

Lesson Title: L9 – Analyzing Linear Systems

Date: _____

(A) Lesson Objectives:

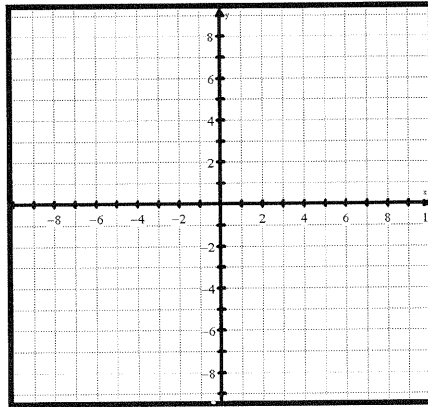
- a. Investigate the numbers of solutions that linear systems can have
- b. Use multiple representations in solving linear systems

(B) Investigation A – What are equivalent linear equations?

1. A) On the same grid, graph the lines $x + 2y = 4$ and $2x + 4y = 8$.
1. B) How are the graphs related?
1. C) How are the equations related?

Algebraic Verification

Graphic Verification



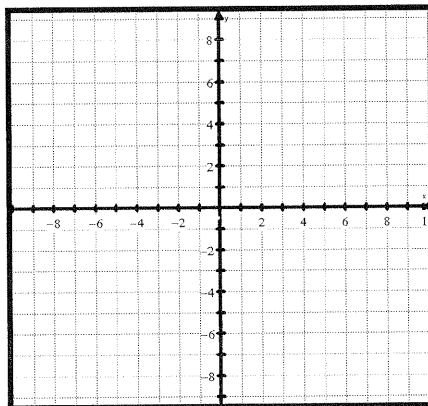
Numeric Verification

x	y in (L1)	Y in (L2)

2. A) On the same grid, graph the lines $y = -\frac{1}{2}x + 3$ and $x + 2y = 6$.
2. B) How are the graphs related?
2. C) How are the equations related?

Algebraic Verification

Graphic Verification



Numeric Verification

x	y in (L1)	Y in (L2)

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3. a) Without graphing, tell which two of the following are **equivalent linear systems**. Explain your reasoning.

(i) $y - x + 5 = 0$

(ii) $y = 3x + 15$

(iii) $2y = 2x - 10$

3. b) Check your answer by graphing the three lines

4. A) On the same grid, graph the lines $y = -\frac{1}{2}x + 3$ and $x + 2y = -12$.

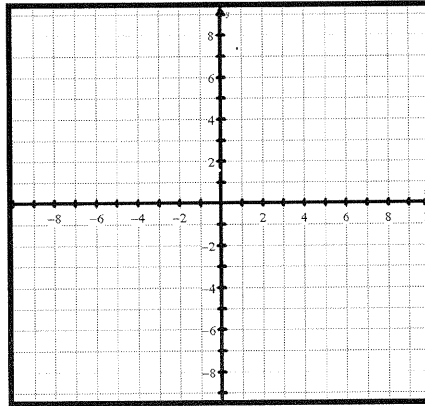
4. B) How are the graphs related?

4. C) How are the equations related?

Algebraic Verification

Graphic Verification

Numeric Verification



x	y in (L1)	Y in (L2)

5. A) On the same grid, graph the lines $x + 2y = 4$ and $2x + 4y = 16$.

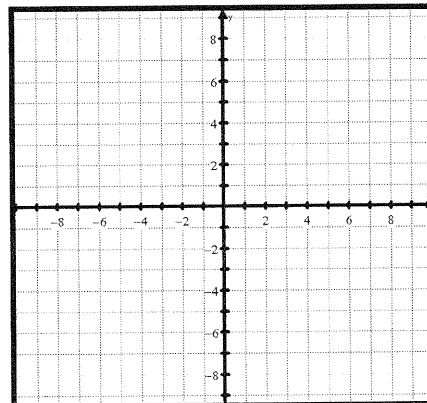
5. B) How are the graphs related?

5. C) How are the equations related?

Algebraic Verification

Graphic Verification

Numeric Verification



x	y in (L1)	Y in (L2)

Tools

- grid paper, graphing calculators, or geometry software

equivalent linear systems

- pairs of linear equations that have the same point of intersection

Investigate B

What are equivalent linear systems?

1. Graph the linear system and find the point of intersection.

$$y = x - 1$$

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

2. Graph the linear system and find the point of intersection.

$$2x - 2y - 2 = 0$$

$$2y + x = 4$$

3. a) Compare the solutions to questions 1 and 2. What do you notice?

- b) Compare the equations in questions 1 and 2. How are the equations related?

4. a) Graph the linear system and find the point of intersection.

$$y = 2x + 1$$

$$y + x = 7$$

- b) Choose a number. Multiply the first equation in part a) by the number. How is the new equation related to the first equation in part a)?

- c) Choose another number. Multiply the second equation in part a) by the number. How is the new equation related to the second equation in part a)?

- d) If you graphed the two new equations that you obtained in parts b) and c), what would you expect the point of intersection to be? Explain why. Check by graphing.

5. **Reflect** Explain how you can use equivalent linear equations to write an **equivalent linear system**. Use your own examples in your explanation.

6. a) Graph the linear system and find the point of intersection.

$$x + 2y = 4$$

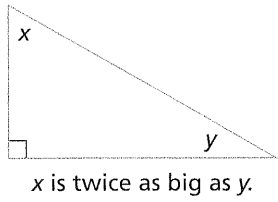
$$x - y = 1$$

- b) If you add the left sides and the right sides of the two equations in part a), you obtain the equation $2x + y = 5$. Graph this equation on the same grid as in part a). What do you find?

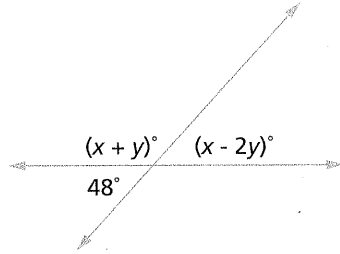
- c) If you subtract the left sides and the right sides of the two equations in part a), you obtain the equation $3y = 3$. Graph this equation on the same grid as in part a). What do you find?

21. Solve for x and y in each diagram.

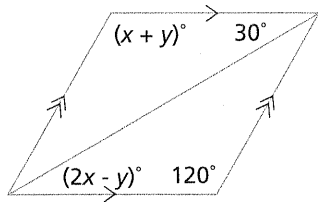
(a)



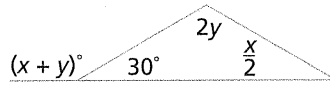
(b)



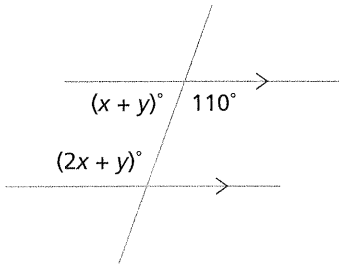
(c)



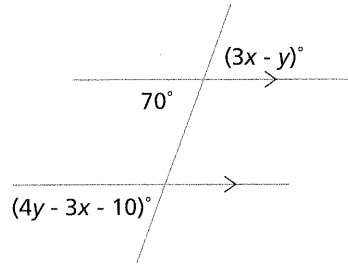
(d)



(e)



(f)



bl

$$2x - y$$

10. Communication: You are trying to solve a linear system graphically and you find that the point of intersection does not appear on the graph you have drawn. Explain what you would do to find the point of intersection.

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9. A system of equations is defined by

$$2y = 5x - 3$$

$$y = 2.5x - 3$$

- (a) Solve by substitution.
- (b) What happens when you try to solve this system? What does this mean?
- (c) Draw a diagram to represent this situation. How does it support your answer to part (b)?

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10. A system of equations is defined by

$$3y + 5x = 30$$

$$y = -\frac{5}{3}x + 10$$

- p103/ 11. (a) Create a linear system of two equations that has no solution.
(b) What happens when you use elimination to solve this system? Show an example and explain.

- p103/ 12. Application:
(a) Create a linear system of two equations that has many solutions.
(b) What happens when you use elimination to solve this system? Show an example and explain.

- p103/ 13. Thinking, Inquiry, Problem Solving:
(a) Make up a word problem that you can solve using a linear system with a solution of $(5, 35)$.
(b) Ask a classmate to solve the problem, then check his or her work. If the solution is incorrect, write suggestions explaining how to correct it.

- p95/ 23. Check Your Understanding: Monique is solving the system of equations defined by $2x - y = 4$ and $y = 4x - 10$ by substitution. She obtained $-2x - 10 = 4$. What did she do wrong? Write out the correct way to solve this linear system. Explain your steps.

- p95/ 24. Solve for x and y .

$$xy + y - 3x - 3 = xy - 2y + 3x - 6$$

$$xy - y + 5x - 5 = xy + 2y + 4x + 8$$

- p99/ 26. Solve by substitution. (Hint: Let m represent $\frac{1}{x}$ and let n represent $\frac{1}{y}$.)

(a) $\frac{1}{x} + \frac{1}{y} = \frac{3}{4}$

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

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

$$\frac{1}{x} + \frac{5}{y} = \frac{3}{4}$$

- p99/ 27. Solve for x and y in terms of a and b .

(a) $x + y = 8a$

$$2x + 5y = 10a$$

(b) $x + y = a + 2b$

$$3x - 2y = 3a - 4b$$

- p104/ 25. The general system of linear equations is

$$ax + by = e$$

$$cx + dy = f$$

The symbols a , b , c , d , e , and f represent constant values.

Using elimination, develop a formula to solve the system for x and y in terms of the other variables. Are there any restrictions on the possible values of a , b , c , d , e , and f ?

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21. Solve for x and y . Both variables must satisfy the equations
 $3(3(x+2y) - 2(x-2y) - y) = 81$ and $9((2x+y) - (x+2y)) = 243$.

22. The solution to this system of equations is $(-2, 1)$. Find the values of p and q .

$$px + (9 - q)y = -10$$

$$(3p + 1) - (q - 6)y = -21$$

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17. **Knowledge and Understanding:** Without graphing, show that the ordered pair $(-2, -5)$ is a solution to the system of equations defined by $3x - 4y = 14$ and $5x + 3y = -25$.

18. The graphs of $2x + 4y = 10$, $4x - y = 11$, and $3x + ay = 14$ all intersect at the same point. Find the value of a . Justify your answer.

19. The equations $y = 2$, $y = 4x - 2$, and $y = -2x + 10$ form the sides of a triangle.

(a) Graph the triangle and find the coordinates of the vertices.

(b) Find the area of the triangle.

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20. The vertices of square $ABCD$ are $A(3, -2)$, $B(7, -2)$, $C(7, 2)$, and $D(3, 2)$.

(a) Draw a graph to find the coordinates of the point where the diagonals intersect.

(b) Find the equations of the diagonals.

(c) Verify that the point you found in (a) satisfies the equations of the diagonals.