

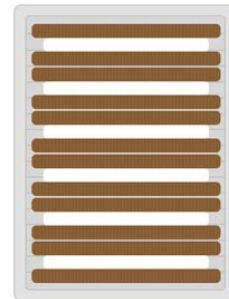
Lesson 13: Cookies and Calories – An Introduction to Systems of Equations

Opening Exercise

- Go to student.desmos.com and type in the class code:
_____ to start the Desmos activity *Wafers and Crème*.
- Use the space below to make your calculations for the number of calories for the Triple Crème package.

Single Crème

Nutrition Facts
Calories



Double Crème


Nutrition Facts
Calories



- What was your calculation for the number of calories in the Triple Crème?
- How did you come up with your answer?

On the third screen you saw the following information. This type of problem can be solved with a *system of equations*.

Single Crème	Double Crème	Triple Crème
Nutrition Facts	Nutrition Facts	Nutrition Facts
Calories 320	Calories 280	Calories



5. What are the two quantities you don't know?
6. Dean wrote the equation $12w + 6c = 320$ for the Single Crème package.
 - A. What does the w and c represent in Dean's equations?
 - B. Using Dean's variables, write an equation for the Double Crème package.

The two equations from Exercise 6 are a **system of equations**. This means there is more than one equation with more than one unknown quantity.

7. It is also possible to solve the Triple Crème packaging problem without writing any equations. How might someone solve this problem without equations?

Throughout this unit, you'll be writing systems of equations or inequalities with different real-world problems.

Let’s look at a story of two people walking along a ramp.

Duke starts at the base of a ramp and walks up it at a constant rate. His elevation increases by 3 ft. every second. Just as Duke starts walking up the ramp, Shirley starts at the top of the same 25 ft. high ramp and begins walking down the ramp at a constant rate. Her elevation decreases 2 ft. every second.

Understanding the Problem

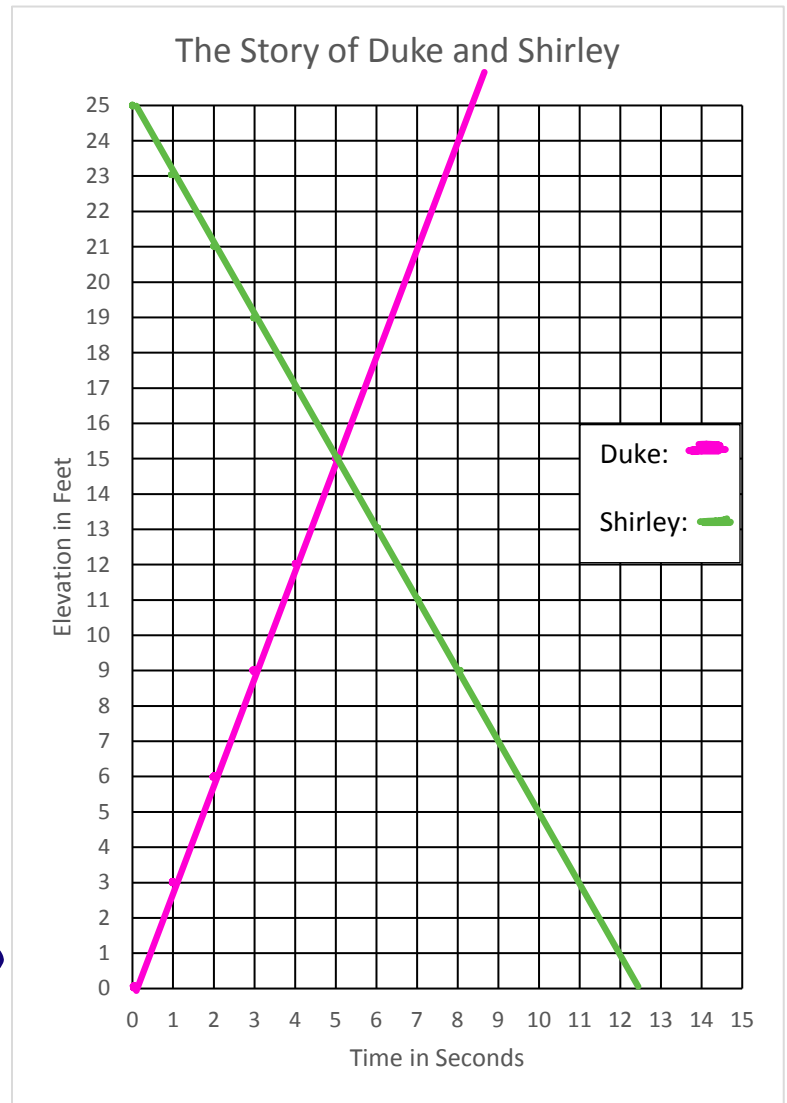
8. Fill in the chart below to help you understand how quickly Duke and Shirley move and where they start.

Duke’s Path	
Time in Seconds	Elevation in Feet
0	0
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
n	3n

$y = mx + b$
 $y = 3n + 0$

Shirley’s Path	
Time in Seconds	Elevation in Feet
0	25
1	23
2	21
3	19
4	17
5	15
6	13
7	11
8	9
9	7
10	5
11	3
12	1
n	25-2n

$y = -2n + 25$



9. Use the extra row in each table to write an expression that describes the elevation pattern.

10. Use the grid above to graph the data for Duke and Shirley. Be sure to finish the legend to help the reader understand your graph.

Writing an Equation of a Line

The equation of a line can be in the form $y = mx + b$, where m represents the slope of the line and b represents the y -intercept.

11. Determine the slope of Duke's line and Shirley's line. Why is one of the slopes negative?

Duke's slope: 3 Shirley's slope: -2

12. What is the y -intercept for each line?

Duke's y -intercept: 0 Shirley's y -intercept: 25

13. Write the equation of Duke's line and Shirley's line.

Duke's line: $y = 3x$ Shirley's line: $y = -2x + 25$

14. Where do the two lines intersect? (5, 15) This is the **point of intersection**. What time do Duke and Shirley pass each other?

5 seconds

15. How could you use the equations to find the point of intersection?

$$3x = -2x + 25$$

The equations you wrote in Exercise 13 are in slope-intercept form or $y = mx + b$.

Point-slope is another very useful form of a linear equation. For point-slope we need any point on the line, not just the y -intercept, and the slope of the line. The general form looks like $y - y_1 = m(x - x_1)$ where (x_1, y_1) is any point on the line and m is the slope of the line.

16. A. Use the points when $t = 3$ seconds and slope from Exercise 11 with the point-slope equation to get equations for Duke and Shirley.

$$(3, 9) \quad m = 3$$

$$y - 9 = 3(x - 3)$$

$$(3, 19) \quad m = -2$$

$$y - 19 = -2(x - 3)$$

B. How do these equations compare to the ones you wrote in Exercise 13?

Lesson Summary

A **system of equations** is a set of equations that describe a situation.

Example: Two numbers have a sum of 12 and a difference of 4. What are those two numbers?

Define your variables.	Let x = the first number Let y = the second number
Use the information in the problem to write two equations.	$x + y = 12$ $x - y = 4$

In later lessons, you'll review solving systems of equations using graphing and substitution and then with a new method, elimination.

Linear Equations: If you know the slope and y -intercept, you can use the equation $y = mx + b$ to write an equation for the line. If you have the slope and any point on line you can use the point-slope equation, $y - y_1 = m(x - x_1)$ where (x_1, y_1) is any point on the line and m is the slope of the line.

Example 1: The slope of a line is -3 and the y -intercept is 5 .

An equation of this line is $y = -3x + 5$.

$$y - 4 = \frac{1}{2}(x - 2)$$

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

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

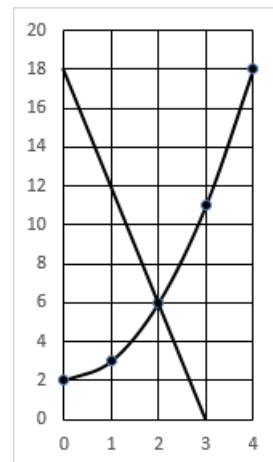
Example 2: The slope of a line is $\frac{1}{2}$ and the point $(2, 4)$ is on the line.

The equation of this line is $y = \frac{1}{2}x + 3$.

Point of Intersection: The point of intersection is an ordered pair that is a solution to both equations. On a graph this is where the two graphs cross each other.

Example: Determine the point of intersection for the graph at the right.

Point of intersection: $(2, 6)$



Homework Problem Set

Write a system of equations for each situation below. Be sure to define your variables. You do NOT need to solve the problem.

1. The difference of two numbers is 3 and their sum is 13. What are the two numbers?

2. The difference of two numbers is -10 and the sum is -4 . What are the two numbers?

3. Kristin spent \$131 on shirts. Fancy shirts cost \$28 and plain shirts cost \$15. If she bought a total of 7 shirts, how many of each kind did she buy?

Let f = the number of fancy shirts

Let p = the number of plain shirts

A. What is the cost of 1 fancy shirt? Of 2 fancy shirts? Of f fancy shirts?

B. What is the cost of 1 plain shirt? Of 2 plain shirts? Of p plain shirts?

C. Write an equation that describes the amount of money spent by Kristin.

D. Write an equation that describes the number of shirts Kristin bought using f and p .

E. **CHALLENGE** Determine the number of each type of shirt Kristin bought.

4. There are 13 animals in the barn. Some are chickens and some are pigs. There are 40 legs in all. How many of each animal are in the barn?

Let c = the number of chickens

Let p = the number of pigs

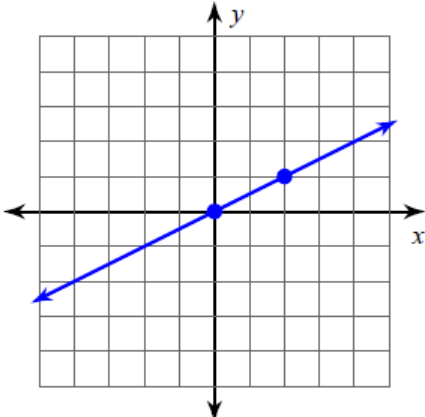
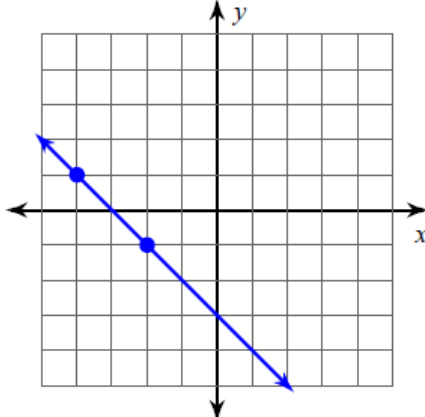
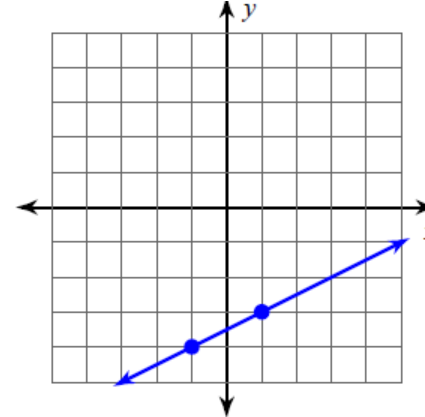
A. Write an equation that describes the number of animals using c and p .

B. Write an equation that describes the number of legs in the barn.

C. **CHALLENGE** Determine the number of chickens and pigs in the barn.

Spiral Review – Determining Slope and y-intercept from Graphs [source: Kuta]

Find the slope and y-intercept of each line.

<p>5. slope = ____ y-intercept = ____</p> 	<p>6. slope = ____ y-intercept = ____</p> 	<p>7. slope = ____ y-intercept = ____</p> 
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<p>8. slope = ____ y-intercept = ____</p>	<p>9. slope = ____ y-intercept = ____</p>	<p>10. slope = ____ y-intercept = ____</p>
<p>11. slope = ____ y-intercept = ____</p>	<p>12. slope = ____ y-intercept = ____</p>	<p>13. slope = ____ y-intercept = ____</p>

Spiral Review – Solving Equations

Solve each equation.

14. $-16 - 6v = -2(8v - 7)$

15. $2(6b + 8) = 4 + 6b$