Foundations of Mathematics and Pre-calculus 10

Module 4 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 .

The FMP 10 course consists of four modules, the blackline master CD, the Foundations of Mathematics and Pre-calculus 10 Website and the Foundations of Mathematics and Pre-calculus 10 Media CD. Foundations of Mathematics and Pre-calculus 10 is available in both print and online versions. Components can be purchased individually or as a complete resource, the Foundations of Mathematics and Pre-calculus 10 Resource Package. All are available from Open School BC.

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Module 4, Section 1—Lesson A: Essential Questions

Essential Questions	**Before the Lesson: What I Know**	**After the Lesson: What I Learned**	**Examples**
How can you change a function written in standard notation to a function written in function notation?			
If $f(x) = 2x + 3$, how do you figure out $f(-1)$?			
If $f(x) = 2x + 3$, how do you figure out which value of x gives $f(x) = 15$?			
What is meant by the word ‘notation’ and why is special notation used in mathematics?			

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Module 4, Section 1—Lesson B: Essential Questions

Essential Questions	**Before the Lesson: What I Know**	**After the Lesson: What I Learned**	**Examples**
If you know the slope of a line and the coordinates of one point on the line, how do you write the equation of the line?			
If you know the coordinates of two points on a line, how do you write the equation of the line?			

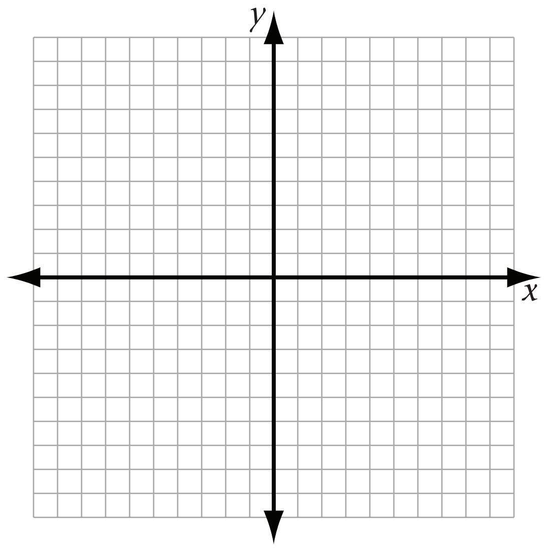
My Notes

Activity 2
Math Lab: Properties of a Line

1. A line passes through the points (–10, 10) and (5, –8). How do you determine the line's properties as listed in the table below? Come up with ways of doing so without graphing the line, as well as by graphing only. You can use the graph on the following page to plot the line.

Property	**Without Using a Graph**	**Using a Graph Only**
slope		
y-intercept		
x-intercept		
equation in slope-intercept form		
domain		
range		

My Notes



Respond to the following questions based on the completed table.

2. Which properties are more easily determined using a graphical approach?

3. Under what conditions would it be more difficult to use a graphical approach to determine the properties of a line?

4. What are the benefits of using an algebraic approach (without using a graph) to determine the properties of a line?

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 4, Section 1—Lesson C: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can you determine the relative orientation of a pair of lines by examining their slopes?			
How do you write the equation of a line that is parallel to a given line and passes through a given point?			
How do you write the equation of a line that is perpendicular to a given line and passes through a given point?			

Activity 2

Math Lab: Parallel and Perpendicular Lines

My Notes

Materials

You will need to the following to complete this math lab.

- graph paper (from Appendix)
- ruler or straightedge
- index card or heavy-weight paper

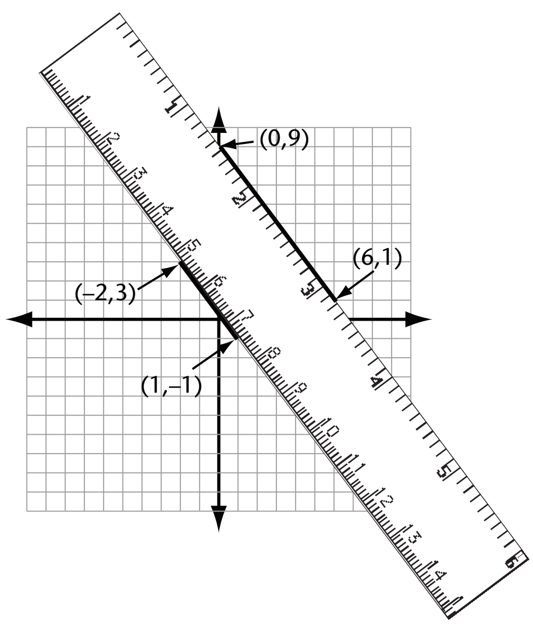
Purpose

You will analyze the slopes of parallel and perpendicular lines.

Part 1: Parallel Lines

Procedure

Step 1: Place the ruler diagonally across a piece of graph paper so that one edge passes through at least two points with integer coordinates on the graph paper. See the following image as an example.



Step 2: Trace a line onto the graph paper along each edge of the ruler as shown in the image.

My Notes

Step 3: Remove the ruler. Calculate the slope of each line. You may use the $\frac{\text{rise}}{\text{run}}$ method or the slope formula. In either case, check that the sign of each is correct.

Analysis

1. What do you notice about the slopes of the two lines?

2. Using the evidence you have collected, justify how you know that the two lines that you drew are parallel.

3. Repeat the experiment, but place the ruler in a different orientation across the grid. Compare the slopes of the lines. Do you get similar results as the first time? **Note**: You may want to repeat the experiment a third time in order to discover a pattern or to confirm the pattern that you have observed in the first two trials.

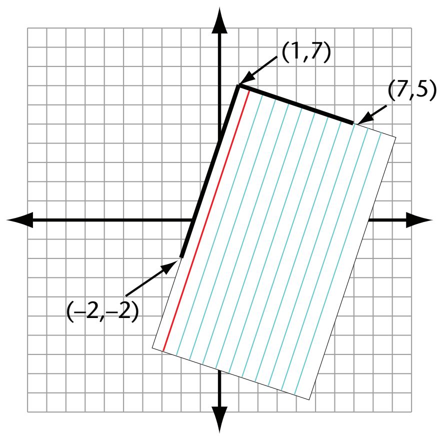
4. What can you conclude about the slopes of parallel lines?

Part 2: Perpendicular Lines

My Notes

Procedure

Step 1: Place one corner of the index card (or heavyweight paper) at a point with integer coordinates on a piece of graph paper.



Step 2: While holding the corner in position, rotate the card such that the edges of the card, which meet at the corner, pass through integer coordinates. See the image as an example.

Step 3: Trace a line onto the graph paper along *each* edge of the index card that arises from the corner as shown in the image.

Step 4: Remove the index card. Calculate the slope of each line. You may use the $\frac{\text{rise}}{\text{run}}$ method or the slope formula. In either case, check that the sign of each slope is correct.

Analysis

1. How do you know that the two lines that you drew are perpendicular?

My Notes

2. What do you notice about the slopes of the two lines?

3. Repeat the experiment but place the index card in a different orientation across the grid. Compare the slopes of the two lines. How are the results similar to the initial results? **Note**: You may want to repeat the experiment a third time in order to discover a pattern or to confirm the pattern you observed in the first two trials.

4. What can you conclude about the slopes of perpendicular lines?

Note: You will revisit your answers to these Analysis questions later in the lesson.

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 4, Section 1—Lesson D: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How are the fixed and variable elements of a problem related to the linear equation $y = mx + b$?			
What's the difference between an independent variable and a dependent variable?			
When you are reading a word problem, what clues can help you tell the difference between fixed values and variable values?			

My Notes

Activity 2
Math Lab: Counting Beats

Materials
You will need to the following to complete this math lab.

- CD or MP3 player
- music CD or MP3 song
- stopwatch or timepiece

Purpose
You will analyze the slopes of parallel and perpendicular lines.

Procedure
Part 1: Data Collection

Step 1: Choose a song to which you can count the beats. All songs have a beat, but you may find examples that are easier to count in the hip hop and funk genres, as well as in electronica and pop music. If you have ever nodded your head or tapped your foot to music, then consider each nod or tap as a beat.

Step 2: Play your selected song. Count the number beats (e.g., nods or taps) that you hear in the song for a period of 10 seconds. Record this number in the following table. **Note**: You may have to allow the music to play through the introduction before a regular beat pattern is established.

Time (seconds)	Number of Beats
10	
15	
20	
30	
60	

Step 3: Now count the number of beats for 15 seconds. Record this number in the table show with step 2. In order to do this, you may want to start the track again, or else start counting from wherever the music is playing.

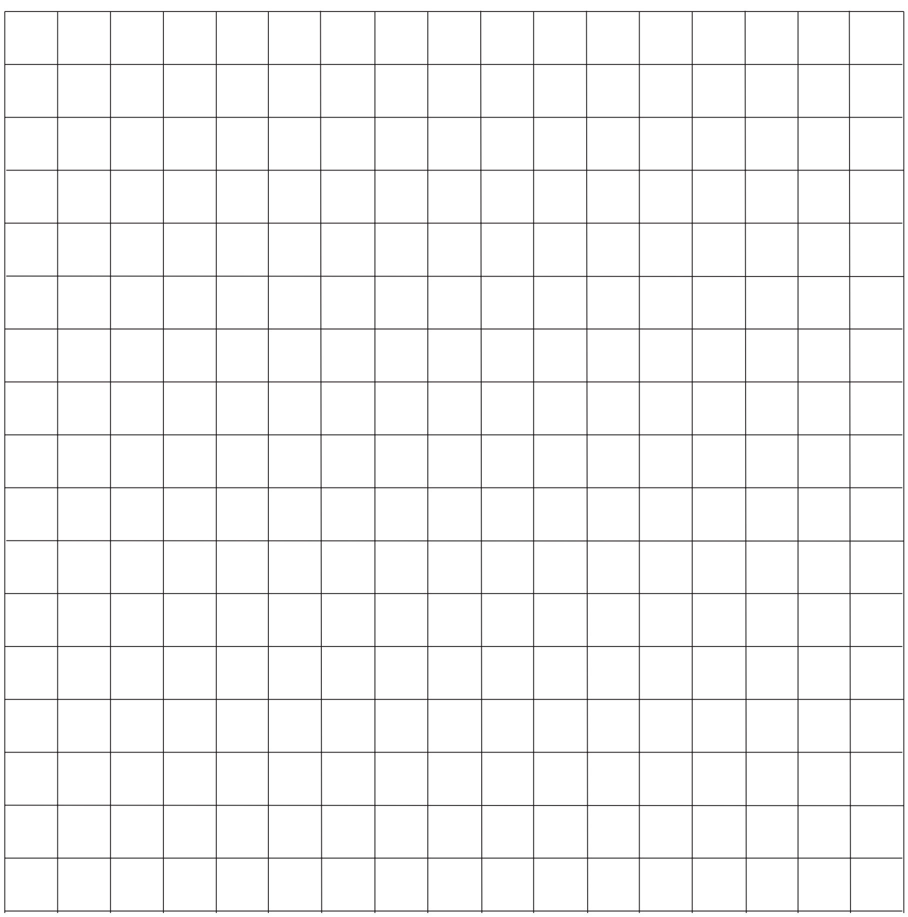
Step 4: Continue to count and record beats 20, 30, and 60 seconds. Record your findings to the table shown with step 2.

Part 2: Graph Data

Step 5: On the graph paper provided blow, plot the data you collected.

- Be sure to place the independent and dependent variables on the appropriate axes.
- Extend your time axis to 120 seconds. Extend your "Number of Beats" axis to an appropriate number.

Step 6: Draw a line of best fit through the points.



My Notes

My Notes

Analysis

1. What is the BPM (beats per minute) of your selected song?

2. a. What is the slope of the line?

   b. What does the slope represent?

   c. How does this compare with the BPM?

3. a. What is the y-intercept of the line?

   b. What does the y-intercept represent?

   c. Would this y-intercept change with a different song? Why or why not?

My Notes

4. What is the equation of the line expressed in function notation?

Collect data for a second song. You can graph your data on the same grid that you used for the first song.

5. Compare the BPM of your of your two songs. Which song has more beats per minute?

6. a. Is your first graph steeper or less steep than your second?

   b. What does the slope of the line imply about the tempo of the song?

   c. If you had a device that could be used to adjust the tempo of any song, how would you make the tempos of the two songs equal?

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

Section Assignment 4.1 Part 1
Function Notation

1. For the function $f(x) = -2x + 5$, determine the outputs for the following inputs. (2 marks)
   a. $f(4)$

   b. $f(-3)$

2. The function converts temperature in Celsius (c) to Fahrenheit. (11 marks)
   a. Calculate
      i. $f(30)$

      ii. $f(-10)$

b. Find the value of c when

   i. $f(c) = 0$

   ii. $f(c) = -20$

c. Write an equation in function notation to display the information in the following facts.

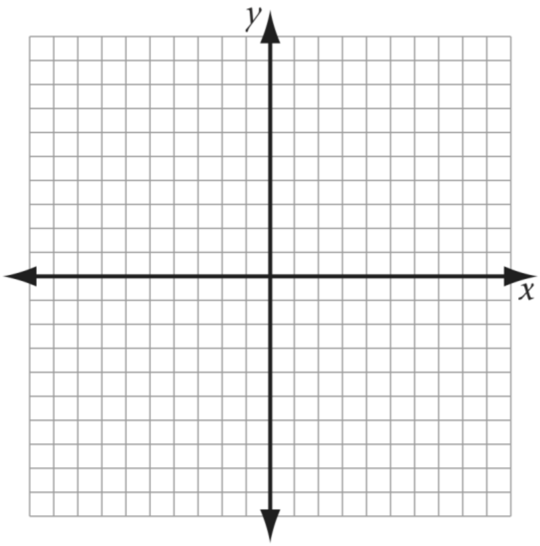
   i. The Fahrenheit and Celsius scales are equal at –40 degrees.

   ii. Water boils at 212 degrees Fahrenheit and 100 degrees Celsius.

   iii. The melting point of aluminum is approximately 2000 degrees Celsius and 3632 Fahrenheit.

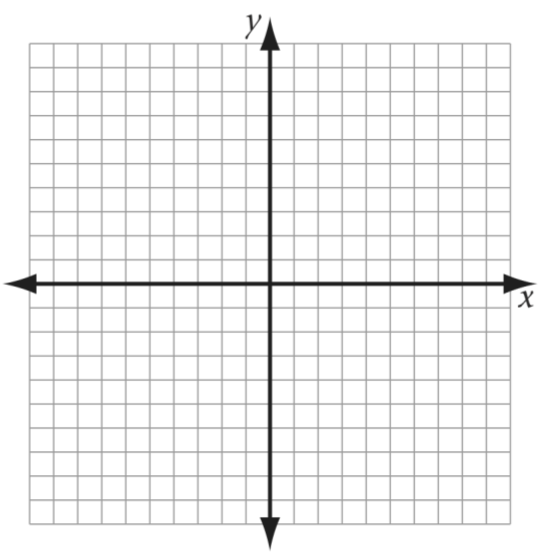
3. Sketch a graph of this linear function. (4 marks)

$f(x) = 3x - 2$



4. Sketch a graph of this linear function for all positive values of the independent variable. (4 marks)

$f(x) = 6 - 2x$

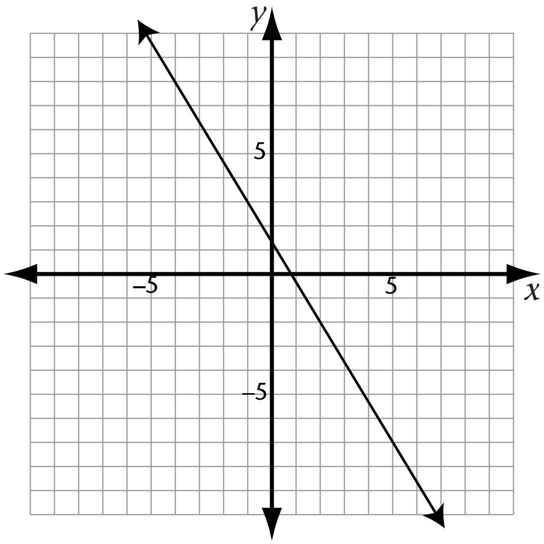


Section Assignment 4.1 Part 2
The Equation of a Line

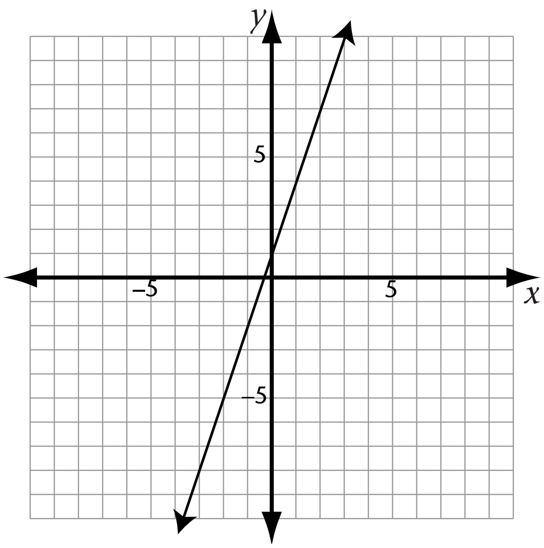
1. Write an equation for the graph of a linear function described below. Write the equation in point-slope form; then convert to slope-intercept and general form. (8 marks; 4 marks each)
   a. The line has a slope of 4 and passes through W(–2, 3).

   b. The line has a slope of –2 and passes through W(5, –1).

2. Write the equation for each graph in general form. Describe your strategy.
(6 marks; 3 marks each)



b.



3. Write the equation for a line that passes through each pair of points. Write your equation in general form. Verify your equation using the other point. (8 marks; 4 marks each)

   a. A(3, 5) and B(–1, 3)

   b. D(0, –3) and E(5, 7)

Section Assignment 4.1 Part 3
Parallel and Perpendicular Lines

1. The slope of a line is $-\frac{3}{4}$.

   a. What is the slope of a line parallel to this line? (1 mark)

   b. What is the slope of a line perpendicular to this line? (1 mark)

2. The slope of a line is 5.

   a. What is the slope of a line parallel to this line? (1 mark)

   b. What is the slope of a line perpendicular to this line? (1 mark)

3. The endpoints of segment XY are X(2, 5), Y(0, –1). The endpoints of segment AB are A(–3, 4), B(3, 2). Are XY and AB parallel, perpendicular, or neither? Explain your answer. (5 marks)

4. Write the equation of the line in general form that passes through X(5, 8) and has the following properties. (6 marks; 3 marks each)

   a. parallel to the line $y = \frac{2}{3}x - 3$

   b. perpendicular to the line $y = \frac{2}{3}x - 3$

5. Two perpendicular lines intersect on the *x*-axis. One line has the equation $y - 5 = 3(x + 2)$. What is the equation of the second line? Write your answer in general form. (3 marks)

6. Two perpendicular lines intersect at (–2,5). One equation has the equation $y-5=\frac{1}{4}(x+2)$. What is the equation of the second line? Write your answer in general form. (3 marks)

Section Assignment 4.1 Part 4
Applications of Linear Equations

1. Kevin opened a bank account and plans to deposit $200 each month. Each time he makes a deposit, his parents have agreed to add 50% of the amount the family collects for returning cans and bottles. (6 marks; 2 marks each)

    a. Write an equation that will show his monthly amount (A) when the family collects b dollars of bottle returns.

    b. What is the amount when the family collects $27 in bottle returns?

    c. If the amount is $223, how much did they collect in bottle returns?

2. A cell phone company offers a cell phone plan when you pay a flat fee of $20. Each minute that you use, you pay $0.02. (6 marks; 2 marks each)

    a. Write an equation that will show the total cost (C) when you talk m minutes.

    b. If you talk for 1550 minutes, what will be the cost?

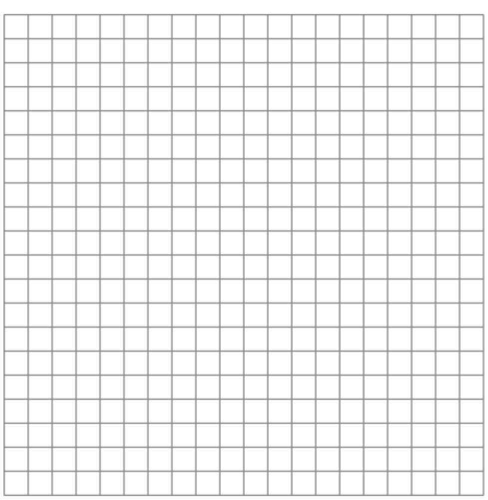
c. If your bill was $45, how long did you talk?

3. Erin saves coins in a jar. She only collects dimes and quarters. She finds that she has $5.00. (10 marks; 2 marks each)

   a. Complete the table to show the possible numbers of dimes and quarters.

Dimes	Quarters
0	20
5	
10	
15	
20	
25	
30	
35	
40	
45	
50	

   b. Graph the data.



c. Should you join the points?

d. Write an equation to demonstrate this situation.

e. Can she have 12 dimes? Use the graph and the equation to justify your answer.

f. Can she have 12 quarters? Use the graph and the equation to justify your answer.

Section Assignment 4.1 Part 5
Glossary

Write a short definition from your personal glossary for each term below. (7 marks; 1 mark each)

- function notation
- linear equation
- negative reciprocal
- parallel lines
- perpendicular lines
- fixed term
- variable term

Section Assignment 4.1 Part 6
Multiple Choice

20 marks: 2 marks each

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

1. Determine the equation of a line, in slope-intercept form, that passes through the points (–8, 3) and (6, –4).

   a. $y = -\frac{1}{2}x - 4$

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

   c. $y = 2x + 3$

   d. $y = -4x + 3$

2. The cost C, in dollars, of hiring a caterer to provide food for a birthday party is given by the formula $C(n) = 250 + 22n$, where n is the number of guests at the party. Calculate the cost of the caterer if there are 50 guests at the party.

   a. $11 004

   b. $3300

   c. $272

   d. $1350

3. Determine the equation of a line in general form that has a slope of 2 and an x-intercept of 5.

   a. $y = 2x - 10$

   b. $2x - y - 10 = 0$

   c. $2x - y + 5 = 0$

   d. $y = 2x + 5$

4. What is $5x + 4y - 8 = 0$ expressed in function notation?

   a. $5x + 4f(x) - 8 = 0$

   b. $y = \frac{-5}{4}x + 2$

   c. $f(x) = \frac{-5}{4}x + 2$

   d. $4f(x) = -5x + 8$

5. The fixed cost for renting a hall for the prom is $500, and it will cost an additional $400 for 100 students to attend. Which equation best represents the total cost © of renting the hall as a function of the number of students attending, (*n*)?

   a. $C(n) = 400 + 4n$

   b. $C(n) = 500 + 100n$

   c. $C(n) = 400 + 100n$

   d. $C(n) = 500 + 4n$

You may use your calculator for the last five questions.

6. Determine the slope-intercept equation of the line that is parallel to $y = \frac{3}{4}x - 3$ and passes through the point $(-4, -1)$.

   a. $y = -\frac{4}{3}x - 1$

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

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

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

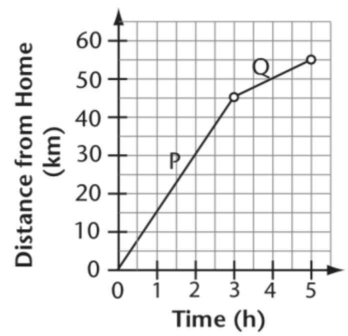
7. The cost to insure the band's instruments against loss or damage is a fixed amount plus a percentage of the value of the instruments. It costs \$237.50 to insure \$1000 worth of instruments. It costs \$850 to insure \$4500 worth of instruments. What is the fixed amount to insure the instruments?

   a. \$62.50
   b. \$100
   c. \$612.50
   d. \$237.50

8. Lines A and B are perpendicular and have the same *x*-intercept. The equation of line A is $2x - 3y - 8 = 0$. Determine the *y*-intercept of line B.

   a. –8
   b. –2
   c. 6
   d. 4

9. The graph below models a bicycle's distance from home over time.



   Calculate the change in the speed of the bike from segment P to segment Q.

   a. decreased by 5 km/h
   b. decreased by 10 km/h
   c. increased by 35 km/h
   d. increased by 10 km/h

10. Which ordered pair represents $f(2) = -7$?

a. $(-7, 2)$
b. $(-2, 7)$
c. $(2, -7)$
d. $(7, -2)$

Title	Marks
Part 1: Function Notation	/21
Part 2: The Equation of a Line	/22
Part 3: Parallel and Perpendicular Lines	/21
Part 4: Applications of Linear Equations	/22
Part 5: Glossary	/7
Part 6: Multiple Choice	/20
Total Marks	/113

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Module 4, Section 2—Lesson A: Essential Questions

Essential Questions	**Before the Lesson: What I Know**	**After the Lesson: What I Learned**	**Examples**
When solving linear systems, how do you decide what parts of a problem should be represented by variables?			
When solving linear systems, how do you find the information that you need to write the equations?			

Activity 2
Math Lab: Pennies and Paper Clips

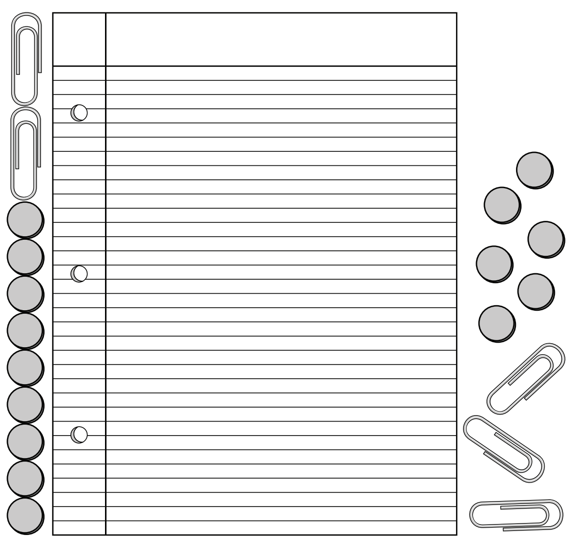
My Notes

Materials

- sheet of paper with dimensions 8.5 inches × 11 inches
- handful of identical paper clips
- handful of pennies

Procedure

Step 1: Place a combination of paper clips and pennies along the longer edge of the sheet of paper. Line them up so that the total length of paper clips and pennies is equal to the length of the paper. Your combination may be different from the one shown.



Step 2: Place a combination of paper clips and pennies along the shorter edge of the sheet of paper. Line them up so that the total length of paper clips and pennies is equal to the width of the paper.

Step 3: Write an equation in terms of paper clips, *C*, and pennies, *P*, to express the length of the sheet. (Remember that your expression should be equal to 11, since the length of the sheet is 11 in.)

My Notes

Step 4: Write a second equation in terms of *C* and *P* to express the width of the sheet. (What should this expression be equal to?)

Step 5: Use graph paper or the graph paper template to graph the system of equations you wrote. Label the solution. What does the solution represent?

Step 6: Repeat the experiment but with a different combination of paper clips and pennies along the edges of the paper. Write and graph the system of equations and note the solution.

Analysis

1. a. What is the significance of the solution? What does it mean?

   b. How do the solutions from the two trials compare?

   c. Should the solutions be identical or can they be different? Why?

2. How can you verify the accuracy of the solution?

3. What is the connection between the number of pennies and paper clips used in the experiment and the equations used in the linear system?

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 4, Section 2—Lesson B: Essential Questions

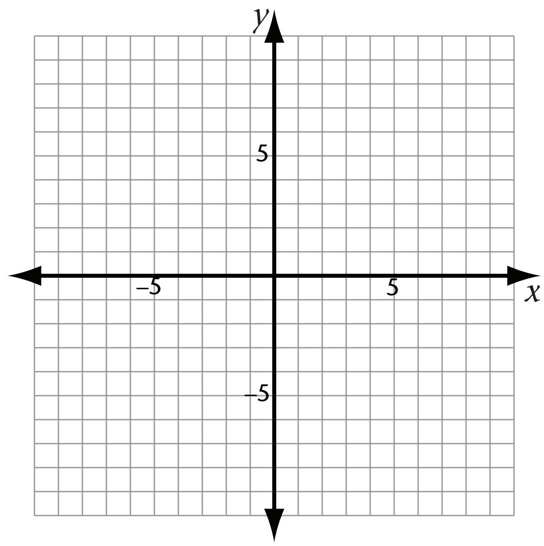
Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
What is meant by the solution of a system of equations?			
How is solving a mathematical problem different from verifying a solution to the problem?			
When you solve a system of equations by graphing, which point on the graph represents the solution?			

My Notes

Activity 2
Math Lab: Finding a Solution

In the last lesson, you learned to create a system of equations from a problem. Now we're going to learn one method of finding the solution to the systems of equations that you create.

1. Graph the equation $x + y = 5$.



2. Graph the equation $x + 3y = 9$ on the grid above.

3. Identify the point where the two lines intersect.

4. Use algebra to confirm that the coordinates of the point of intersection satisfy both equations.

My Notes

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 4, Section 2—Lesson C: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
When solving a linear system by substitution, how do you decide which variable to isolate?			
How do you know when the substitution method is ideally suited to solving a linear system?			

My Notes

Activity 2

Math Lab: Pan Balance

Study Figure 1 and Figure 2. Each square has a mass that is the same as the other squares. Similarly, each circle has the same mass as the other circles.

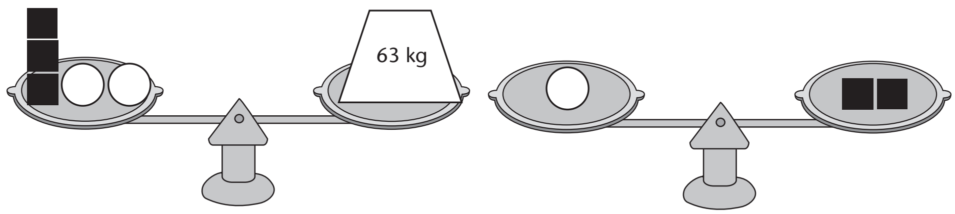

Figure 1

Figure 2

1. Use the information from Figure 2 to draw a diagram that is equivalent to Figure 1. Your new diagram should not have any circles.

2. Based on your diagram as well as the two figures, describe how you would determine the mass of the following:

   a. square

   b. circle

3. State the mass of a square as well as the mass of a circle.

My Notes

4. Re-examine the figures. If the mass of each square is equal to x, and the mass of each circle is equal to y, then write the algebraic statement that is represented by each figure.

5. Describe how you could use the two equations in a similar manner as in step 2 to solve for the values of x and y.

6. State the mass of a square, as well as the mass of a circle.

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 4, Section 2—Lesson D: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
In using the elimination method, how do you know whether equations need to be multiplied, added, or subtracted?			
How does adding or subtracting the equations of a linear system affect the solution to the system?			

My Notes

Activity 2

Math Lab: Properties of Linear Systems

Purpose

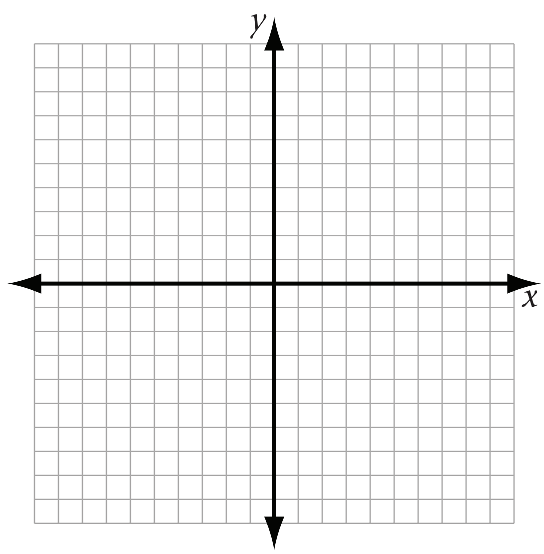
In this Math lab you will determine the effect of adding, subtracting, and multiplying linear equations on the solution to a linear system consisting of those equations.

Analysis

Consider the following linear system.

$$\begin{aligned} 2x + 3y &= 18 \\ 4x - y &= 8 \end{aligned}$$

1. Solve the system by graphing. Label the point of intersection.



My Notes

2. We can form a new equation by adding the two equations.

   Combine the x-terms, $2x$ and $4x$, to make $6x$.

   Combine the y-terms, $3y$ and $-y$, to make $2y$.

   Finally, combine the constant terms to make 26.

$$\begin{array}{r} 2x+3y=18 \\ \underline{4x\ -\ y=\ \ 8} \\ 6x+2y=26 \end{array}$$

   Graph the new equation on the same set of axes as the original system. What do you notice?

3. We could also form a new equation by subtracting the two equations.

$$\begin{array}{r} 2x+3y=18 \\ \underline{4x-y\ =\ \ 8} \\ -24x+4y=10 \end{array}$$

   Graph the new equation on the same set of axes as the other equations. What do you notice?

4. New equations (that mean the same thing!) can also be formed by multiplying. We'll form a new equation by multiplying the first equation by a factor of 2.

$$\begin{aligned} 2x+3y&=18 \\ 2(2x+3y)&=2(18) \\ 4x+6y&=36 \end{aligned}$$

   Isolate y in this new equation (in other words, write the equation in slope-intercept form). Graph the equation on the same graph you used for the other lines. What do you notice?

My Notes

5. a. In questions 1b. and 1c., you formed two new equations. What would be the solution to the linear system consisting of the two new equations?

   b. How do you know? Explain why.

   c. How does multiplying the terms of an equation by a common factor affect the graph?

6. What purpose is there for adding, subtracting, or multiplying the equations of a linear system?

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

Section Assignment 4.2 Part 1

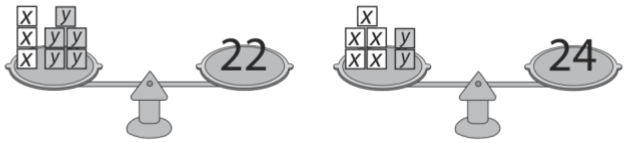
Modelling Linear Systems

1. Match each situation on the left to a linear system on the right. (3 marks)

______	a. The perimeter of a rectangle is 46 centimetres. The length is four more than the width.	i. $x + y = 46$ $x = 4y$
______	b. The sum of two numbers is 46. One number is four more than twice the other.	ii. $2x + 2y = 46$ $x - y = 4$
______	c. A 46 cm pipe is divided in two parts. One part is four times the other.	iii. $x + y = 46$ $x = 2x + 4$

2. a. Create a linear system to model this situation. The images show soccer balls and tennis balls purchased. (2 marks)

3. The balance scales below show the relationship of a variety of boxes.



a. Create a linear system to model this relationship. (2 marks)

b. Verify that $x = 4$ and $y = 2$. (1 mark)

4. Janet is selling adult and student tickets. She wrote the following equations.

$5x + 12y = 1090$ $\qquad$ $x + y = 120$

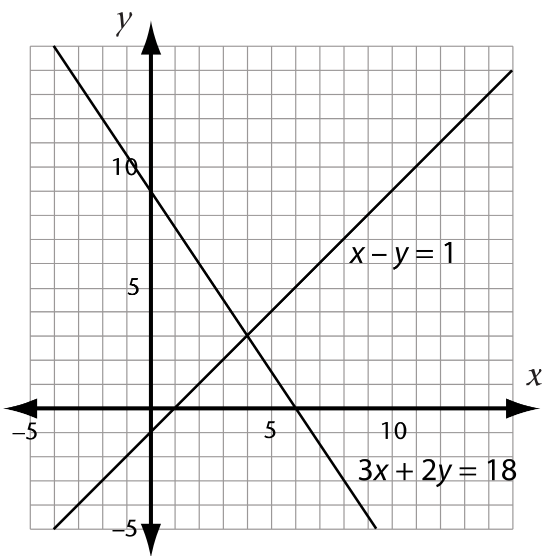
a. Explain what the equations might represent. (2 marks)

b. What does each variable represent? (1 mark)

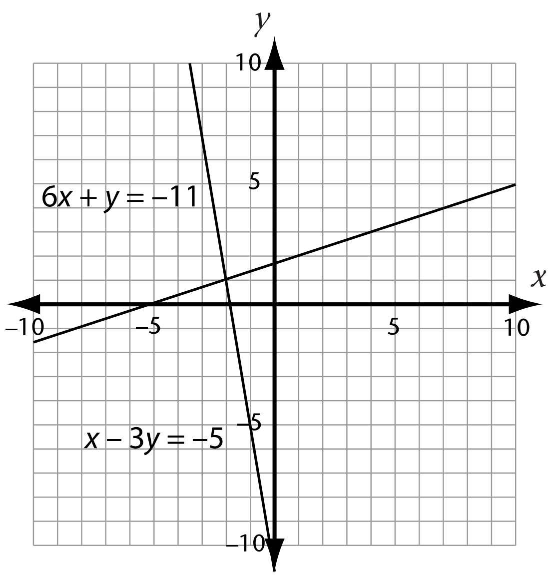
Section Assignment 4.2 Part 2
Solving Linear Systems by Graphing

1. Determine the solution of each of the linear systems. (3 marks)

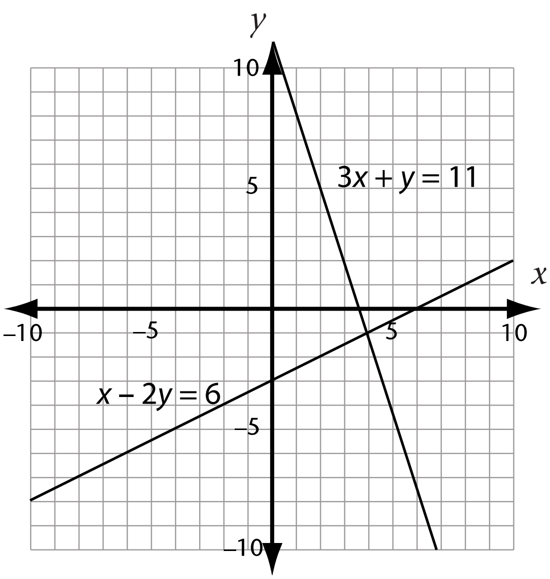
a.



b.

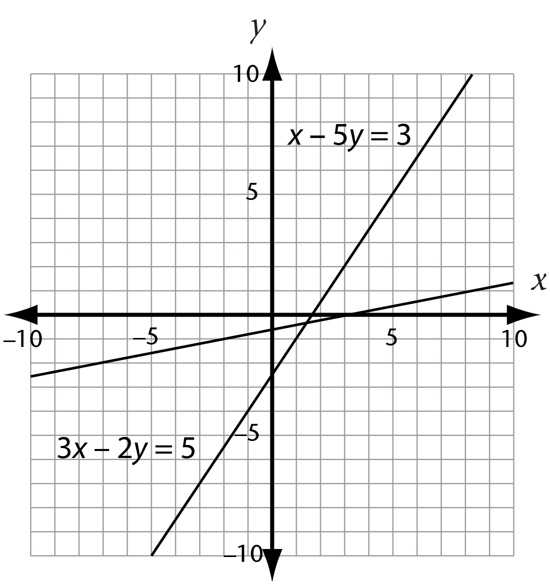


c.

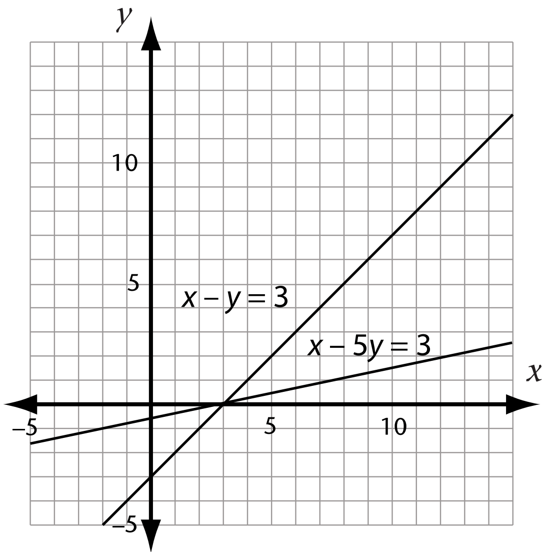


2. For each linear system, determine the solution. Discuss whether the solution is exact or approximate. (4 marks; 2 marks each)

a.

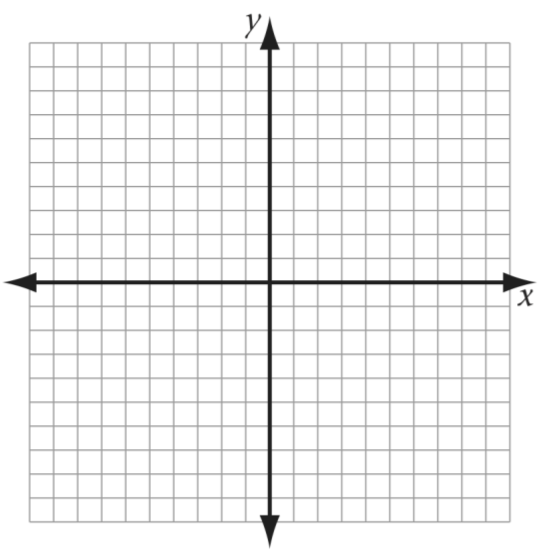


b.

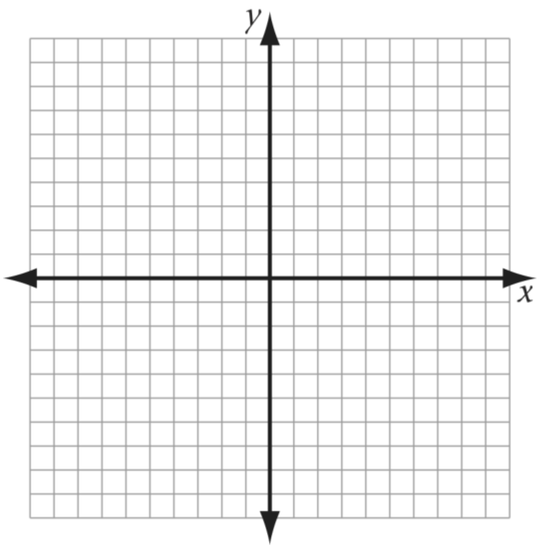


3. Solve each system of linear equations. (8 marks; 4 marks each)

   a. $x - y = 1$
      $3x + 2y = 18$



b. $x - 2y = 7$
$3x + 4y = 1$



4. Katrina found that the solution of $x + 6y = 9$ and $3x - 2y = -23$ was . Is this solution exact or approximate? Justify your answer. (3 marks)

5. Car rental company A offers cars at a daily rate of $20 plus $0.20 per kilometer driven. Company B offers a daily rate of $30 plus $0.10 per kilometer. The equation for Company A is $C = 20 + 0.2m$. The equation for Company B is $C = 30 + 0.1m$.

   a. Graph the linear system described. (4 marks)

   b. How far would you have to drive to make the two company costs to be equal? (1 mark)

   c. When is it cheaper to rent from Company B? (1 mark)

Section Assignment 4.2 Part 3
Solving Linear Systems by Substitution

1. Solve by substitution (4 marks; 2 marks each)

   a. $x - y = 7$
      $2x + y = -10$

   b. $4x + y = -5$
      $2x + 3y = 5$

2. Solve each linear system (4 marks; 2 marks each)

   a. $3x + 6y = 4$
      $x - 2y = 1$

   b. $2x + 8y = 1$
      $x = 2y$

3. Solve each of the following systems of equations in the least number of steps. Explain why you chose the solution method you used. (6 marks; 2 marks each)

   a. $x - y = 12$
      $x = 4$

   b. $x + y = 10$
      $x - y = 14$

   c. $x - 2y = -1$
      $3x + 4y = 12$

4. Examine the following system of linear equations. By what number would you multiply each equation to ensure integer coefficients? (2 marks)

   a. $\frac{2x}{3}+\frac{y}{4}=1$

   b. $\frac{x}{3}+\frac{5y}{6}=2$

5. Solve each set of linear equations by substitution. (4 marks; 2 marks each)

   a.
   $$\frac{2x}{3}+\frac{y}{5}=-2$$
   $$\frac{x}{3}-\frac{y}{2}=-7$$

b.

$$\frac{1}{2}x + \frac{1}{3}y = 1$$
$$\frac{1}{4}x + \frac{2}{3}y = -1$$

Section Assignment 4.2 Part 4
Solving Linear Systems by Elimination

1. Use the elimination strategy to solve each set of linear equations. (8 marks; 2 marks each)

   a. $3x + y = 3$
      $2x + 3y = -5$

   b. $5x + 2y = 5$
      $3x - 4y = -23$

c. $11x + 12y = 11$
$7x + 8y = 3$

d. $5x + 11 = 7y$
$8y - 18 = 3x$

2. Solve each set of linear equations. (6 marks; 2 marks each)

   a. $0.5x - y = -1$
      $2.5x + 6y = 28$

   b. $15x - 2.5y = 10$
      $3x + 5y = 13$

   c.
$$\frac{2}{3}x + \frac{1}{2}y = -1$$
$$x - \frac{1}{4}y = -\frac{7}{2}$$

3. Solve the following set of linear equations. Explain your strategy for solving. (4 marks)

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

Section Assignment 4.2 Part 5
Glossary

Write a short definition from your personal glossary for each term below. (5 marks; 1 mark each)

- system of linear equations

- point of intersection

- substitution method

- additive inverse

- elimination method

Section Assignment 4.2 Part 6
Multiple Choice

20 marks: 2 marks each

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

1. Solve for y in the following system of equations:

   $2x - y = 7$
   $x - 5y = -10$

   a. 5
   b. –7
   c. 3
   d. 2

2. Which of the following systems of linear equations has a solution of (−1, 2)?

   a. $y = x + 3$
      $2x + 3y = 4$
   b. $y = x - 3$
      $2x + 3y = 4$
   c. $y = x + 3$
      $2x - 3y = 4$
   d. $y = x - 3$
      $2x - 3y = 4$

3. Solve the following system of equations:

$2x + y = 0$
$7x + 5y = 1$

a. $\left(\frac{1}{3}, -\frac{2}{3}\right)$

b. $\left(\frac{2}{3}, -\frac{1}{3}\right)$

c. $\left(-\frac{1}{3}, \frac{2}{3}\right)$

d. $\left(-\frac{2}{3}, \frac{1}{3}\right)$

4. Two planes have a cruising speed of 620 km/h without wind. The first plane flies for 14 hours against a constant headwind. The second plane flies for 9 hours in the opposite direction with the same wind (a tailwind). The second plane flies 340 km less than the first plane.

Determine two equations that could be used to solve for the wind speed, *w*, and the distance travelled by the first plane, *d*.

a. $(620 - w)(14) = d$
$(620 + w)(9) = d - 340$

b. $(620 - w)(14) = d$
$(620 + w)(9) = d + 340$

c. $(620 + w)(14) = d$
$(620 - w)(9) = d - 340$

d. $(620 + w)(14) = d$
$(620 - w)(9) = d + 340$

5. The solution to the system of equations $x + y = 2$, $2x - 3y = -11$ is

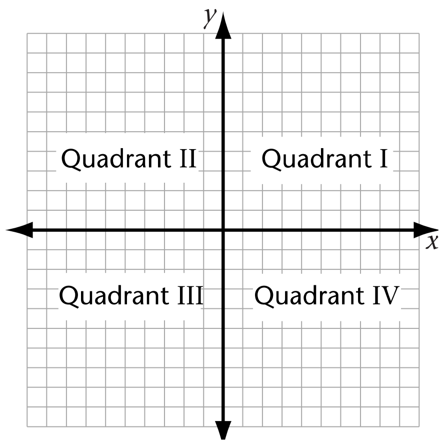
a. (2, –3)

b. (–1, 3)

c. (2, –11)

d. (1,–3)

6. In which quadrant do the graphs of $x = 3$ and $y = 2x - 7$ intersect?



a. Quadrant I
b. Quadrant II
c. Quadrant III
d. Quadrant IV

7. Consider the following system of equations:

$2x + 3y = 0$
$x + y = 2$

The solution is:

a. (6, –4)
b. (4, –2)
c. (2, 0)
d. (0, 2)

8. Consider the following system of equations.

Equation 1: $2x + y = 7$
Equation 2: $x - 3y = -5$

To eliminate *x* in this equation, you could:

a. Subtract Equation 1 from Equation 2.
b. Multiply Equation 2 by –2 and then add the result to Equation 1.
c. Multiply Equation 1 by 3 and add the result to Equation 2.
d. Add the equations together.

9. Renee chose to solve this system of equations using the substitution method.

$x - 3y = 8$
$2x + y = 23$

Find and correct her first mistake.

$$
\begin{aligned}
x - 3y &= 8 \\
x &= 3y + 8 \leftarrow \text{Line 1} \\
\\
2x + y &= 23 \\
2(3y + 8) + y &= 23 \leftarrow \text{Line 2} \\
6y + 16 + y &= 23 \\
7y &= 23 - 16 \\
7y &= 7 \\
y &= 1 \\
\\
x - 3(1) &= 8 \leftarrow \text{Line 3} \\
x &= 5 \leftarrow \text{Line 4}
\end{aligned}
$$

a. In Line 1, Renee should have solved for y.

b. Line 2 should be $2(x - 3y) + y = 23$.

c. Line 3 should be $2x + (1) = 23$

d. Line 4 should be $x = 11$.

10. Which of the following is the best first step to eliminate a from this system?

$2b - a = 8$
$2a - 3b = 4$

a. Multiply the second equation by 2.

b. Multiply the first equation by 3.

c. Subtract the second equation from the first equation.

d. Rearrange the first equation so the a-term comes before the b-term.

Title	Marks
Part 1: Modelling Linear Systems	/12
Part 2: Solving Linear Systems by Graphing	/24
Part 3: Solving Linear Systems by Substitution	/20
Part 4: Solving Linear Systems by Elimination	/18
Part 5: Glossary	/5
Part 6: Multiple Choice	/20
Total Marks	/99

Foundations of Mathematics and Pre-calculus 10

Module 4, Section 3—Lesson A: Essential Questions

Essential Questions	**Before the Lesson: What I Know**	**After the Lesson: What I Learned**	**Examples**
Why can linear systems have different numbers of solutions?			
How do the equations of a linear system indicate the number of solutions of that system?			

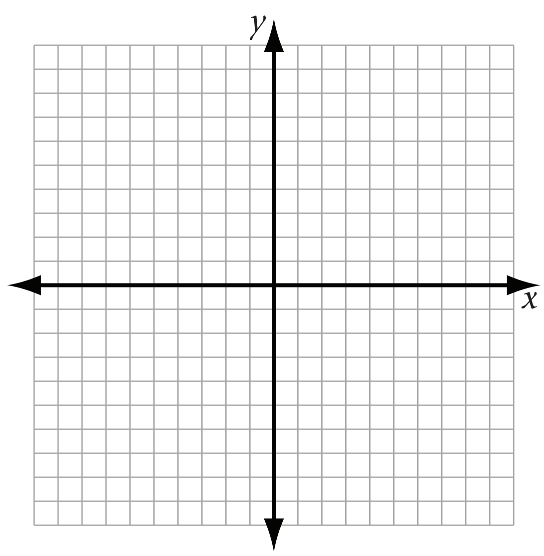
My Notes

Activity 2
Math Lab: Two Lines on a Graph

1. a. In what ways can two lines be oriented relative to each other on a coordinate plane?

   b. Will you always have one point of intersection when you draw a pair of lines on a sheet of graph paper?

2. Use the grid to represent each way for a pair of lines to be oriented.



Next, you will create several systems of equations. You will then graph each system to determine the number of solutions of the system. You will then analyze the relationship between the format of the equations in the system and the number of solutions.

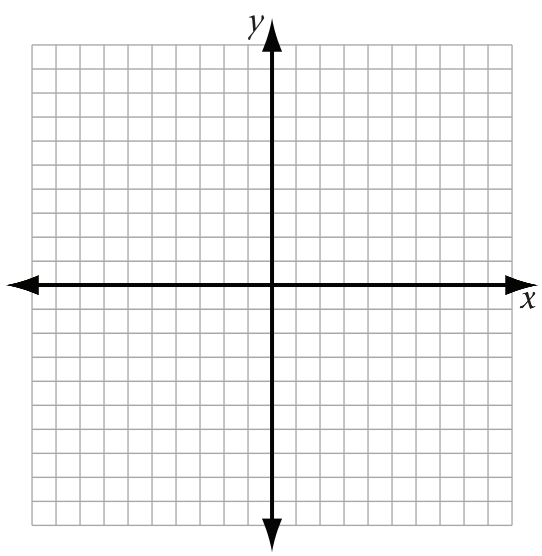
My Notes

3. In each system, one of the equations will be $2x + y = 3$. Complete the table below by writing the second equation for each system according to the following conditions:
   - **System A**: Choose a non-zero number. Multiply each term of Equation 1 by this number.
   - **System B**: Choose two non-zero numbers. Multiply the left side of Equation 1 by one of these numbers. Multiply the right side of Equation 1 by the other number.
   - **System C**: Choose two non-zero numbers. On the left side of Equation 1, multiply the *x*-term by one of these numbers and the *y*-term by the other one.

	System A	System B	System C
Equation 1	$2x + y = 3$	$2x + y = 3$	$2x + y = 3$
Equation 2			

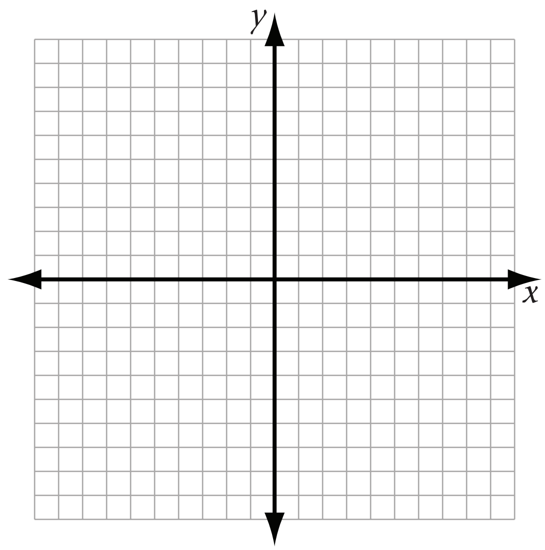
4. Graph each system separately on the grids provided. Determine the number of solutions in each case.

System A

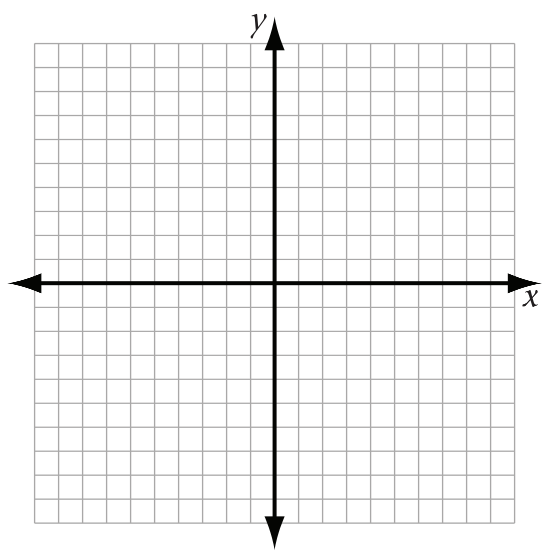


My Notes

System B



System C



5. Compare the slopes and the y-intercepts of the graphs of each system. Based on the graphs, complete the table below by stating whether the slopes are the same or different. Also, use a word to describe how the graphs are oriented relative to each other.

	System A	System B	System C
Slopes			
y-intercepts			
Description of the Lines' Orientation			

6. a. Indicate the number of solutions in each of Systems A, B, and C.

	System A	System B	System C
Number of Solutions			

b. Describe how you can identify the number of solutions of a system by looking at its graph.

7. Describe how you can identify the number of solutions of a system by looking at its equations.

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

My Notes

Foundations of Mathematics and Pre-calculus 10

Module 4, Section 3—Lesson B: Essential Questions

Essential Questions	Before the Lesson: What I Know	After the Lesson: What I Learned	Examples
How can you recognize which strategy is most appropriate for solving a given system of equations?			

Section Assignment 4.3 Part 1
Number of Solutions of a Linear System

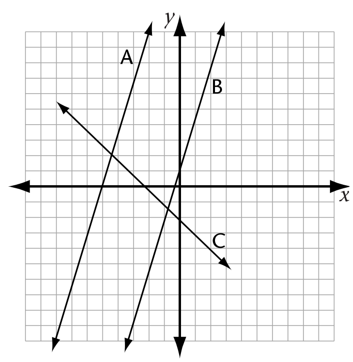
1. Use the following equations for a. and b. below.

   i. $-2x + y = 12$
   ii. $-2x - y = 24$
   iii. $-4x + 2y = 15$
   iv. $x + y = 7$

   a. Without graphing, determine the slope of the graph of each equation. (2 marks)

   b. Which of the lines are parallel? (1 mark)

2. The graph of three lines is shown below.



   a. Which two lines will form a system with exactly one solution? (1 mark)

   b. Which two lines will form a system with no solution? (1 mark)

3. i. $x + 2y = 10$

   i. $4x - 2y = 20$

   ii. $2x + 3y = 5$

   iii. $2x + 4y = 20$

   iv. $x + 2y = 20$

   v. $x + y = 10$

   Use each of the equations shown above only once to find the following:

   a. a pair of lines that has no solution (1 mark)

   b. a pair of lines that has exactly one solution (1 mark)

   c. a pair of lines that has an infinite number of solutions (1 mark)

4. Determine the number of solutions of each linear system. (4 marks)

   a. $\frac{x}{2} - \frac{2y}{3} = 6$
      $3x + 4y = -12$

   b. $\frac{x}{2} + \frac{y}{6} = 2$
      $6x + 2y = 24$

   c. $2x + 3y = 8$
      $5x - 4y = -6$

   d. $3x + y = 12$
      $6x + 2y = 6$

5. You are examining a system of two linear equations. You discover that the slopes are 3 and 4. What can you state about the number of solutions for this set of equations? (2 marks)

6. You are examining a system of two linear equations. You discover that the slopes are –3 and –3. What can you state about the number of solutions for this set of equations? (2 marks)

7. Given the equation $2x - 3y = 12$ as one in a set of linear equations:
   a. Write an equation that will have exactly one solution when paired with the above equation. (1 mark)
   b. Write an equation that will have no solution when paired with the above equation. (1 mark)
   c. Write an equation that will have an infinite number of solutions when paired with the above equation. (1 mark)

Section Assignment 4.3 Part 2
Solving Problems With Linear Systems

1. Jessica is making patterns with a set of 20 dominos like the one shown. If she places them matching the short side, the perimeter of the rectangle formed is 244 cm. If she makes a rectangle matching the long sides, the perimeter is 92 cm.

   a. Draw a diagram to show each situation. (1 mark)

   b. Write an equation to demonstrate each situation. (2 marks)

c. Solve the equations to find the length and width of the domino. (2 marks)

2. Solve the following systems of linear equations. (12 marks; 4 marks each)

a. $3x + 2y = 5$
$2x + 3y = 0$

b. $3x + 2y = 8$
$\frac{7}{2}x + 3y = 4$

c.

$$\frac{1}{3}x+\frac{1}{2}y=-\frac{1}{2}$$
$$\frac{1}{5}x-\frac{1}{3}y=\frac{27}{5}$$

3. A community organization distributed 50 kg of candy in its Cheer Boxes. Part of the candy was bought at $2 per kilogram and part at $6 per kilogram. How many kilograms of candy were bought at each price if the total cost was $182.40? (4 marks)

4. Robert invested $800, part at 9% per year and the rest at 12% per year. In one year, the interest was $79.50. How much did he invest at each rate? (4 marks)

Section Assignment 4.3 Part 3
Glossary

Write a short definition from your personal glossary for each term below. (5 marks; 1 mark each)

- coincident lines

- consistent system

- dependent system

- inconsistent system

- independent system

Section Assignment 4.3 Part 6
Multiple Choice

20 marks: 2 marks each

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

1. How many solutions does this system of equations have?

   $y = 2x + 5$
   $y = 2x - 1$

   a. no solution
   b. one solution
   c. an infinite number of solutions
   d. cannot be determined without solving

2. The following system has an infinite number of solutions. What does *k* have to be?

   $2x - 4y = 5$
   $4x - 8y = k$

   a. 5
   b. –10
   c. 10
   d. 8

3. Two numbers have a sum of 147 and a difference of 35. One of the numbers is:

   a. 91
   b. 112
   c. 52.
   d. 37

4. Kim bought 7 gifts for her friends at the charity sale. Some gifts cost \$5 each, and the rest cost \$3 each. She spent a total of \$29.

   Which of the following systems of linear equations could represent the given situation?

   a. $x + y = 29$
      $5x + 3y = 7$

   b. $x + 5y = 7$
      $x + 3y = 29$

   c. $5x + y = 7$
      $x + 3y = 29$

   d. $x + y = 7$
      $5x + 3y = 29$

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

5. Marcus deposited a total of $700 in two savings accounts. One account earned 3% per annum and the other earned 5% per annum. In one year, Marcus earned $27 in interest. How much did he deposit into the account that earned 3%?

   a. $300
   b. $350
   c. $400
   d. $500

6. Three burgers and two orders of fries cost $16. How much would you expect to pay if you ordered two burgers and four orders of fries?

   a. $18
   b. $22
   c. $17.50
   d. There is not enough information to solve this problem.

7. Peanuts, which cost $8/kg, are mixed with raisins, which cost $4/kg. The mixture weighs 20 kg and sells for $6.40/kg. How many kilograms of peanuts are in the mixture?

   a. 12
   b. 8
   c. 10
   d. 6.4

8. There were 575 people in the theatre. The adults paid $15 per ticket and students were able to buy discounted tickets for $9 each. The theatre took in a total of $6525. How many student tickets were sold?

   a. 225
   b. 275
   c. 350
   d. 575

9. The average of two numbers is 11. Four times the first number is two less than twice the second number. Find the numbers.

   Which system of equations could be used to solve this problem?

   a. $\frac{a}{2}+\frac{b}{2}=11$
      $4a+2=2b$

   b. $\frac{a}{2}+\frac{b}{2}=11$
      $4a-2=2b$

   c. $2(a+b)=11$
      $4a=2b+2$

   d. $a+b=11$
      $4a+2=2b$

10. Which of these systems has (1, –2) as a solution?

    a. $x + 2y = 5$
       $2x + 3y = -4$

    b. $x + 2y = -3$
       $2x + 3y = 8$

    c. $x + 2y = 5$
       $2x + 3y = 8$

    d. $x + 2y = -3$
       $2x + 3y = -4$

Title	Marks
Part 1: Numbers of Solutions of a Linear System	/20
Part 2: Solving Problems With Linear Systems	/25
Part 3: Glossary	/5
Part 4: Multiple Choice	/20
Total Marks	/70