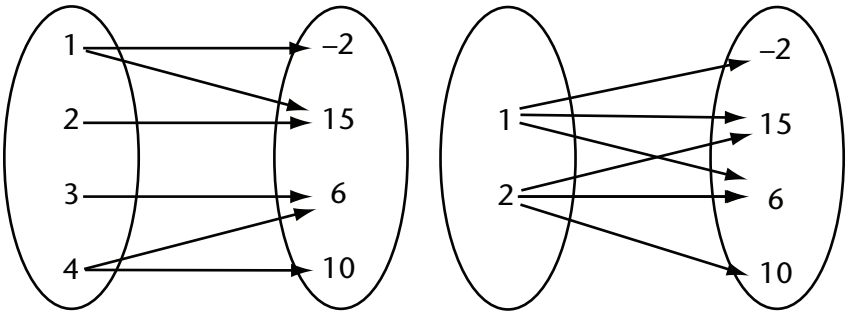
My Notes

Part B: Arrow Diagram Comparison

The first set of arrow diagrams are functions.



The second set are not functions.



Study each set of arrow diagrams. Record the similarities and differences between each set of arrow diagrams.

Part C: Ordered Pairs Comparison

The ordered pairs in Set A and Set B are functions.

Set A = {(0,3), (1,2), (2,5), (3,–7)}
Set B = {(–2,1), (0,4), (10,3), (4,5)}

My Notes

The ordered pairs in Set C and Set D are not functions.

Set C = {(–2,1), (–2,4), (–2,3), (–2,5)}
Set D = {(0,3), (1,2), (1,5), (3,–7)}

a. Study each set of ordered pairs. Record the similarities and the differences between the two sets of ordered pairs.

b. Construct an arrow diagram representing Set A and one representing Set D. Study the main difference between the two arrow diagrams.

Analysis

1. From your observations in Parts A, B, and C, explain how you can tell a function from a non-function when the relation is represented as:
   - a graph
   - an arrow diagram
   - a set of ordered pairs

My Notes

Write your explanation in the form of a hypothesis that can be used to identify each of the relations shown above as functions or non-functions.

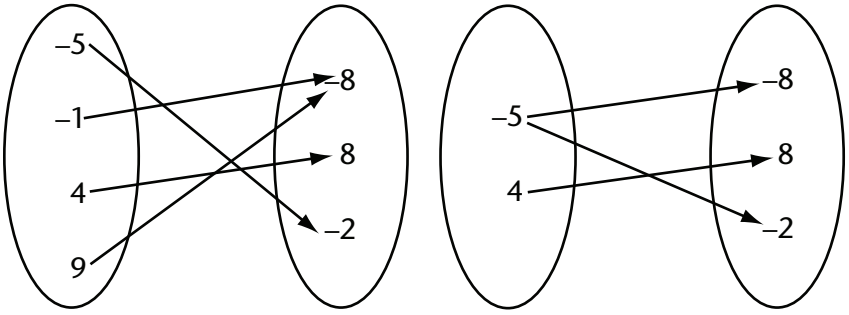
2. Construct a definition of a function based on your responses to the questions above.

Before moving on to the next part of the lab, turn to Solutions at the end of the module and mark your work.

Applying the definition

1. For each pair of relations, decide which one is a function and which one is not a function. Explain your reasoning.

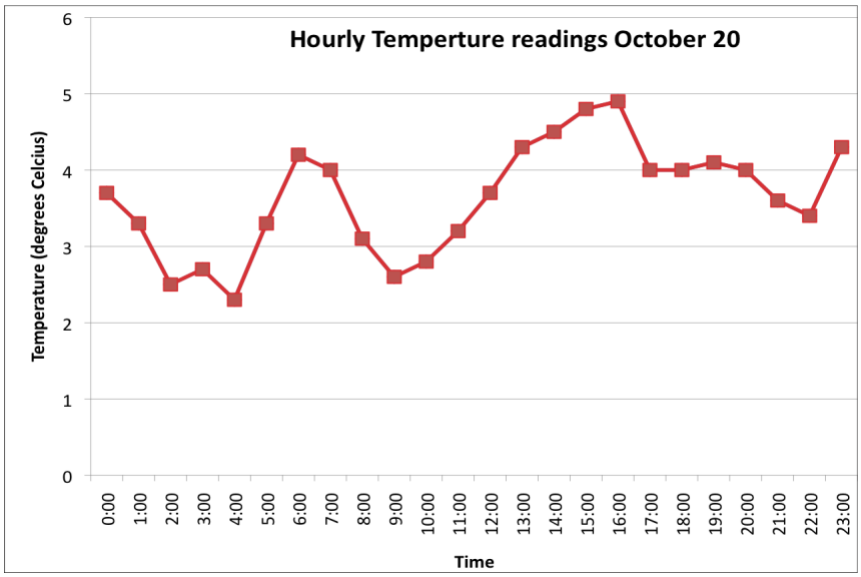
a.



Mapping A **Mapping B**

Section Assignment 3.1 Part 1
Interpreting and Sketching Graphs

1. The graph below shows the hourly temperatures for October 20 in a British Columbia City. Using the graph for information, answer the following questions. (6 marks)



a. What was the temperature at 6 pm?

b. Did the air temperature rise or fall between 6 am and 9 am?

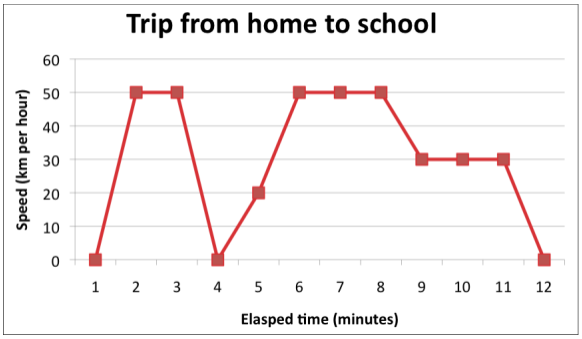
c. What is the difference in air temperature between midnight and noon?

d. Was it warmer at 9 am or 9 pm?

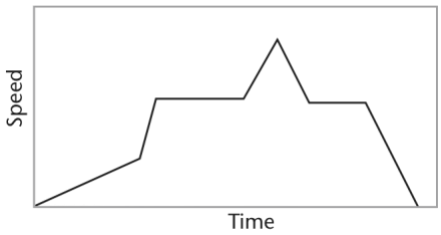
e. At what time was the air temperature the warmest?

f. Is this more likely to be a line graph showing temperatures in Vancouver or Prince George? Explain your answer.

2. Mary drives to school each day. The graph below shows a sample trip. Using the graph for information, describe her trip. (2 marks)

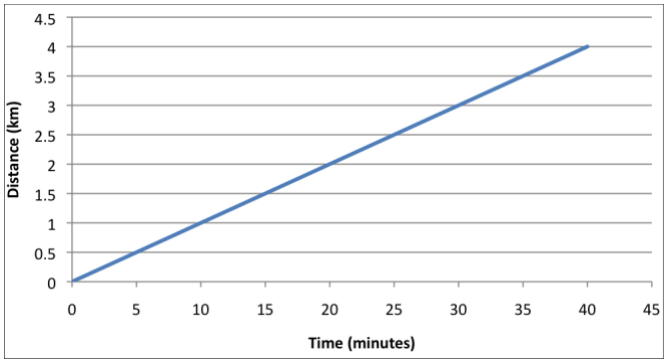


3. Erin enjoys riding her bicycle. Her time and speed is shown on the graph below. Describe her ride. (2 marks)

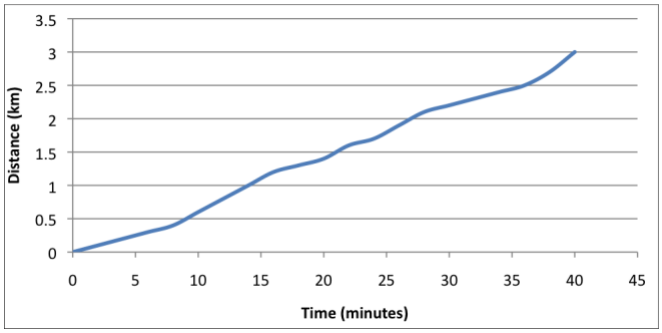


4. Bob jogs 4 kilometers every morning. He stops three times during the run to take his pulse. He runs an "out and back" route along a wooded trail. Which graph below best represents the time/distance analysis of his run? Give reasons for your choice. (2 marks)

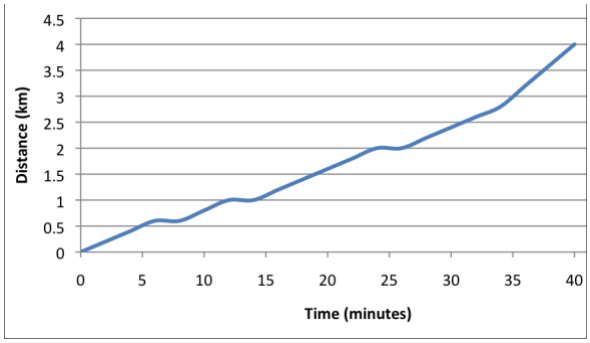
a.



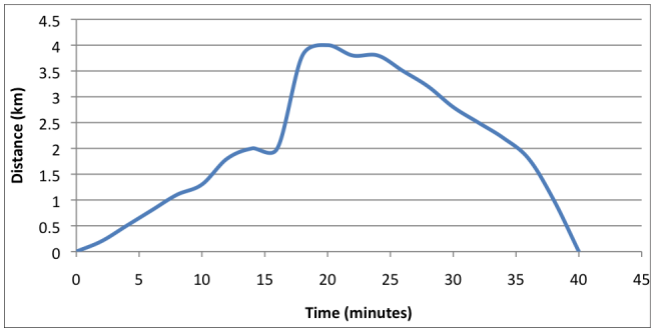
b.



c.

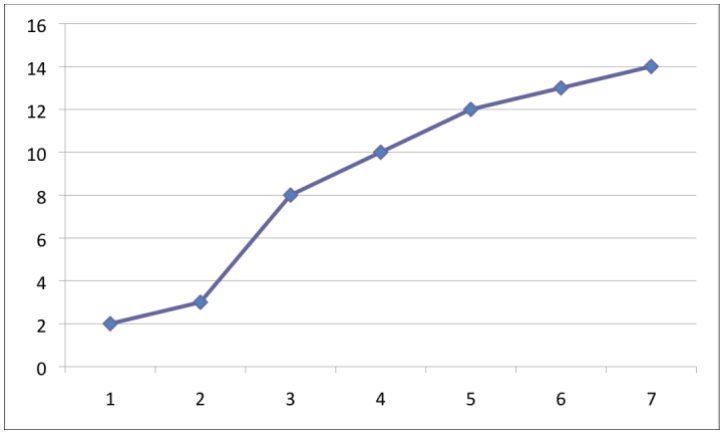


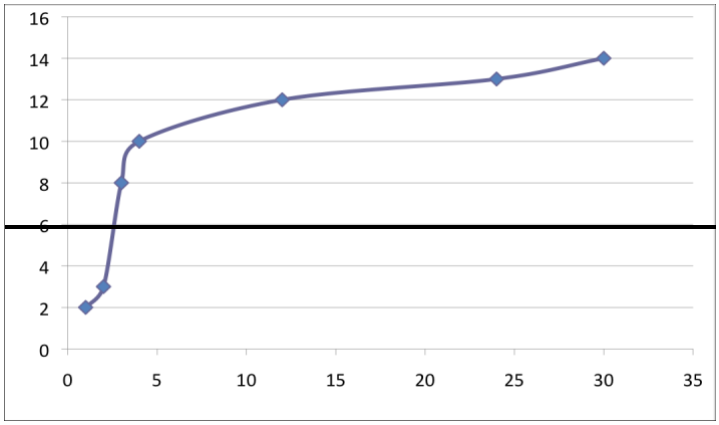
d.



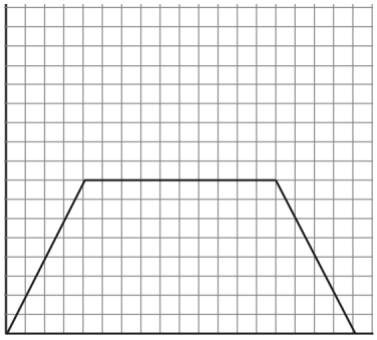
5. Matthew has a new puppy. He keeps a record of the mass of his puppy as it grows. He creates two graphs from this data. Which graph is correct? Give a reason for your choice. (2 marks)

Age in months	Weight in Kg
1	2
2	3
3	8
4	10
12	12
24	13
30	14





6. Given this graph, describe two completely different situations that might result in the graph. Label both axes of the graph with titles, scales, and units, then describe in words what is happening. (6 marks)



Section Assignment 3.1 Part 2
Relations

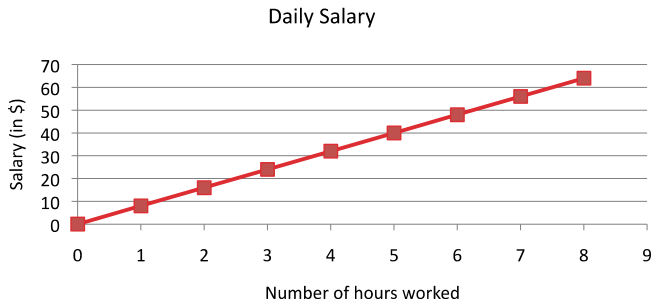
1. If you draw the graph of each of the functions below, in which of the graphs will you connect the points? Justify your answer. (3 marks)

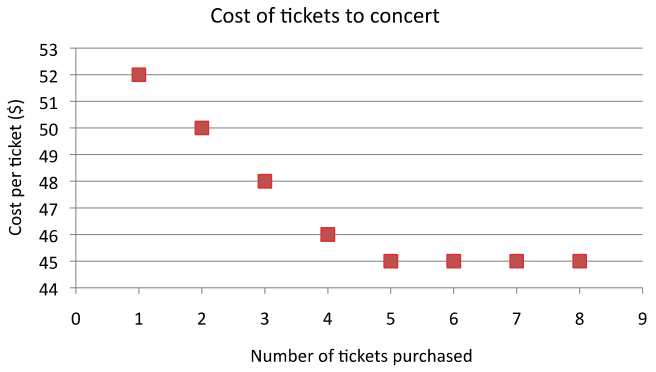
   a. The value of a car is a function of the age of the car.

   b. The amount of rainfall in the rainforest is a function of the number of hours.

   c. The number of people on the bus is a function of the time of day.

2. a. What does each of the graphs below represent? (2 marks)





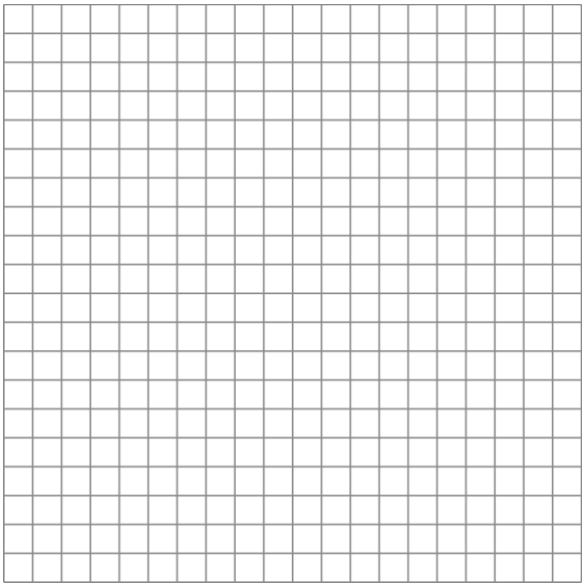
b. Identify the independent and dependent variables in each graph. (2 marks)

c. What are the points connected on the first graph and not the second? (2 marks)

3. The table shows the population of Canada at the beginning of each decade from 1861 to 2001.

Population of Canada	
1861	3,230,000
1871	3,689,000
1881	4,325,000
1891	4,833,000
1901	5,371,000
1911	7,207,000
1921	8,788,000
1931	10,377,000
1941	11,507,000
1951	13,648,000
1961	16,081,000
1971	21,568,000
1981	24,820,000
1991	28,031,000
2001	31,021,000

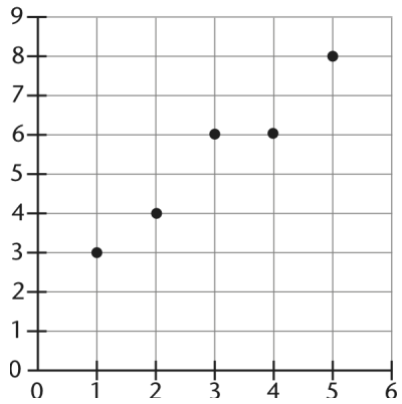
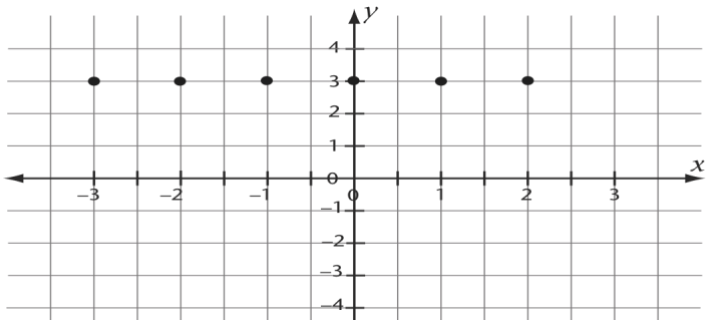
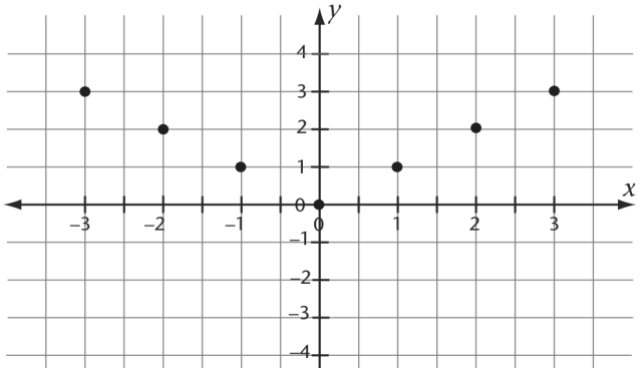
a. Choose an appropriate scale and graph the data. (4 marks)



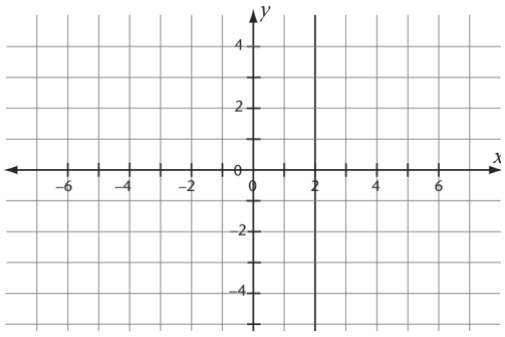
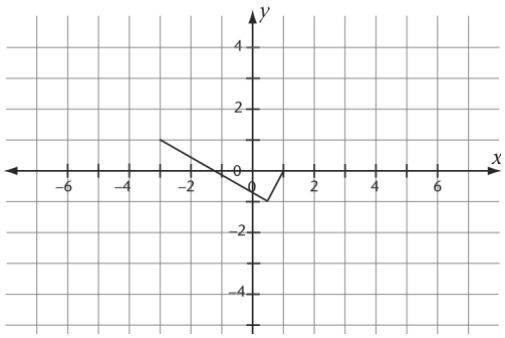
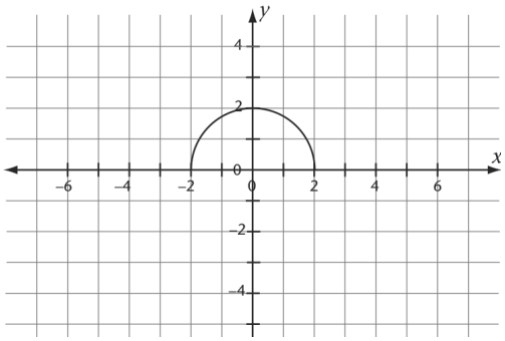
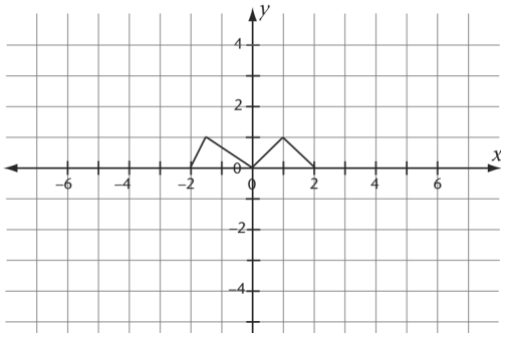
b. Do you join the points? Why or why not? (1 mark)

c. Give the best estimate of the domain and range of this function. (1 mark)

4. Give the domain and range of each of the following graphs. (3 marks)

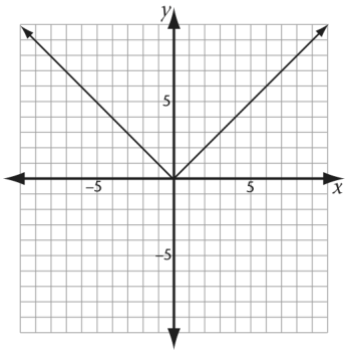
	Domain	Range
a. 		
b. 		
c. 		

5. Match each graph with its domain and range. (4 marks)

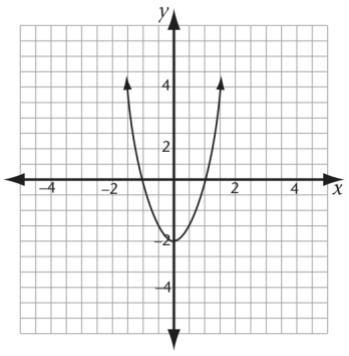
a. _____		I. Domain $-2 \le x \le 2$ Range $0 \le y \le 1$ II. Domain $x = 2$ Range all real numbers III. Domain $-3 \le x \le 1$ Range $-1 \le y \le 1$ IV. Domain $-2 \le x \le 2$ Range $0 \le y \le 2$
b. _____		
c. _____		
d. _____		

6. Give the range and domain of each of the following graphs. (2 marks)

a.

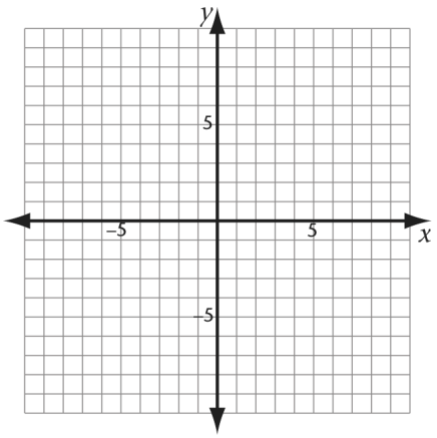


b.

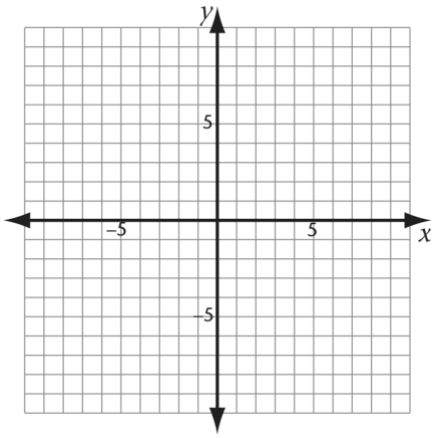


7. Sketch a function that has the following range and domain: (4 marks; 2 marks each)

   a. Domain: $-2 \le x \le 2$ Range: $-2 \le y \le 0$



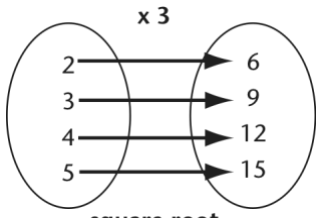
   b. Domain: all real numbers Range: $0 \le y \le 2$



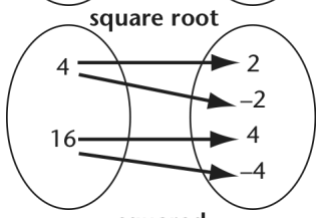
Section Assignment 3.1 Part 3
Functions

1. Which of the following diagrams represent functions? Explain your reasoning. (3 marks)

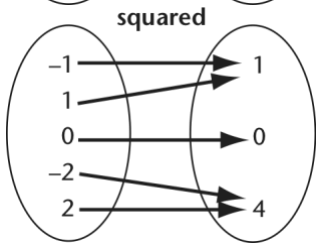
a.



b.



c.



2. Which sets of ordered pairs are functions? State the domain and range for each set of ordered pairs. (4 marks; 2 marks each)

   a. (3,4), (4,5), (6,7), (8,9)

   b. (3,4), (4,5), (6,7), (3,9)

3. Give an example for each of the following. (3 marks)

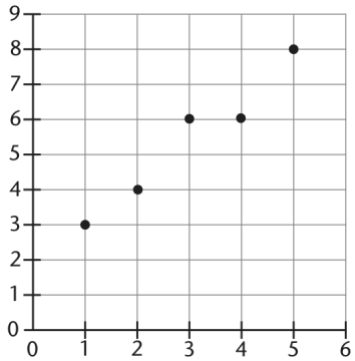
   a. A relation that is a function

   b. A relation that is not a function

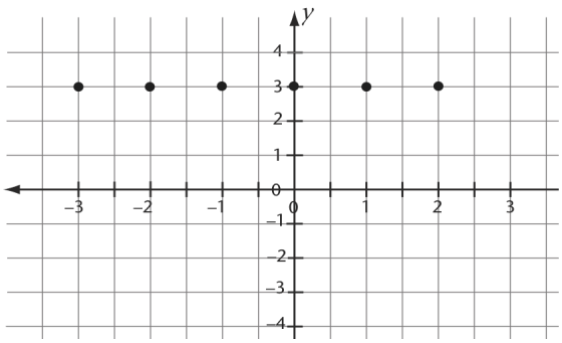
   c. Explain why it is not possible to give an example of a function that is not a relation.

4. Which of the following are functions? How can you tell? (3 marks)

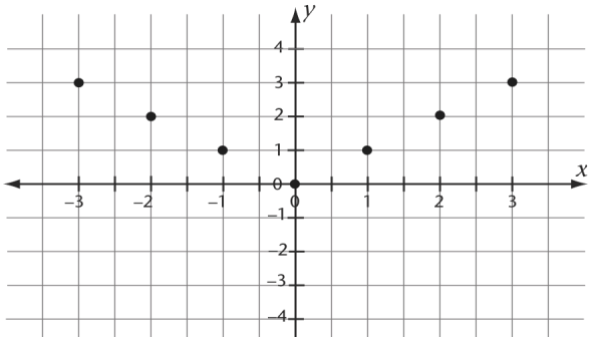
   a.



   b.

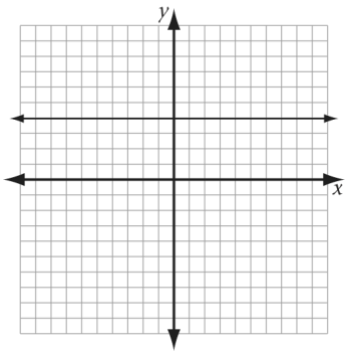


c.



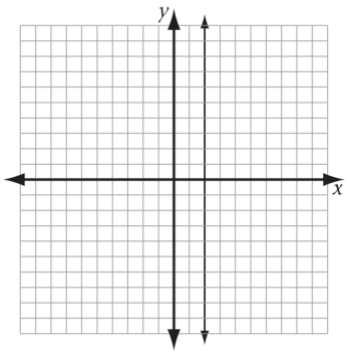
5. The graphs for $y = 2$ and $x = 1$ are shown. Explain why $y = 2$ is a function and $x = 1$ is not a function. (2 marks)

a.



$y = 2$

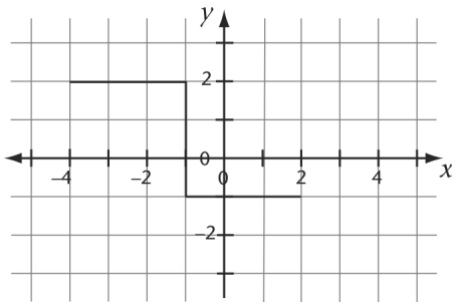
b.



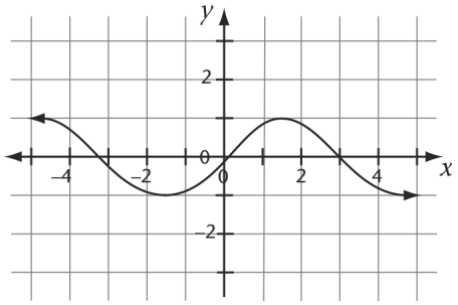
$x = 1$

6. Which of the following graphs represents a function? Justify your answer. Give the range and domain of each graph. (9 marks; 3 marks each)

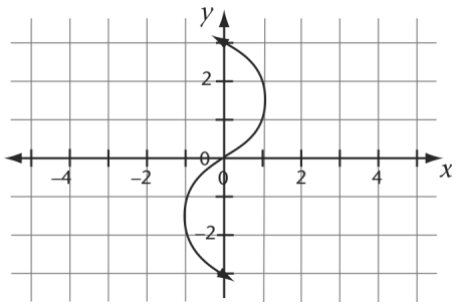
a.



b.



c.



7. Describe your own personal strategies for identifying a relation as a function when expressed as:

   a. an arrow diagram or mapping (1 mark)

   b. a set of ordered pairs (1 mark)

   c. a graph (1 mark)

a table (1 mark)

Section Assignment 3.1 Part 4
Glossary

Write a short definition from your personal glossary for each term below. (10 marks; 1 mark each)

- dependent variable

- independent variable

- continuous data

- discrete data

- domain

- interval notation

- range

- relation

- set notation

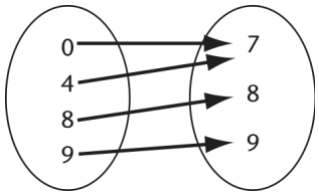
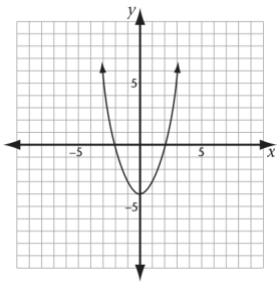
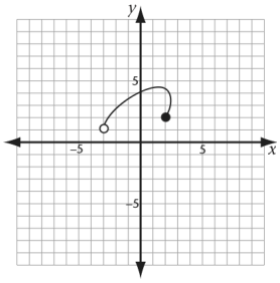
function

Section Assignment 3.1 Part 5
Multiple Choice

20 marks: 2 marks each

No calculator may be used for this part of the section assignment.

1. Which of the following relations are also functions?

I	{(0, 2), (1,4), (3,6), (4,5), (4,3), (7,8)	II	
III		IV	

a. I only

b. I and IV only

c. II and III only

d. II, III, and IV only

2. Sam has a list of 25 potential customers for her lawn-mowing business. In order to get a business grant, she must graph her income versus the number of customers. Determine the domain of the graph.

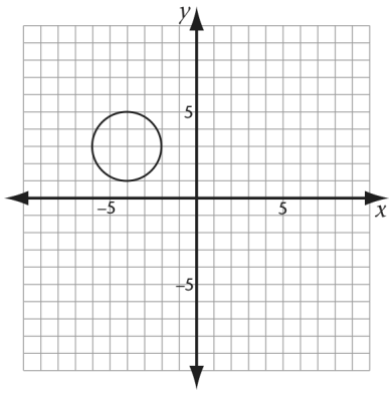
a. {0, 1, 2, 3, ...}

b. {0, 1, 2, 3, ... 25}

c. all real numbers

d. all real numbers between 0 and 25

3. What is the range of the graph below?



I	All x values between –2 and –6 inclusive.
II	(–2, –6)
III	[1, 5]
IV	$1 \leq y \leq 5$

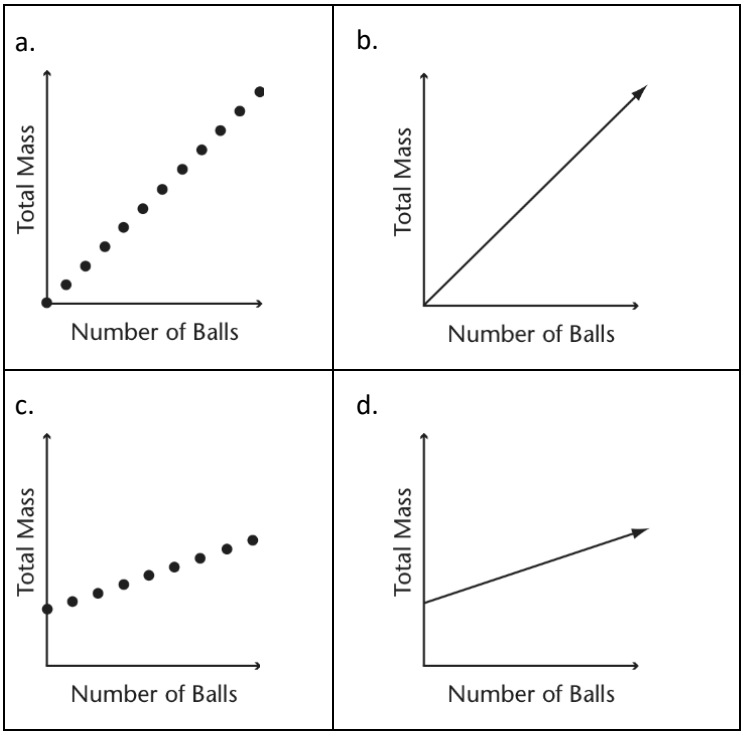
a. III only

b. IV only

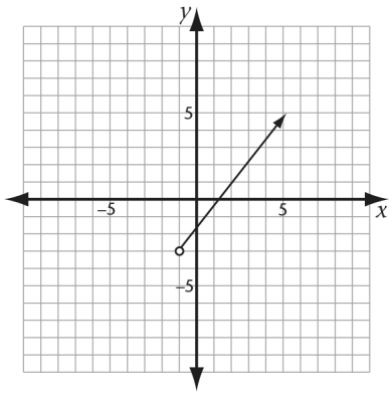
c. I and II only

d. III and IV only

4. Balls are placed in a bucket one at a time. Which graph below best represents the total mass of the bucket and balls as the balls are added?



5. Determine the range of the linear relation graphed below.



a. $y > -1$

b. $y \geq -1$

c. $y > -3$

d. $y \geq -3$

You may use your calculator for the last five questions.

6. Kara wants to start a small business where she would provide a basic bicyle tune-up for $40. She thinks she can do 15 tune-ups per week after school and on weekends. In order to apply for a loan from the bank, she needs to graph total revenue per week vs. the number tune-ups. Determine the range of the graph.

   a. all real numbers

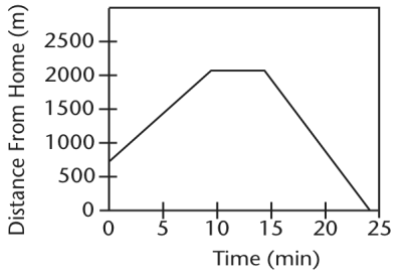
   b. {0, 1, 2, 3, ... 15}

   c. {0, 40, 80, 120, ...}

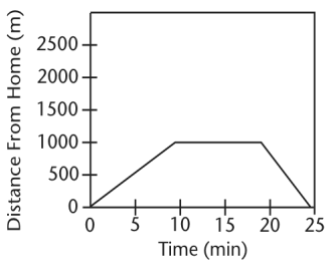
   d. {0, 40, 80, ... 600}

7. Maddy biked from her friend's house to the school, stayed at the school for awhile, and then went home. Which graph below best represents Maddy's distance from home?

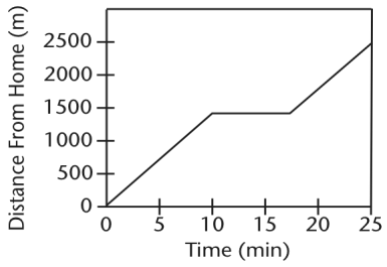
a.



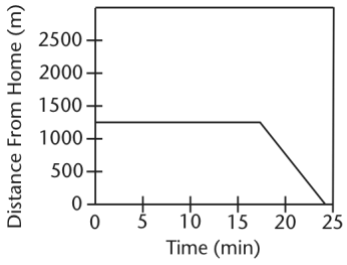
b.



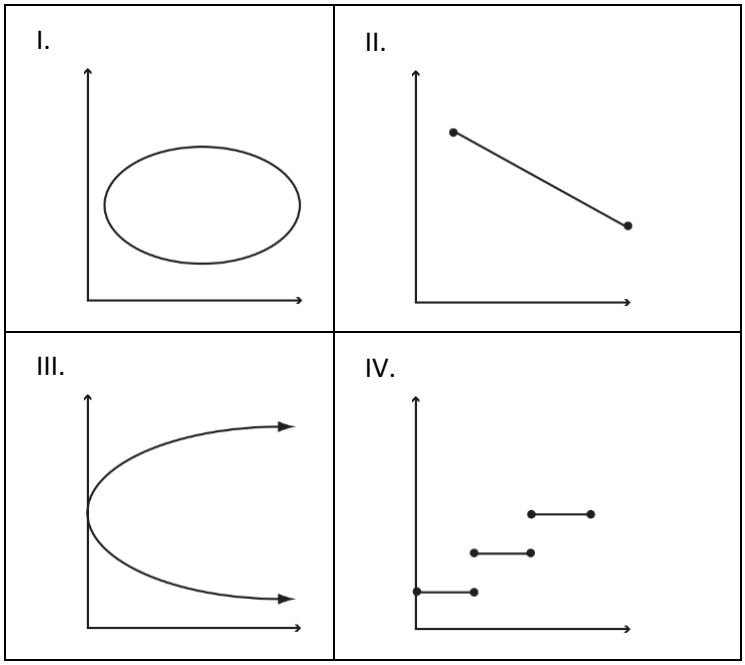
c.



d.



8. Which of the following are also functions?



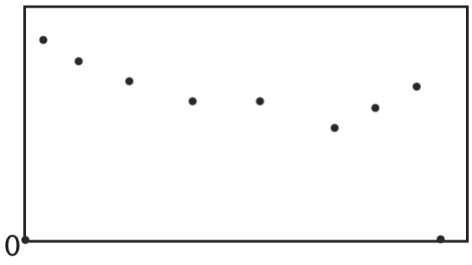
a. II only

b. I and III only

c. II and IV only

d. I, III, and IV only

9. Which scenario best describes the graph shown below?



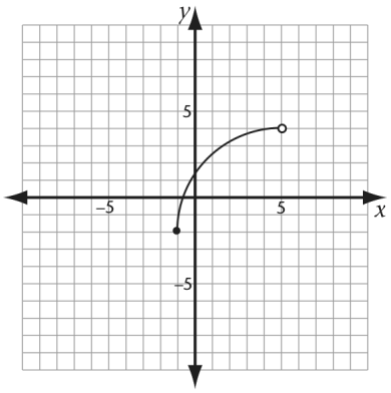
a. The water level in a lake over six winter months.

b. The height of an elevator in a mine shaft over a period of 20 minutes as it takes miners down and then comes back up.

c. The number of people in a store throughout the day during a Boxing Day shopping event.

d. Katy's distance from home as she takes a leisurely bike ride to a point 8 km from her house and then back.

10. Determine the domain of the relation graphed below.



a. (–1, 5]

b. [–1, 5)

c. [–2, 4)

d. [–2, 4]

Title	Marks
Part 1: Interpreting and Sketching Graphs	/20
Part 2: Relations	/28
Part 3: Functions	/28
Part 4: Glossary	/10
Part 5: Multiple Choice	/20
Total Marks	/106

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Module 3, Section 2—Lesson A: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can slope be used to describe the properties of objects?			
How is it possible to use any two points to determine the slope of a line?			
What is meant by positive, negative, zero and undefined slopes?			

My Notes

Discover

Stairs are made up of risers (the vertical part) and treads (the horizontal part you step on). Sometimes, a tread has a nosing (the edge part of the tread that protrudes).

In order to do the following math lab, you'll need to find a staircase in your school, home, or other building that you can measure.

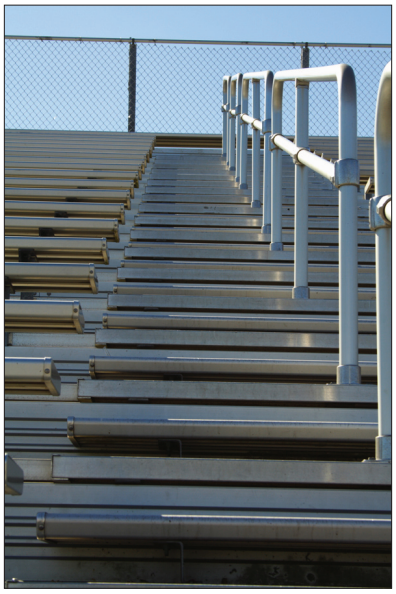


Photo by Felix Mizioznikov © 2010

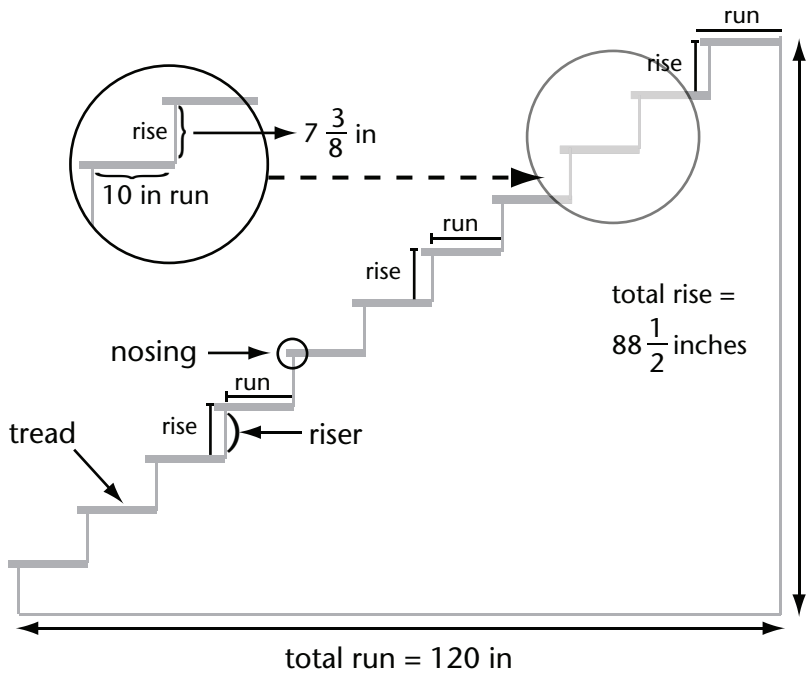
Activity 2
Math Lab: Slope of a Staircase

Materials

- tape measure or ruler
- staircase to measure

The following diagram is a profile of a staircase with the horizontal run of each stair (tread width) equal to 10 in and vertical rise of each stair equal to $7\frac{3}{8}$ in. You will use this diagram to answer questions 1, 2, and 3.

My Notes



Remember the following terms:

- rise: the height of a step's riser
- run: the depth of the step's tread (not including the nosing)

Procedure

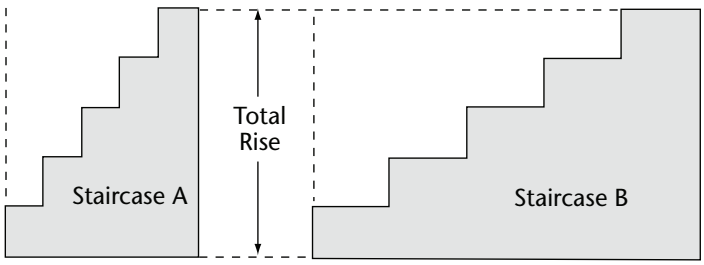
1. Study the diagram above. State the rise and run of one step.

2. Divide the rise by the run. Record this as the "steepness of one step."

3. Divide the total rise of the set of stairs by the total run of the set of stairs. Record this value as the "steepness of staircase."

My Notes

4. Look at the following diagrams. The relationship between the rise and the run determines the steepness of the staircase.



   a. Which staircase has a steep slope?

   b. Which has a gentler slope?

   c. How can you tell?

5. Find a staircase in your school or your home that you can measure.
   a. Measure the run. If the tread has a nosing, don't include it in your measurement. Record your calculation.
   b. Measure the rise. Record your calculation.

   c. Calculate the steepness of the stairs by dividing the rise by the run.

Analysis

My Notes

6. How does the rise and run of a single step compare with the rise and run of the entire staircase?

7. How do you think the rise and run calculation for several consecutive steps compares with the rise and run of a single step? Show the calculation of the steepness of several steps (choose two or more) to check your hypothesis.

8. a. How do the stairs that you measured compare with the stairs in the diagram?

   b. How can you tell which set of stairs is steeper?

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

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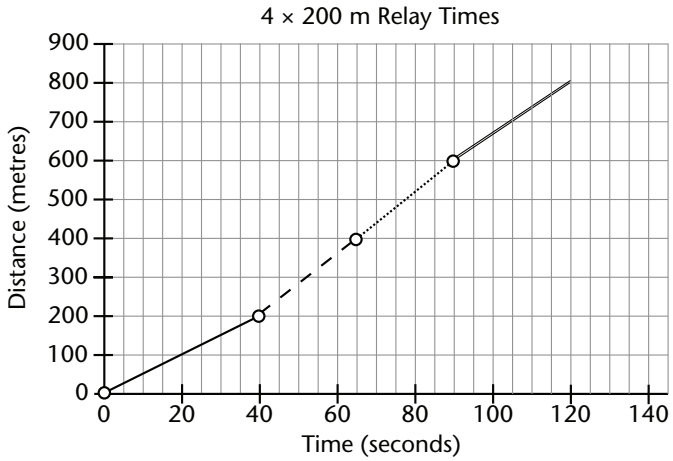
Module 3, Section 2—Lesson B: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can you draw a line, given its slope and a point on the line?			
How can you determine another point on a line, given the slope and a point on the line?			
Why is slope sometimes referred to as “a rate of change”?			

My Notes

Activity 2
Math Lab: Analyzing Slope

The following graph represents the times required for each runner in a particular 4 × 200 m relay race. Study the graph and answer the following questions.



1. Use the information for the first runner (i.e., the solid line) to answer the following questions.

   a. How long did it take the first runner to run 200 m?

   b. Calculate the slope of the first solid line segment, and report the final answer with units.

My Notes

c. What does the slope of the solid line segment represent?

2. A generally accepted strategy for ordering the runners in a relay race is to start with the second-fastest runner, followed by the third-fastest runner, then the slowest runner, and finally the fastest runner.

   Who is the slowest runner as represented by the graph? How do you know?

3. a. Construct a line segment joining the first point on the graph and the last point on the graph.

   b. Use the slope formula and the two endpoints of the line segment to calculate its slope. Show your answer rounded to the nearest hundredth.

My Notes

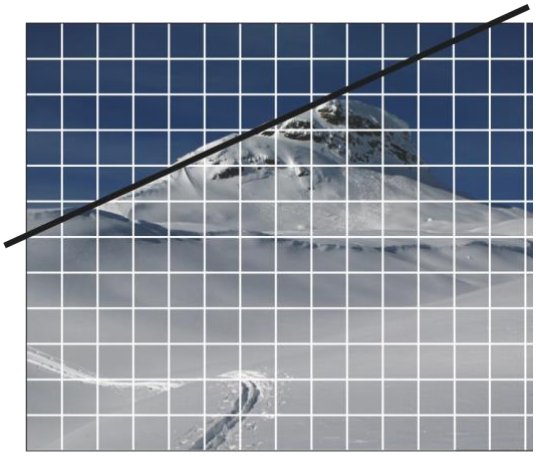
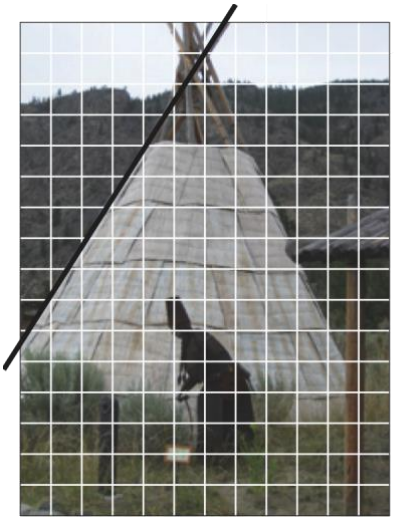
c. What does the slope of this line represent?

d. Find two other points on the line besides the endpoints. Use these points in the slope formula to determine the slope rounded to the nearest hundredth. What do you notice about the result?

e. Extend the line segment beyond the endpoint. Choose a point on the extended part of the line, and explain what this point represents.

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

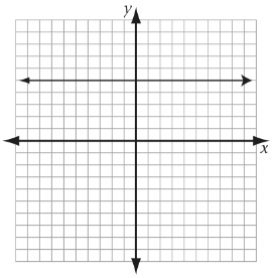
Section Assignment 3.2 Part 1
Slope

1. a. While skiing at the Campbell Glacier, Bob viewed the peak in the picture. What is the slope of the peak? (1 mark)	
b. Barb was visiting the Nk'Mip Desert Cultural Centre in Penticton when she snapped this photo. What is the slope of the shelter? (1 mark)	

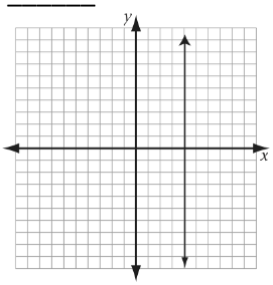
2. Match the graph in column A with the slope description in column B. (4 marks)

Column A

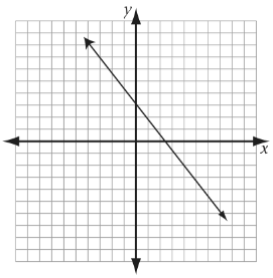
a. _____



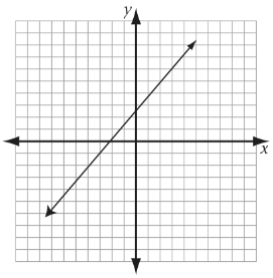
b. _____



c. _____



d. _____



Column B

a. positive slope

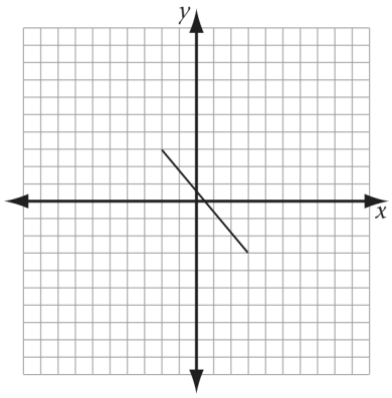
b. negative slope

c. zero slope

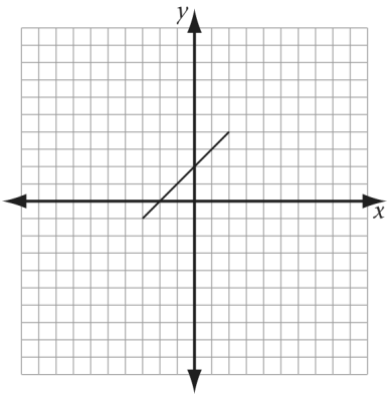
d. undefined slope

3. For each of the line segments below, determine the rise, run, and slope. (8 marks)

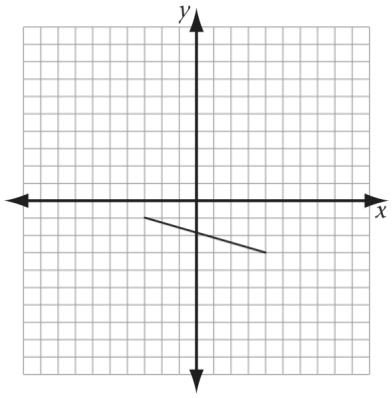
a.



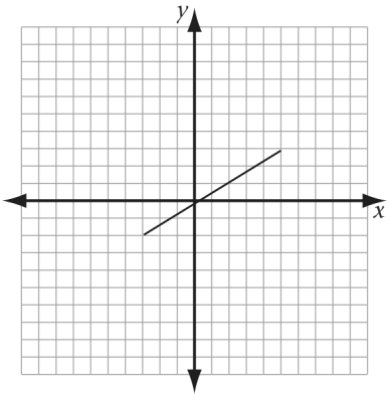
b.



c.



d.



4. Find the slope of the following line segments. Describe each line by stating whether it rises or falls when you move from left to right, is horizontal, or vertical. (12 marks; 3 marks each)

   a. A(2,1) B(5,3)

   b. C(–3,4) D(–1,–2)

   c. E(–2,4) F(6,4)

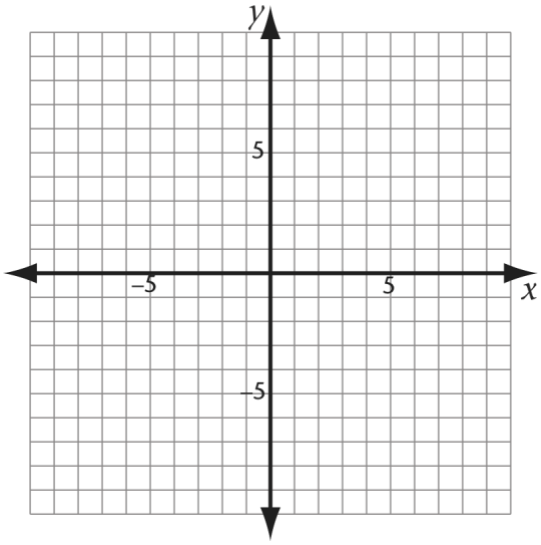
   d. G(1,–2) H(1,5)

5. A new overpass is being built to allow bicycles to cross a major highway. The ramp starts 250 metres from the road and rises to a height of 8 metres above the highway. What is the slope of the ramp? Answer to three decimal places. (2 marks)

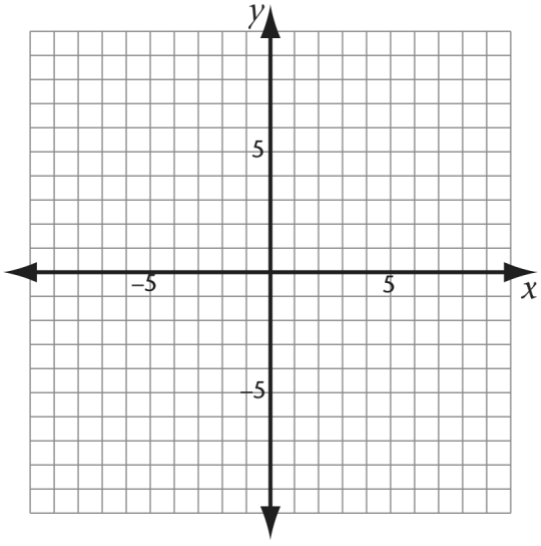
Section Assignment 3.2 Part 2
Slope as a Rate of Change

1. Draw a line segment as described below: (4 marks; 2 marks each)

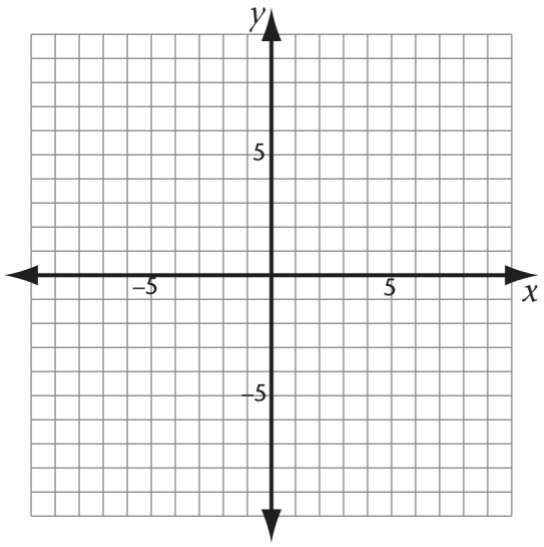
   a. endpoint (–2, 4) slope = $-\frac{1}{2}$



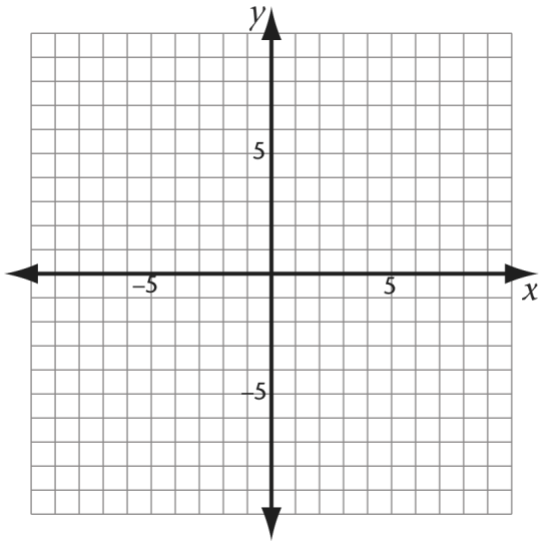
   b. endpoint (1,5) slope = 2



2. a. Draw a line through (0, 0) with a slope of $-\frac{2}{3}$. List the coordinates of three other points on the line. (5 marks)



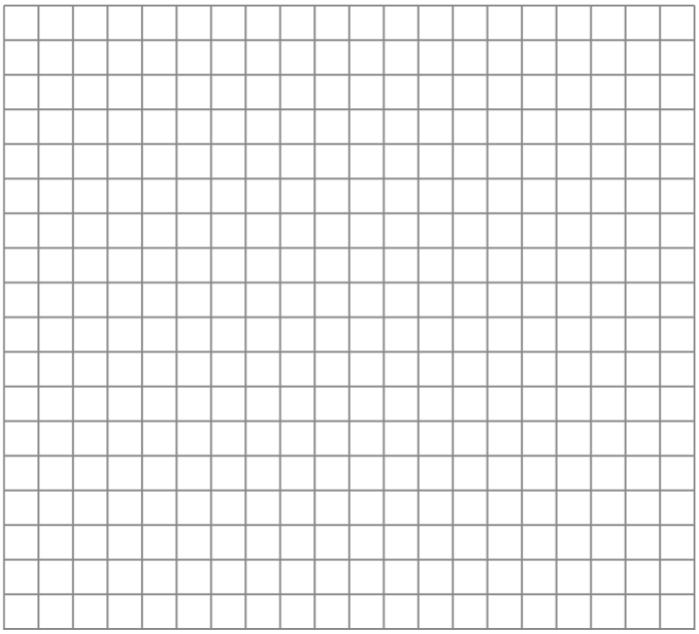
b. Draw a line through (–2, –3) with a slope of 3. List the coordinates of three other points on the line. (5 marks)



3. Robert sells cars at a local car lot. He receives a base salary and an additional amount depending on the number of cars that he sells. The following table shows the monthly pay that can be earned.

# Cars	Pay
0	1000
1	1400
2	1800
3	2200
4	2600
5	3000
6	3400
7	3800

a. Graph the data. (5 marks)



b. Are the points joined? Why or why not? (1 mark)

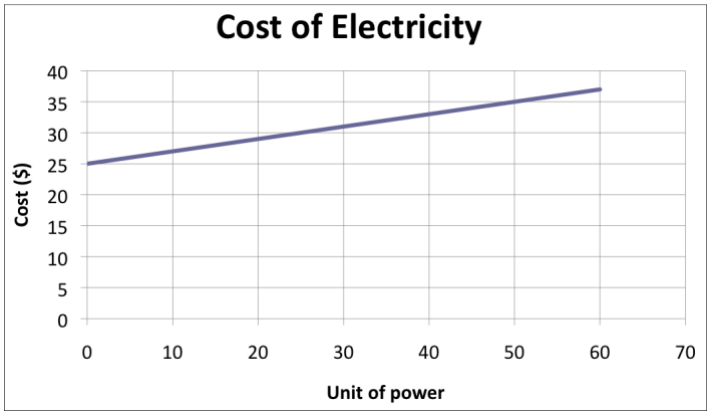
c. Calculate the slope of this relation. (1 mark)

d. What does the slope represent? (1 mark)

e. How could you use the slope to find his pay if he sells 8 cars? (1 mark)

f. How much would he earn if he sells 10 cars in a month? (1 mark)

4. An electric company charges a fixed monthly rate plus a constant rate for each unit of power consumed. The following graph shows the cost of electricity depending on the amount of power used. (4 marks)



a. Why is the line continuous?

b. Find the slope of the line.

c. What does the slope of the line represent?

d. What would the cost be if 100 units were used?

Section Assignment 3.2 Part 3
Glossary

Write a short definition from your personal glossary for each term below. (10 marks; 1 mark each)

- Rate of change

- Rise

- Run

- Slope

Section Assignment 3.2 Part 4
Multiple Choice

20 marks: 2 marks each

No calculator may be used for this part of the section assignment.

1. A line with a zero slope passes through the points (−5 , 4) and (*p*, *q*). Which of the following points could be (*p*, *q*)?

a. (−4, 5)

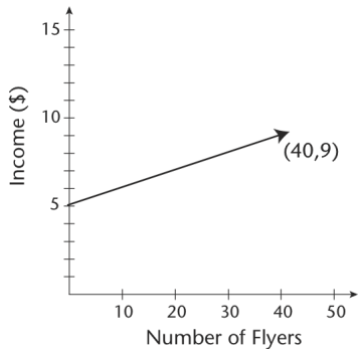
b. (−5, 2)

c. (−5, 0)

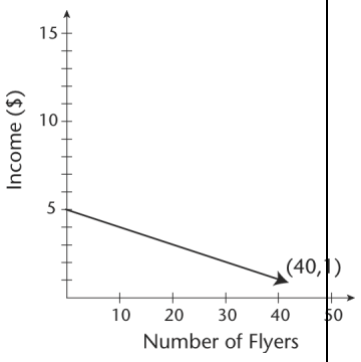
d. (2, 4)

2. Hannah delivers flyers. She gets paid 5 dollars for every day of work, plus 10 cents for every flyer she delivers. Which of the following graphs best represents Hannah's possible income for one day?

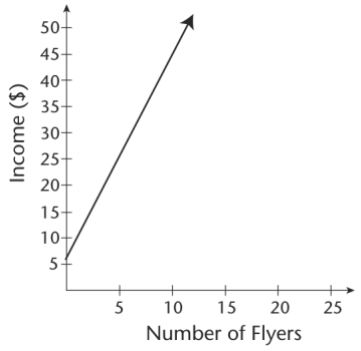
1.



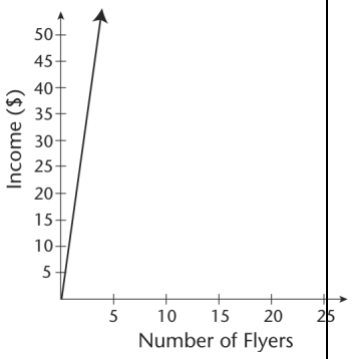
2.



3.



4.



3. Two isosceles triangles have the same height. The slopes of the sides of triangle A are half the slopes of the corresponding sides of triangle B. How do the lengths of their bases compare?

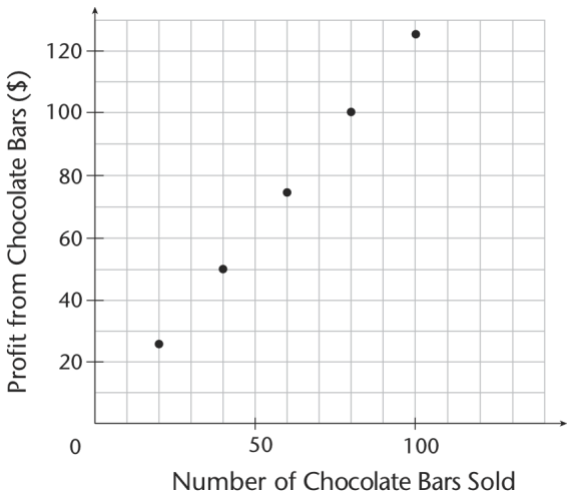
   a. The base of A is quadruple that of B.

   b. The base of A is double that of B.

   c. The base of A is half that of B.

   d. The base of A is one quarter that of B.

4. What does the slope represent in the graph below?



   a. total profit from chocolate bars

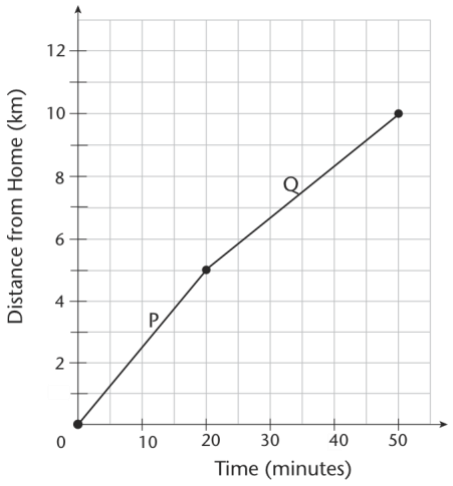
   b. revenue from chocolate bars

   c. profit per chocolate bar

   d. number of chocolate bars sold

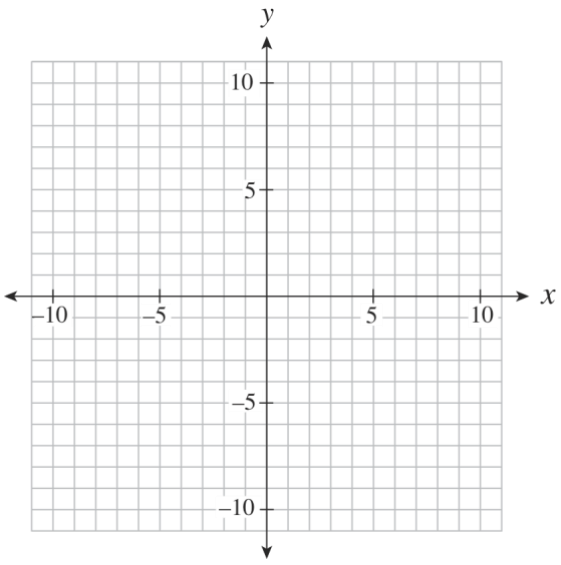
You may use your calculator for the last six questions. (2 marks each)

4. The graph below models a runner's distance from home over time. Calculate the change in the speed of the bike from segment P to segment Q.



a. decreased by 15 km/h
b. decreased by 5 km/h
c. increased by 15 km/h
d. increased by 11 km/h

The grid below may be used for rough work to answer question 6.



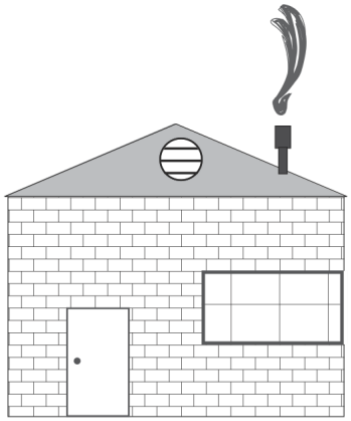
6. A line has a slope of $-\frac{1}{2}$ and passes through the point (0, –4). Which of the following points must also be on the line?

   a. (10, 1)
   b. (−2, –5)
   c. (−3, 2)
   d. (8, –8)

7. Calculate the slope between the points (2, 6) and (–4, 8).

   a. –3
   b. $-\frac{1}{3}$
   c. 3
   d. 7

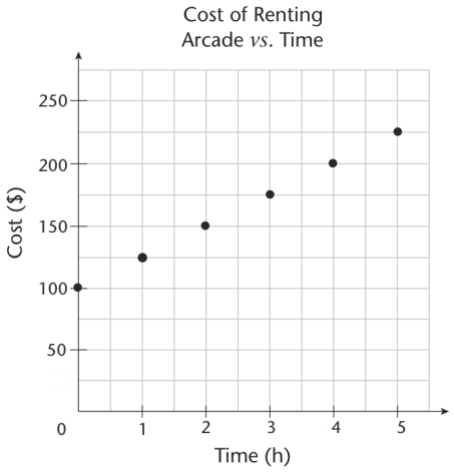
8. Use a ruler to determine the slope of the roof shown below.



Note: This diagram is drawn to scale.

   a. $\frac{22}{9}$
   b. $\frac{9}{44}$
   c. $\frac{9}{22}$
   d. $\frac{44}{9}$

9. What is the cost of renting the arcade for 8 hours?



   a. $800
   b. $500
   c. $300
   d. $200

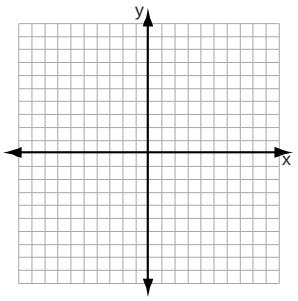
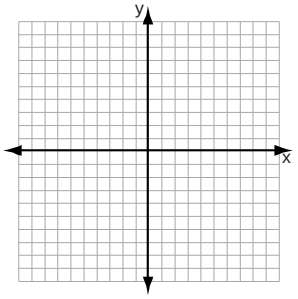
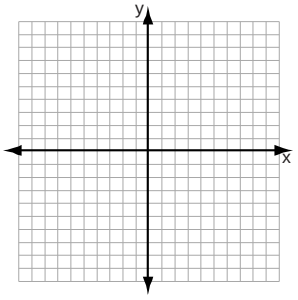
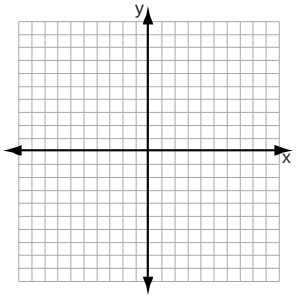
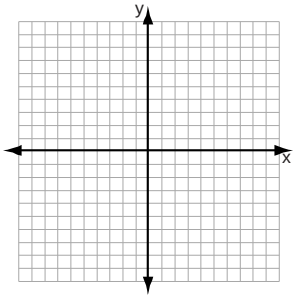
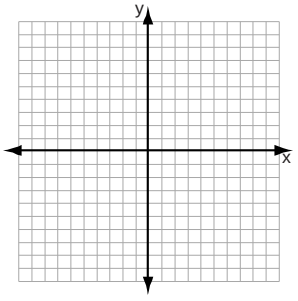
10. A water slide descends a vertical distance of 35 m over a horizontal distance of 50 m. What is the slope of the water slide expressed as a positive number to the nearest tenth?
   a. 1.4
   b. 0.4
   c. 0.3
   d. 0.7

Title	Marks
Part 1: Slope	/28
Part 2: Slope as a Rate of Change	/27
Part 3: Glossary	/4
Part 4: Multiple Choice	/20
Total Marks	/79

Foundations of Mathematics and Pre-calculus 10

Module 3, Section 3—Lesson A: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can you distinguish a linear relation from a non-linear relation?			
If you've drawn a graph from a set of ordered pairs, how can you tell if the relation is linear?			
How is it possible to match linear relations when they are given in various forms such as charts, graphs or sets of ordered pairs?			

Function	Equation	Graph
quadratic		
cubic		
radical		
exponential		
logarithmic		
Absolute value		

My Notes

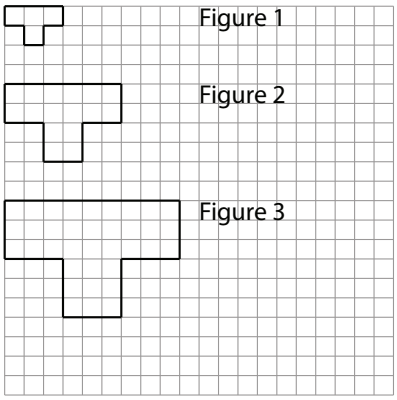
Discover

Activity 2

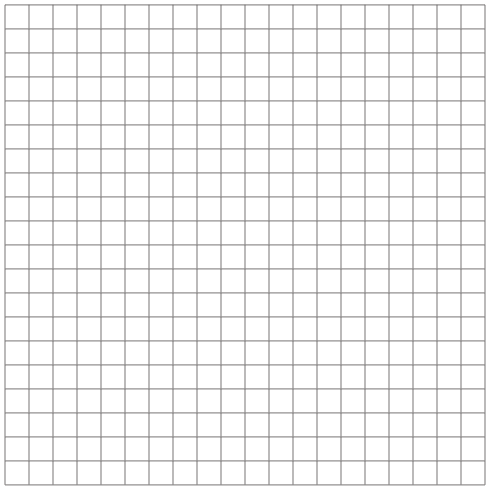
Math Lab: Investigating Linear Relations

Part A: Investigating Graphs and Tables

Study the illustrations below. Focus on the width, area, and perimeter of each figure. Do you see a pattern?



1. Construct Figure 4 and Figure 5.



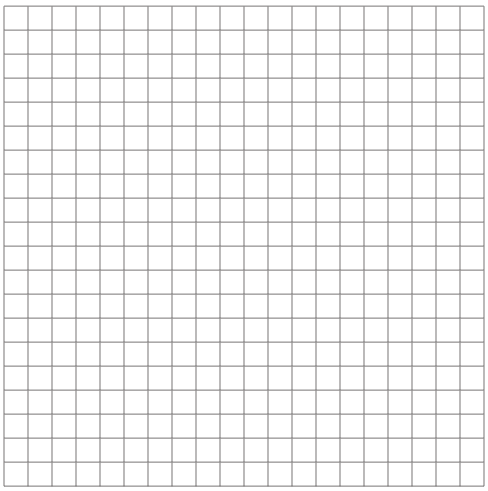
My Notes

2. Complete the table by recording the width, perimeter, and area of each figure, including the ones that you drew in the previous step. The first row has been completed for you as an example.

Figure	Width	Perimeter	Area
1	3	10	4
2			
3			
4			
5			

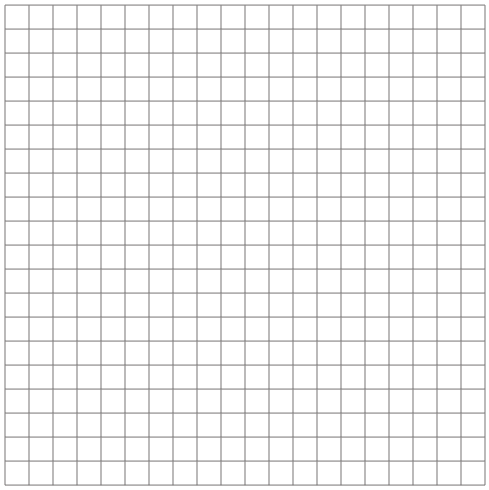
3. Graph the data for all the figures investigated using the following variables.

   a. perimeter versus figure

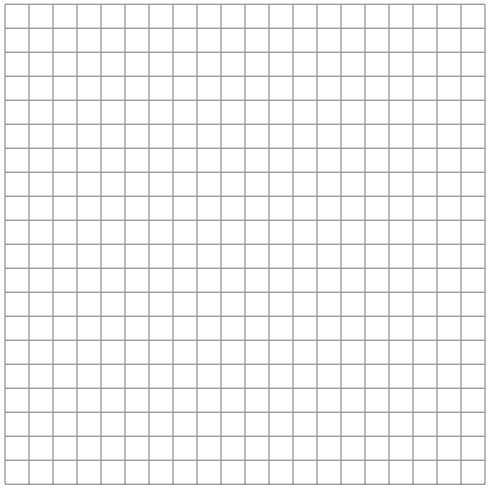


My Notes

b. area versus figure



c. perimeter versus width



Analysis

4. You have just constructed three graphs. In which of these graphs do the points line up along the edge of a ruler?

5. Study the patterns in the tables of the graphs that you identified in Question 4. How are the tables of these relations different from the one whose graph does not have points that line up along a ruler?

Part B: Investigating Equations

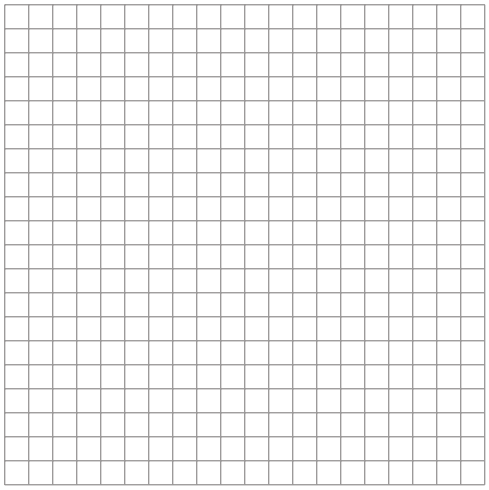
My Notes

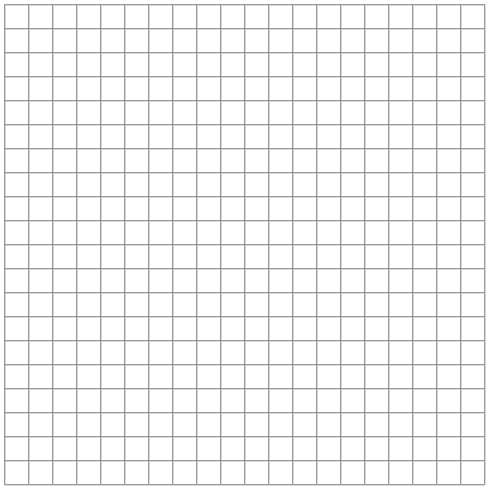
6. Graph each equation by one of the following means:
   - Use a graphing calculator or other graphing software.
   - Create a table of values. Create the following table by calculating the corresponding values of y. Use the data from the table to draw the graph.

Equation	Table		Graph
$y = x + 3$	x	y	
	0		
	2		
	4		
	6		
	8		
	10		

Equation	Table		Graph
$y = -\frac{1}{2}x + 2$	x	y	
	0		
	2		
	4		
	6		
	8		
	10		

My Notes

Equation	Table		Graph
$y = x^2$	x	y	
	0		
	2		
	4		
	6		
	8		
	10		

Equation	Table		Graph
$y = \sqrt{x}$	x	y	
	0		
	2		
	4		
	6		
	8		
	10		

Analysis

7. What properties of an equation indicate that its graph will be a straight line?

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

Foundations of Mathematics and Pre-calculus 10

Module 3, Section 3—Lesson B: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can you determine the intercepts of the graph of a linear relation?			
How can you determine the slope of the graph of a linear relation?			
How can you determine the domain and range of the graph of a linear relation?			
What does the sketch look like for a linear relation that has one intercept, two intercepts, or an infinite number of intercepts?			

My Notes

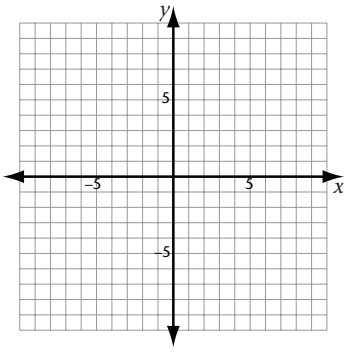
Activity 2
Math Lab: Investigating Intercepts

Sketch the lines from the following descriptions onto the graphs below.

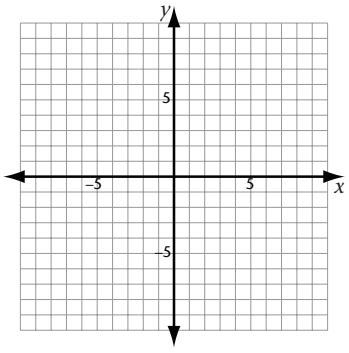
- Line A: A line with exactly two intercepts.
- Line B: A line with exactly two intercepts but with a different slope than Line A.
- Line C: A line with only one intercept.
- Line D: A line with only one intercept but with a different slope than Line C.
- Line E: A line with more than two intercepts. (This one is more challenging, but still possible.)

1. Sketch one line per grid. Label each line according to the letter in each description. Remember that each line is straight—no curves are permitted.

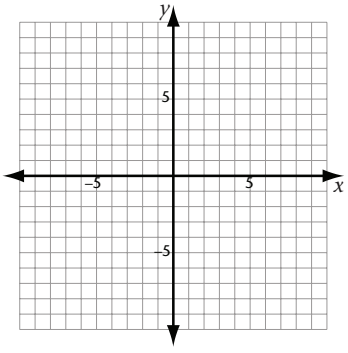
Line A



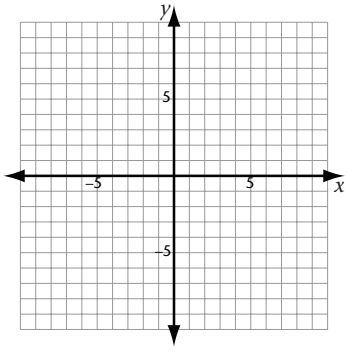
Line B



Line C

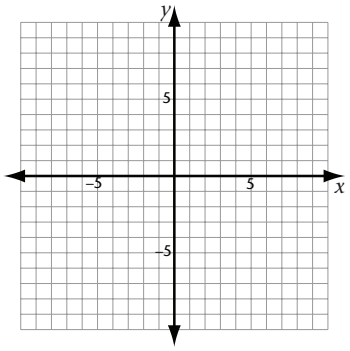


Line D



My Notes

Line E



2. Complete the following table by identifying the domain, range, and slope of each of the lines that you sketched in the previous step.

Line	Domain	Range	Slope
A			
B			
C			
D (option 1)			
D (option 2)			
E (option 1)			
E (option 2)			

Analysis

My Notes

3. a. What kinds of lines have exactly two intercepts?

   b. How would you describe their slopes?

   c. What is the domain and range of these lines?

4. a. What kinds of lines have only one intercept?

   b. How would you describe their slopes?

   c. How is the domain and range of these lines different from lines with two intercepts?

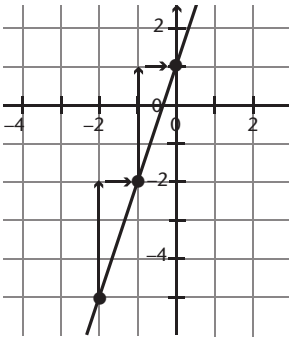
5. Describe lines that have an infinite number of intercepts.

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

Foundations of Mathematics and Pre-calculus 10

Module 3, Section 3—Lesson C: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
What do all the variables in the equation $y = mx + b$ mean?			
How can you identify the graph that corresponds to a given slope and y-intercept?			
How can you determine the slope and the y-intercept of a given linear relation from its graph?			



b. Use a straightedge to connect the points on the graph with a line.

Rearranging Formulas

Use the following media to review the definition of formula and how to rearrange formulas.

Go to your FMP 10 Media CD and open the glossary. Search for *Formula*.

Discover

In this part of the lesson you will investigate the equation of a line. Complete the Math Lab: Exploring Graphs of Linear Functions. You'll need your FMP 10 Media CD to complete the lab.

Activity 2

Math Lab: Exploring Graphs of Linear Functions

Go to your FMP 10 Media CD and open *Linear Function Graph*.

Once you have opened the media, do the following:

- Select the "$y = mx + b$" command tab.
- Drag the sliders to adjust m and b in $y = mx + b$.

My Notes

My Notes

Use the graphing applet to create the graphs for the following sets of equations:

Set 1	$y = x + 3$	$y = 2x + 3$	$y = \frac{1}{2}x + 3$	$y = -2x + 3$
Set 2	$y = x + 3$	$y = x + 1$	$y = x + 5$	$y = x - 3$

For each set, describe what changes and patterns you observed.

Analysis

1. a. What happens to the graph as the *b*-value is changed?

   b. What does the *b* in the equation $y = mx + b$ represent?

2. a. What happens to the graph as the *m*-value is changed?

   b. What do you think the *m* in the equation $y = mx + b$ represents?

3. How do changes in an equation of the form $y = mx + b$ affect the slope and *y*-intercept of a graph?

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

Foundations of Mathematics and Pre-calculus 10

Module 3, Section 3—Lesson D: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How are the general, slope-intercept, and slope-point forms of a linear relation different from each other?			
How can you identify equivalent linear relations when given a set of linear relations?			
How can you rewrite a linear relation in slope-intercept or general form when given the other form?			

My Notes

Example

Linear functions are listed in the following chart. Identify the pairs that are equivalent by rearranging each equation into slope-intercept form. Then determine the slope and the y-intercept.

	Linear Relation	Rearrangement	Slope	y-intercept
A	$y+3=\frac{1}{4}(x-4)$	$y+3-3=\frac{1}{4}(x-4)-3$ $y=\frac{1}{4}x-1-3$ $y=\frac{1}{4}x-4$	$\frac{1}{4}$	(0, –4)
B	$y-3=-\frac{1}{4}(x+4)$	$y-3+3=-\frac{1}{4}(x+4)+3$ $y=-\frac{1}{4}x-1+3$ $y=-\frac{1}{4}x+2$	$-\frac{1}{4}$	(0, 2)
C	$x-4y-4=0$	$x-4y-4+4y=0+4y$ $x-4=4y$ $y=\frac{1}{4}(x-4)$ $y=\frac{1}{4}x-1$	$\frac{1}{4}$	(0, –1)
D	$y=-\frac{1}{4}x+2$	Already in slope-intercept form	$-\frac{1}{4}$	(0, 2)
E	$x-4y-16=0$	$x-4y-16=0$ $x-4y-16+4y=0+4y$ $x-16=4y$ $\frac{1}{4}(x-16)=y$ $y=\frac{1}{4}x-4$	$\frac{1}{4}$	(0, –4)
F	$y=\frac{1}{4}x-1$	Already in slope-intercept form	$\frac{1}{4}$	(0, –1)

State the pairs of relations that are equivalent.

Solution

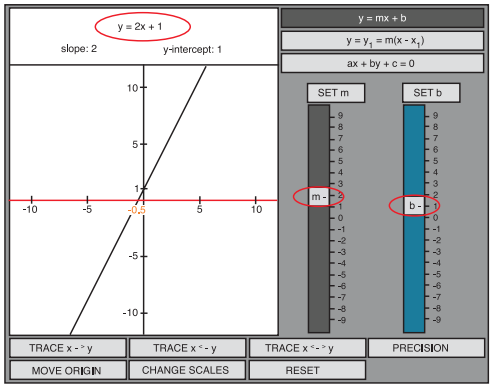
A matches E; B matches D; C matches F

Activity 2
Math Lab: Linear Forms

My Notes

For this lab you'll use the *Linear Function Graph* media you have looked at in previous lessons. This time, you'll use it to observe how the slope-intercept equation relates to the point-slope equation and general equation.

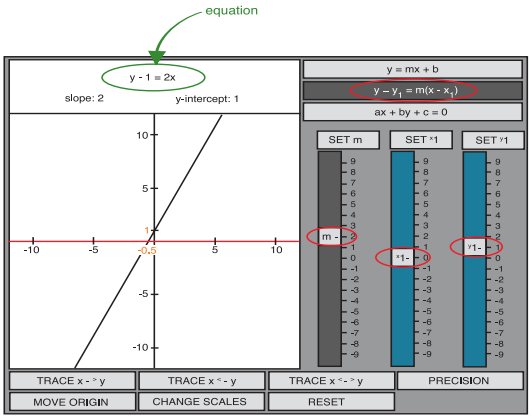
In the media, use the sliders to adjust "m" and "b" in "$y = mx + b$" as shown in the following image.



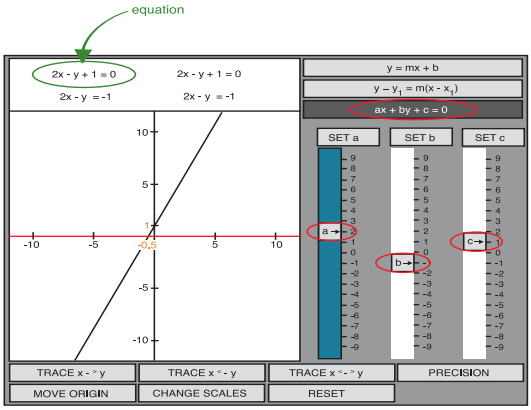
For example, to create the graph of $y = 2x + 1$, move the "m" slider to 2 and the "b" slider to 1. Keep your eye on the equation above the graph to make sure you have the equation you want.

Once you have the equation set properly in the slope-intercept equation (above), you can click on one of the other equation types. This will leave you with the same graph, but a different equation.

My Notes



Note: This applet shows you the slope-point equation in simplified form.

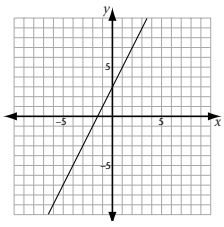
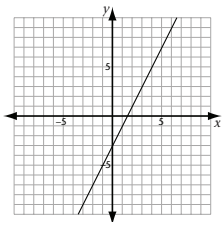
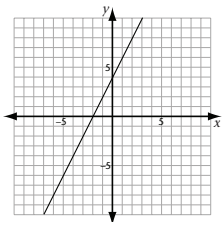
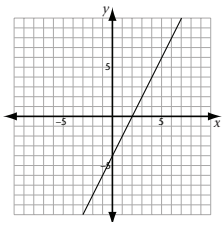


Part A

Use the graphing applet to create the specified graphs below for the slope-intercept equation, and then view the graph in both the point-slope form and the general form.

Complete the last two columns in the table for each graph by copying the appropriate equation from the applet. See if you can figure out how the equations in these two columns relate to the points on the corresponding graph.

My Notes

Equation	Slope-Intercept Form $y = mx + b$	Point-slope form $y - y_1 = m(x - x_1)$	General Form $Ax + By + C = 0$
$y = 2x + 3$ 	$m =$ $b =$	Write the equation in point-slope form.	Write the equation in general form.
$y = 2x - 3$ 	$m =$ $b =$		
$y = 2x + 4$ 	$m =$ $b =$		
$y = 2x - 4$ 	$m =$ $b =$		

Analysis

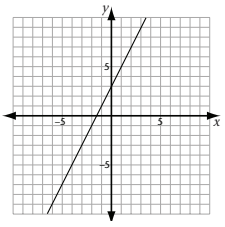
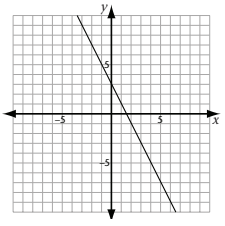
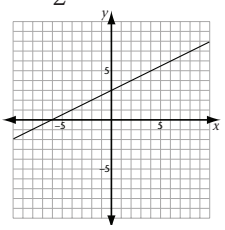
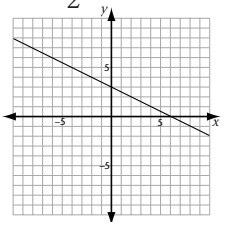
1. Examine the four graphs in the table above. What aspects of these graphs remains the same?

My Notes

2. What aspects of all four graphs above are different?

3. Why do three different equations give you the same line?

Part B

Equation	Slope-Intercept Form $y = mx + b$	Point-slope form $y_1 - y = m(x + x_1)$	General Form $Ax + By + C = 0$
$y = 2x + 3$ 	$m =$ $b =$	Write the equation in point-slope form.	Write the equation in general form.
$y = -2x + 3$ 	$m =$ $b =$		
$y = \frac{1}{2}x + 3$ 	$m =$ $b =$		
$y = -\frac{1}{2}x + 3$ 	$m =$ $b =$		

Analysis

My Notes

1. Examine the four graphs in the table above. What aspects of these graphs remains the same?

2. What aspects of all four graphs above are different?

3. Why does the general form have different numbers in it when compared with the slope-intercept and point-slope equation?

Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.

Foundations of Mathematics and Pre-calculus 10

Module 3, Section 3—Lesson E: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
What are the similarities and differences among linear relations graphed in slope-intercept, general, or point-slope form?			
How can you use technology to graph a linear relation given in slope-intercept, general, or point-slope form?			
How can you match a set of linear relations to their graphs?			

Section Assignment 3.3 Part 1
Slope

1. Which of the following tables of values represent linear relations? (2 marks)

a.

Time	Distance
2	40
5	100
6	120
9	180

b.

Time	Distance
3	9
4	16
5	25
6	36

2. Which set of ordered pairs represents a linear relation? Explain your answers. (4 marks; 2 marks each)

   a. {(1, –2), (8, –6), (9, 6), (–2, –1), (2, –2), (7, –6)}

   b. {(3, 7), (4, 9), (6, 13), (9, 19), (10, 21)}

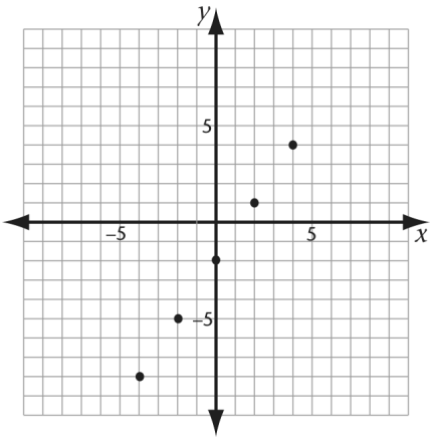
3. Do the following situations represent linear relations? Explain how you know. (4 marks; 2 marks each)

   a. The school sponsors a tennis tournament. When the tournament begins, there are 64 participants. During each round, half of the players are eliminated.

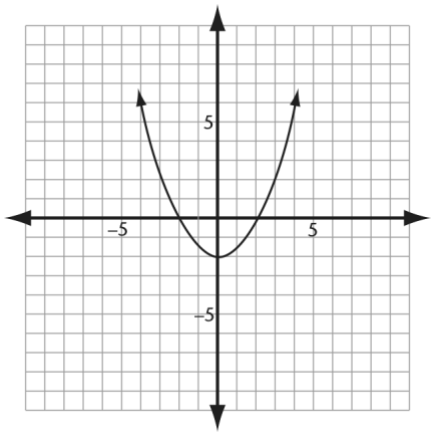
   b. A cell phone company charges a sign-up fee of $50 and then $0.08 for every minute used.

4. Which of the following graphs represent linear relations? (2 marks; 0.5 mark each)

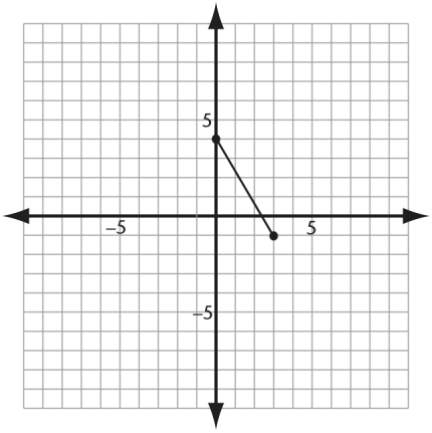
a.



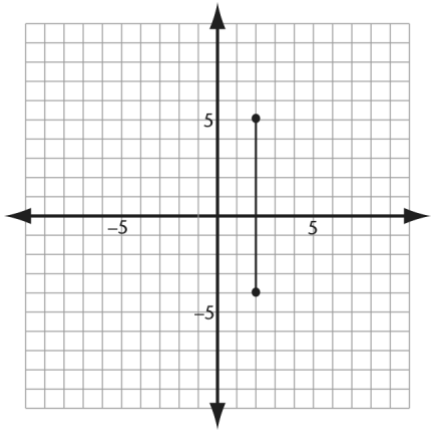
b.



c.



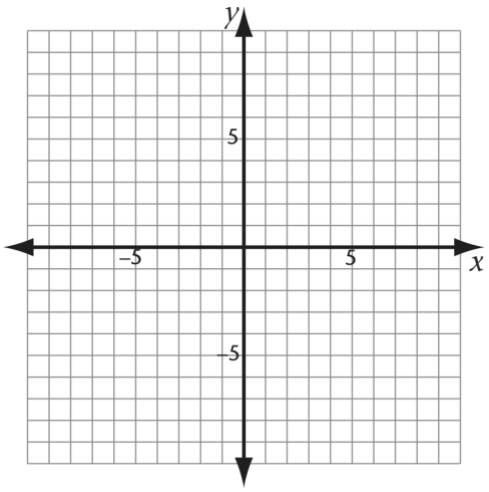
d.



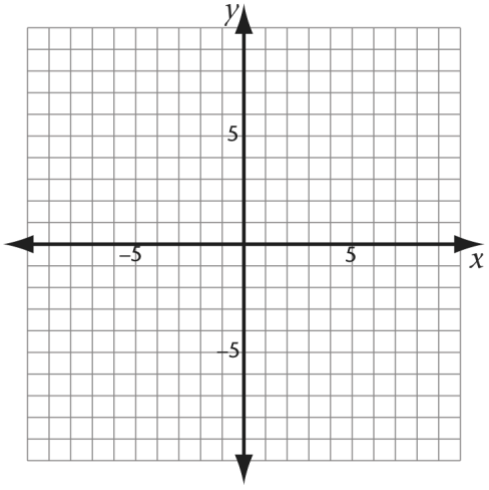
5. How can you tell if a graph represents a linear relation? (1 mark)

6. Create a table of values and graph each of the following relations. Which are linear relations? (6 marks; 2 marks each)

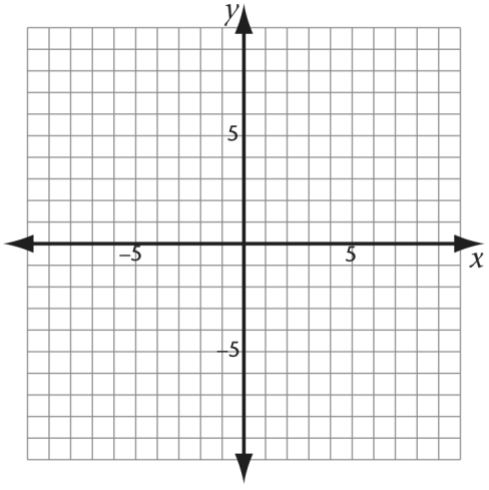
a. $y = 2x - 3$



b. $y = -x$

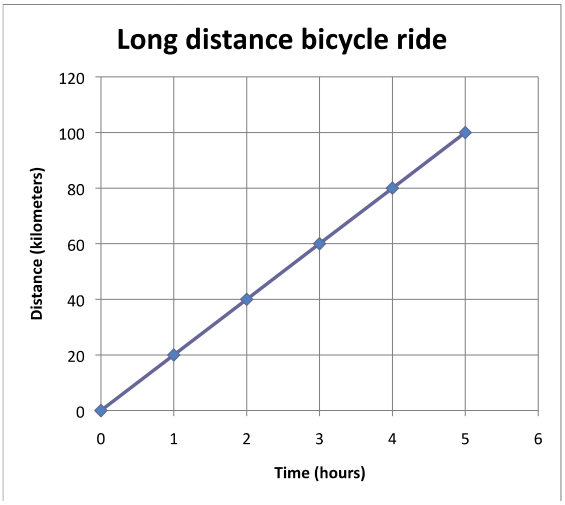


c. $y = -2x^2$



Section Assignment 3.3 Part 2
Properties of Linear Functions

1. This graph shows the distance traveled by a bicyclist on a long distance ride.

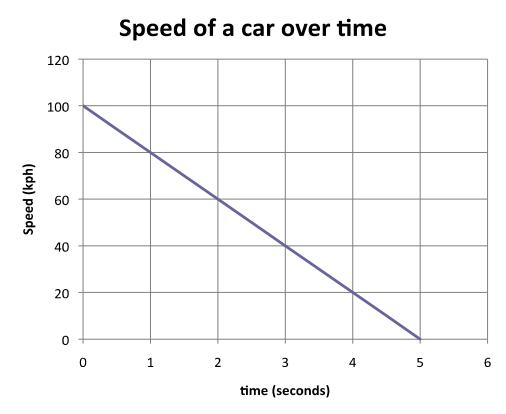


d. Determine the horizontal and vertical intercepts. Write the coordinates where the line crosses the *x*- and *y*-axis. (1 mark)

e. What is the rate of change? (1 mark)

What is the range and domain of this function? (2 marks)

2. This graph shows the speed of a car over time.



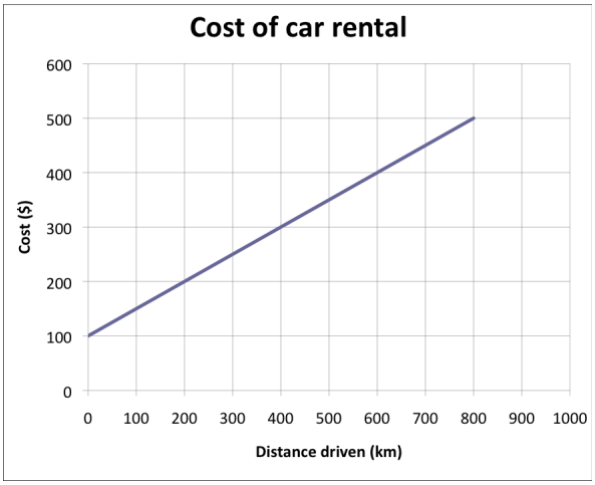
a. Determine the horizontal and vertical intercepts. Write the coordinates where the line crosses the *x*- and *y*-axis. (2 marks)

b. What is the rate of change? (1 mark)

c. What is the range and domain of this function? (2 marks)

d. Describe a situation that might result in this graph. (1 mark)

3. A car rental company charges a fixed fee of $100 per day plus an additional $0.50 for every kilometre driven. The graph shows this relation.



a. What is the vertical intercept? What does this represent? (2 marks)

b. What is the rate of change? What does this represent? (2 marks)

c. What is the domain and range of this function? (2 marks)

What would it cost if one drove 1000 km? (2 marks)

Section Assignment 3.3 Part 3
Slope-Intercept Form

1. For each equation, identify the slope and *y*-intercept. (3 marks)

   a. $y = 3x - 10$

   b. $y = 6$

   c. $y = -\frac{2}{3}x + 4$

2. Write the equation for the graph of a linear function that:

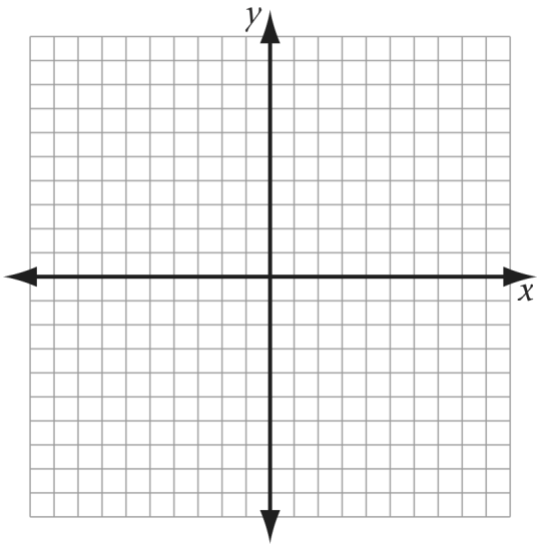
   a. has a slope of –2 and a *y*-intercept of 3. (1 mark)

   b. goes through (0, –3) and has a slope of 1. (1 mark)

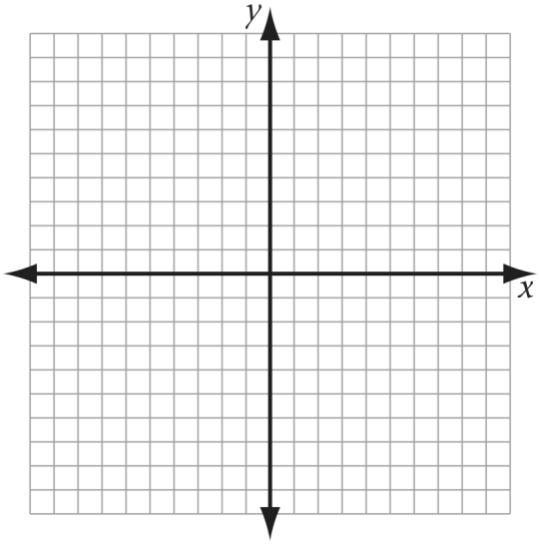
   c. has a slope of $\frac{3}{4}$ and passes through the origin. (1 mark)

3. Graph the lines described below. (4 marks; 2 marks each)

   a. The line has a slope of –2 and a *y*-intercept of 4.



   b. The line has a slope of and passes through the origin.



4. The graph below shows the time (t) it takes to pump (v) litres of water out of a barrel.

   a. Determine the slope and the vertical intercept. What do they represent? (2 marks)

   b. Write an equation to represent the situation. (1 mark)

   c. Use the equation to calculate the volume after 15 minutes. Verify on the graph. (2 marks)

   d. Suppose the barrel had to be emptied in 30 minutes. How would the graph change? Discuss the slope and the horizontal (or x-) intercept

Section Assignment 3.3 Part 4
General Form

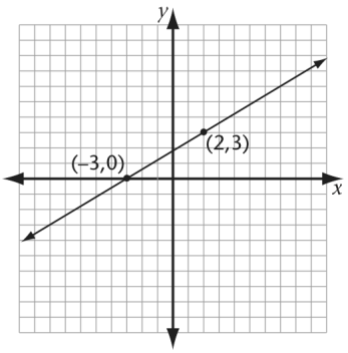
1. For each of the equations below, identify the slope of the line and the coordinates of a point on the line. (2 marks)

   a. $y - 4 = -2(x + 6)$

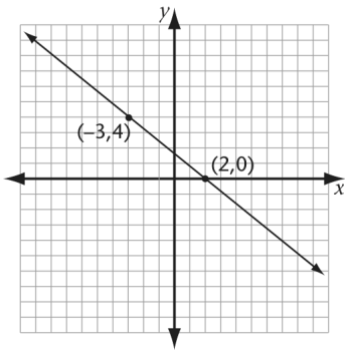
   b. $y = 4(x - 3)$

2. From each graph write an equation in point-slope form. (8 marks; 2 marks each)

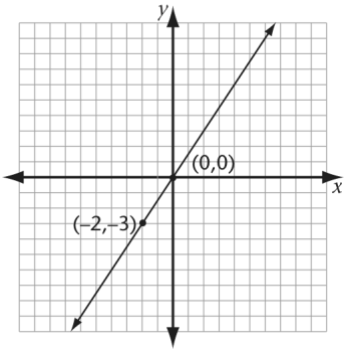
a.



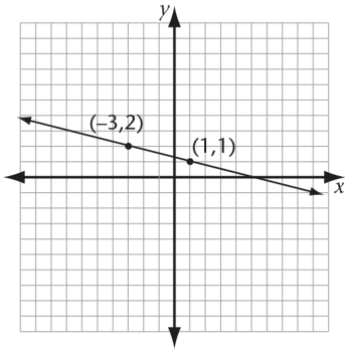
b.



c.



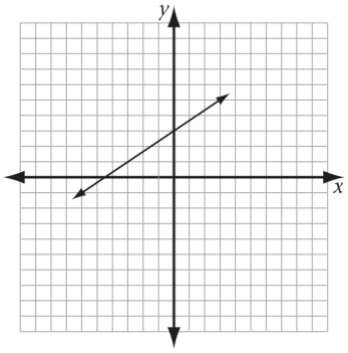
d.



3. Put the letter of the correct graph in the blank beside its equation. (4 marks)

Graph

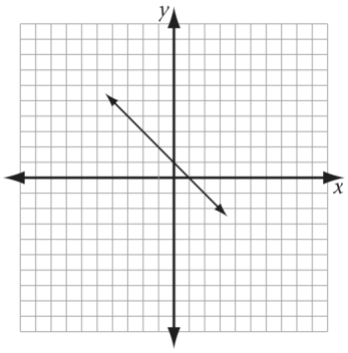
a.



i. $y-2=-1(x+1)$

_____

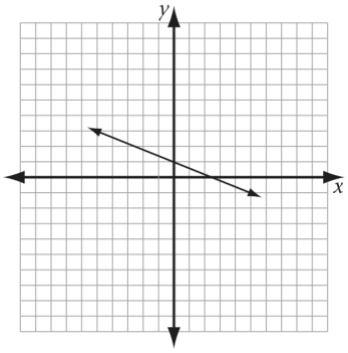
b.



ii. $y-2=x-3$

_____

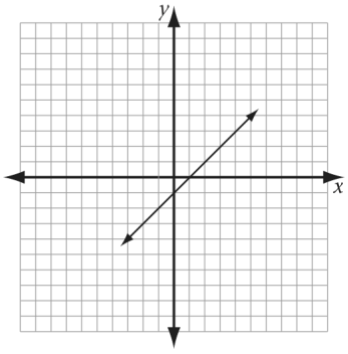
c.



iii. $y-5=\frac{2}{3}(x-3)$

_____

d.



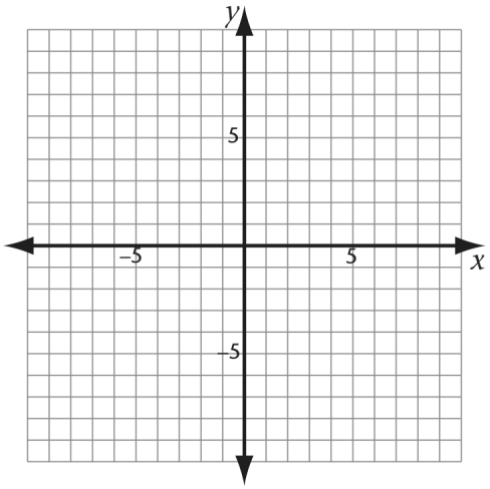
iv. $y+1=-\frac{2}{5}(x-5)$

_____

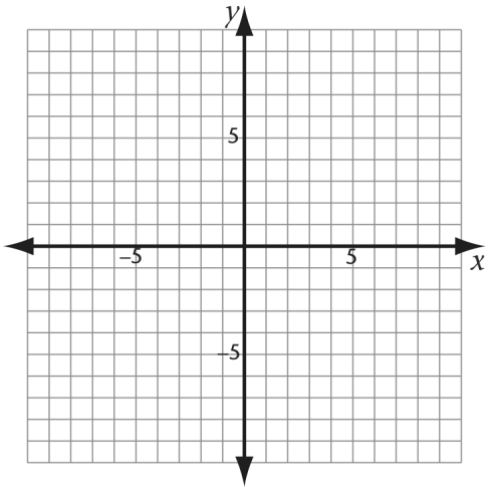
Section Assignment 3.3 Part 5
Graphing Linear Functions

1. Graph each equation. (6 marks)

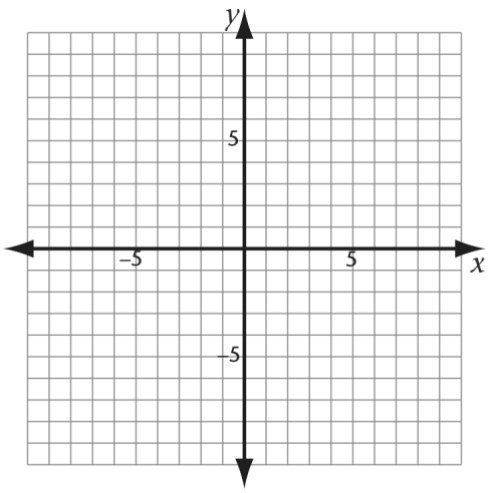
   a. $y = 4x - 2$



   b. $y = -\frac{1}{3}x + 3$



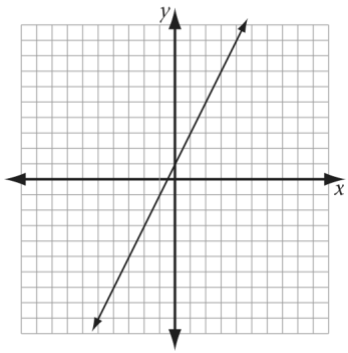
c. $y = -x + 2$



3. Put the letter of the correct graph in the blank beside its equation. (4 marks)

Graph

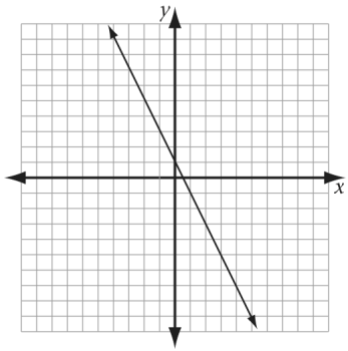
a.



i. $y = -2x + 1$

_____

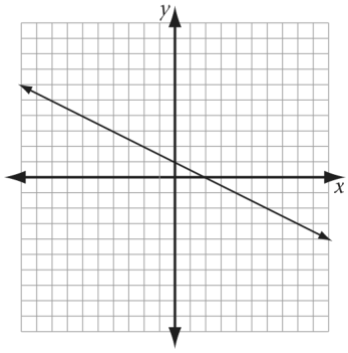
b.



ii. $y = -\frac{1}{2}x + 1$

_____

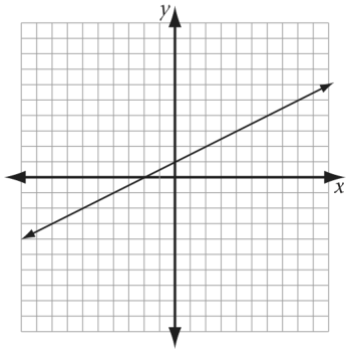
c.



iii. $y = \frac{1}{2}x + 1$

_____

d.

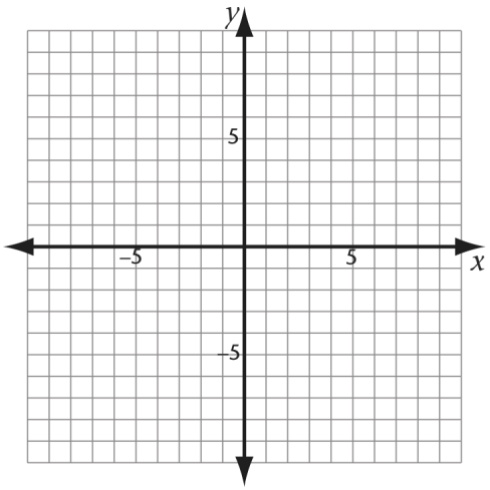


iv. $y = 2x + 1$

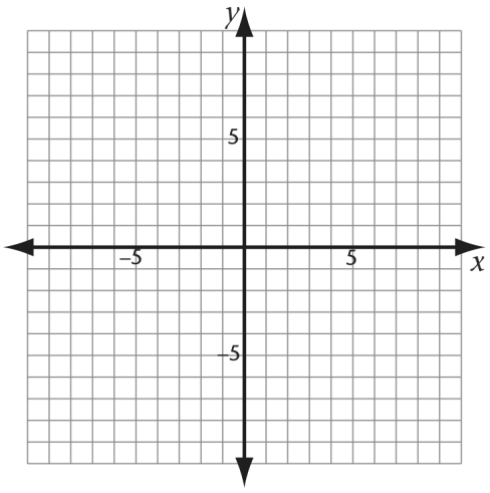
_____

3. Using a graphing calculator or graphing software on a computer, graph the following equations. Explain how you constructed the graph. (4 marks; 2 marks each)

a. $y - \frac{2}{5} = \frac{1}{2}(x + 2)$

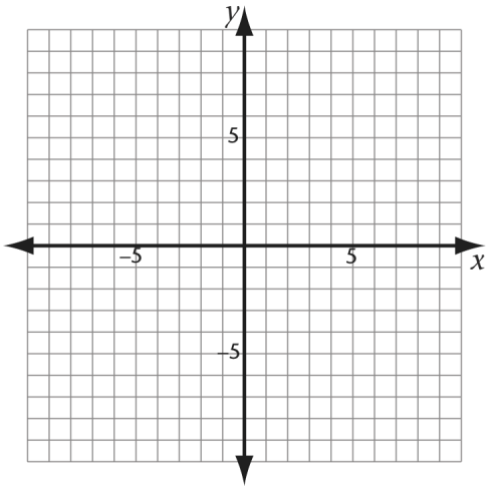


b. $y + \frac{3}{4} = \frac{2}{3}(x - 10)$

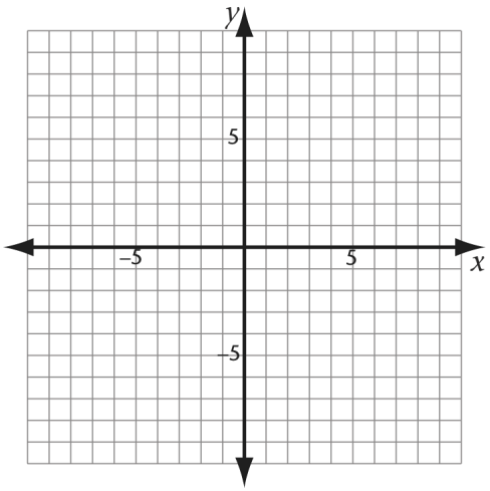


4. Graph the following equations. (4 marks; 2 marks each)

a. $2x + 3y - 9 = 0$



b. $x - 2y + 8 = 0$



5. Graphing Linear Functions: Summary of Strategies (8 marks)

   Complete the following chart. One cell of the table has been filled in as an example.

   The various forms of a linear relation have been written in the first column.

   In the second column, describe how to obtain a point or a slope from the linear form. Include notes about the manipulation of equations or the proper extraction of points.

   In the third column, describe the procedure to follow when graphing.

   Finally, record specific points to remember when using the strategy. Also, indicate any special cases where the normal procedure requires modification.

Linear Form	Information to Obtain from Linear Form	Steps to Follow When Graphing	Tips and Special Cases
$y = mx + b$	***m*** **is the slope** ***b*** **is the *y*-intercept**		
$y - y_1 = m(x - x_1)$			
$Ax + By + C = 0$			

Section Assignment 3.3 Part 6
Multiple Choice

20 marks: 2 marks each

No calculator may be used for this part of the section assignment.

1. Krista explained her method for graphing the linear relation $y = -\frac{3}{2}x - 1$.

Steps	
a.	Place a dot on the *y*-axis at negative 1.
b.	Move down three on the *y*-axis to negative 4.
c.	From the negative 4, move to the left two spots and place a dot there.
d.	Draw a line through the two dots.

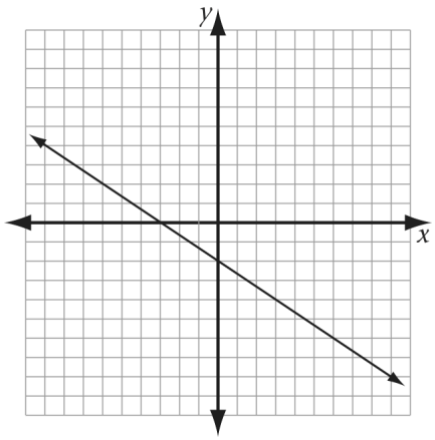
Where did Krista make the first mistake in her explanation?

a. Step I
b. Step II
c. Step III
d. There is no mistake.

2. Given the equation $Ax + By + C = 0$, which of the following conditions must be true for the graph of the line to have a positive slope and a negative *y*-intercept?

a. $A < 0, B < 0, C > 0$
b. $A < 0, B < 0, C < 0$
c. $A > 0, B < 0, C > 0$
d. $A > 0, B < 0, C < 0$

Use the following graph to answer question 3.



3. Which of the following equations describes the linear relation graphed above?

I.	$y - 2 = -\frac{2}{3}(x + 6)$
II.	$y = -\frac{2}{3}x - 2$
III.	$2x + 3y - 6 = 0$

a. II only

b. I and II only

c. I and III only

d. II and III only

4. Determine the slope of the linear relation $2x + 5y - 10 = 0$.

a. $\frac{5}{2}$

b. $\frac{2}{5}$

c. $-\frac{2}{5}$

d. $-\frac{5}{2}$

5. Determine the equation of a line, in slope-intercept form, that passes through the points (4, –2) and (0, –5).

a. $y = \frac{4}{3}x + 5$

b. $y = \frac{3}{4}x + 5$

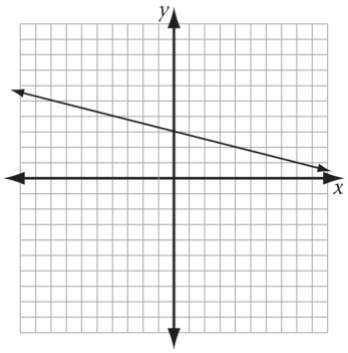
c. $y = \frac{4}{3}x - 5$

d. $y = \frac{3}{4}x - 5$

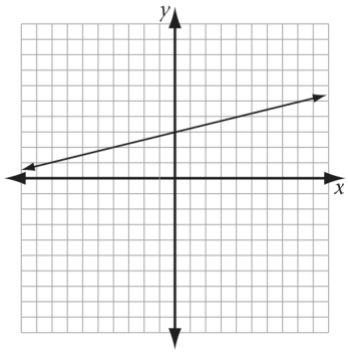
You may use your calculator for the last five questions. (2 marks each)

6. Which graph represents the relation $x + 4y - 12 = 0$?

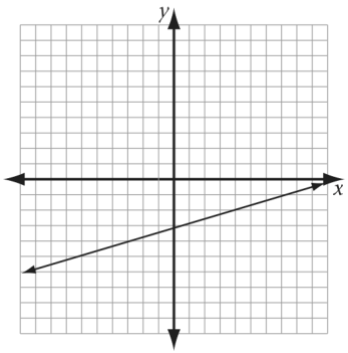
1.



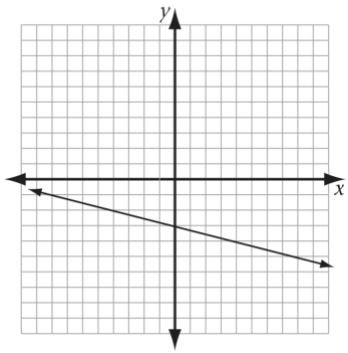
2.



3.



4.



7. Which of the following coordinates are intercepts of the linear relation $3x + 5y - 15 = 0$?

I.	(0, –)
II.	(0, 3)
III.	(5, 0)
IV.	(3, 0)

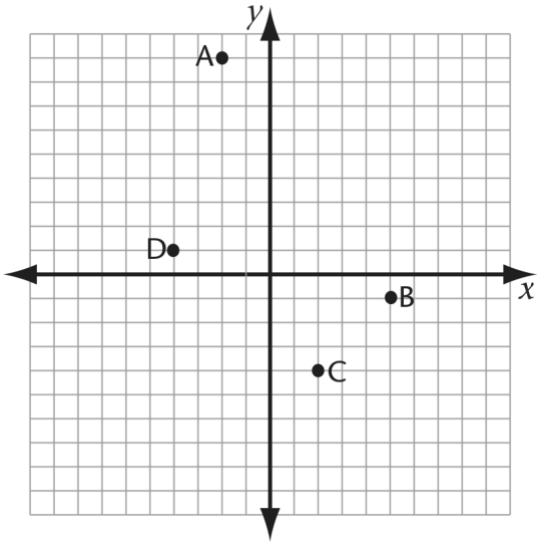
a. I only

b. I and IV only

c. II and III only

d. II and IV only

8.



The line $y + 3 = -2(x - 4)$ passes through which point on the graph?

a. A

b. B

c. C

d. D

9. Rewrite $y = \frac{x}{3} + 7$ in general form.

   a. $3x - 3y + 21 = 0$
   b. $x - 3y + 21 = 0$
   c. $\frac{x}{3} - y + 7 = 0$
   d. $x + 3y - 21 = 0$

10. Which of the following lines have a positive slope?

I.	$4x - y = 3 = 0$
II.	$y + 1 = -\frac{2}{3}x$
III.	$y = x$

   a. II only
   b. III only
   c. I and III only
   d. II and III only

Title	Marks
Part 1: Linear Relations	/19
Part 2: Properties of Linear Functions	/18
Part 3: Slope-Intercept Form	/17
Part 4: General Form	/14
Part 5: Graphing Linear Functions	/26
Part 6: Multiple Choice	/20
Total Marks	/114

Discover

My Notes

Activity 2
Math Lab: Analyzing General Form

Part A

1. Rearrange each of the following equations into slope-intercept form. Do not reduce fractions. For instance, do not reduce $\frac{6}{2}$ to 3. Instead, leave the expression as $\frac{6}{2}$.

General Form	Slope-Intercept Form	Slope	y-Intercept
$2x + 3y + 6 = 0$			
$3x + 4y - 12 = 0$			
$9x - 3y + 12 = 0$			
$5x - 2y - 10 = 0$			

Analysis

2. Which coefficients in general form are used to determine the slope of the linear function?

3. Which coefficients in general form are used to determine the y-intercept of the linear function?

My Notes

4. What would be the slope and the y-intercept of the linear function represented by the equation $Ax + By + C = 0$?

Part B

1. Consider the equation $2x + 3y - 6 = 0$.

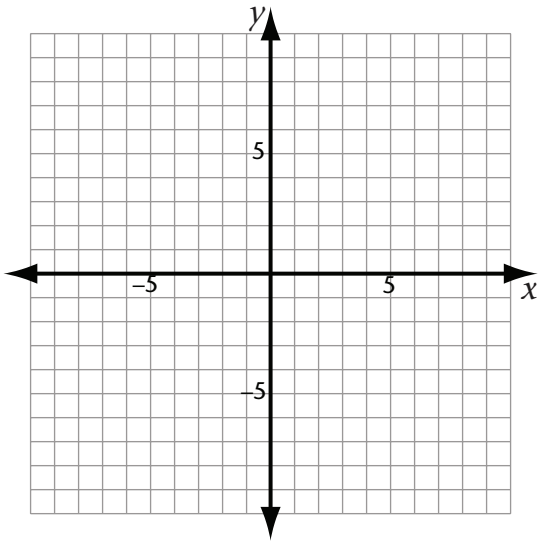
   a. How could you find the y-intercept of the line represented by this equation without graphing?

   b. How could you find the x-intercept of the line represented by this equation without graphing?

   c. Determine the x-intercept and the y-intercept of this graph.

My Notes

d. Use your result from the previous question to graph the equation $2x + 3y - 6 = 0$.



Turn to Solutions at the end of the module and mark your work. Contact your teacher if you have any questions.