Secondary One Mathematics: An Integrated Approach
Module 2 Honors
Systems

By

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In partnership with the
Utah State Office of Education

Module 2 – Systems of Equations and Inequalities

Classroom Task: Pet Sitters- A Develop Understanding Task
An introduction to representing constraints with systems of inequalities (**A.CED.3**)
Ready, Set, Go Homework: Systems 2.1

Classroom Task: Too Big or Not Too Big, That is the Question - A Solidify Understanding Task
Writing and graphing linear inequalities in two variables (**A.CED.2, A.REI.12**)
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Classroom Task: Some of One, None of the Other– A Solidify Understanding Task
Writing and solving equations in two variables (**A.CED.2, A.CED.4**)
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Classroom Task: Pampering and Feeding Time – A Practice Understanding Task
Writing and graphing inequalities in two variables to represent constraints (**A.CED.2, A.CED.3, A.REI.12**)
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Ready, Set, Go Homework: Systems 2.7

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Classroom Task: Taken Out of Context – A Practice Understanding Task
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Ready, Set, Go Homework: Systems 2.10

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An introduction to solving systems of linear equations using matrices (**UT Honors Standard**)
Ready, Set, Go Homework: Systems 2.13H

Honors Classroom Task: Solving Systems with Matrices – A Practice Understanding Task
Solving systems of linear equations using matrices (**UT Honors Standard**)
Ready, Set, Go Homework: Systems 2.14H

2.1 Pet Sitters

A Develop Understanding Task

The Martinez twins, Carlos and Clarita, are trying to find a way to make money during summer vacation. When they overhear their aunt complaining about how difficult it is to find someone to care for her pets while she will be away on a trip, Carlos and Clarita know they have found the perfect solution. Not only do they have a large, unused storage shed on their property where they can house animals, they also have a spacious fenced backyard where the pets can play.

Carlos and Clarita are making a list of some of the issues they need to consider as part of their business plan to care for cats and dogs while their owners are on vacation.

- *Space*: Cat pens will require 6 ft^2 of space, while dog runs require 24 ft^2. Carlos and Clarita have up to 360 ft^2 available in the storage shed for pens and runs, while still leaving enough room to move around the cages.

- *Start-up Costs*: Carlos and Clarita plan to invest much of the $1280 they earned from their last business venture to purchase cat pens and dog runs. It will cost $32 for each cat pen and $80 for each dog run.

Of course, Carlos and Clarita want to make as much money as possible from their business, so they are trying to determine how many of each type of pet they should plan to accommodate. They plan to charge $8 per day for boarding each cat and $20 per day for each dog.

After surveying the community regarding the pet boarding needs, Carlos and Clarita are confident that they can keep all of their boarding spaces filled for the summer.

So the question is, how many of each type of pet should they prepare for? Their dad has suggested the same number of each, perhaps 12 cats and 12 dogs. Carlos thinks they should plan for more dogs, since they can charge more. Clarita thinks they should plan for more cats since they take less space and time, and therefore they can board more.

What do you think? What recommendations would you give to Carlos and Clarita, and what argument would you use to convince them that your recommendation is reasonable?

Name: Systems 2.1

Ready, Set, Go!

Ready

Topic: Determine if given value is a solution and solve systems of equations

Substitute the given points into the equations to determine which ordered pair satisfies the system of linear equations, then graph both equations and label the point of intersection.

1. $y = 3x - 2$ *and* $y = x$

   a. $(0, -2)$

   b. $(2, 2)$

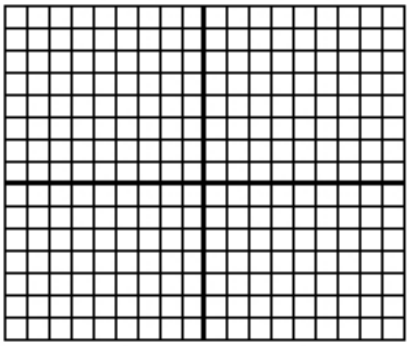
   c. $(1, 1)$

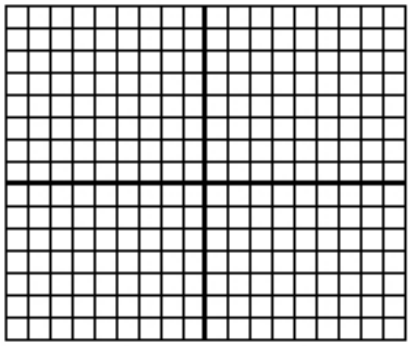
2. $y = 2x + 3$ *and* $y = x + 5$

   a. $(2, 7)$

   b. $(-7, 11)$

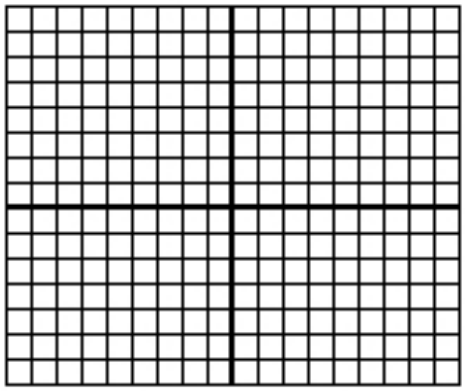
   c. $(0, 5)$



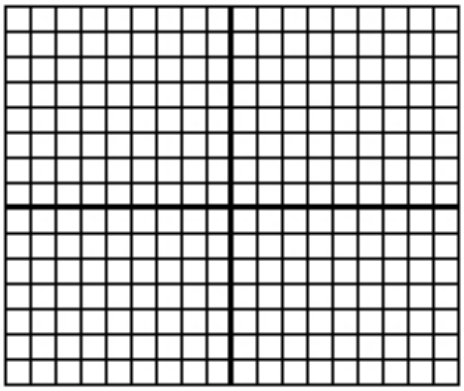


Solve the following systems by graphing. Check the solution by evaluating both equations at the point of intersection.

3. $y = x + 3$ *and* $y = -2x + 3$



4. $y = 3x - 8$ *and* $y = -x$



Name: Systems | 2.1

Set

Topic: Determining possible solutions

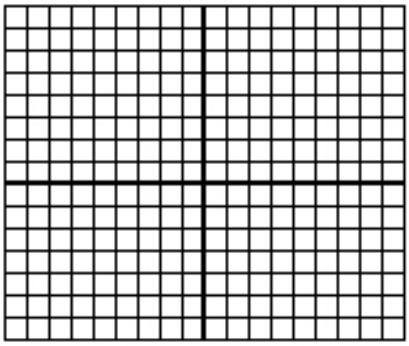
5. A theater wants to take in at least $2000 for a certain matinee. Children's tickets cost $5 each and adult tickets cost $10 each. The theater can seat up to 350 people. Find five combinations of children and adult tickets that will make their goal.

Go

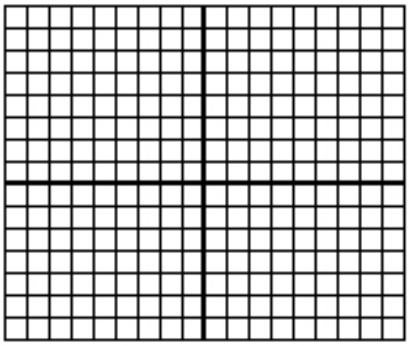
Topic: graphing linear equations and determining if a given value is a solution

Graph each equation below, then determine if the point (3,5) is a solution to the equation. Name two additional points that are solutions to the equation and show these points on the graph.

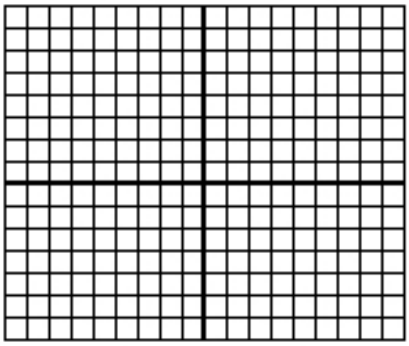
6. $y = 2x - 1$



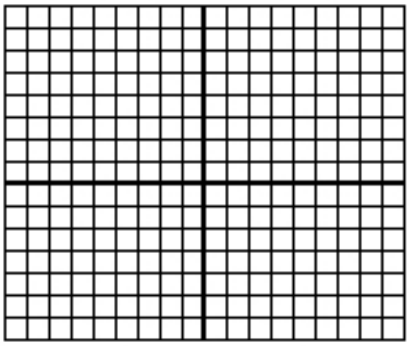
7. $y = \frac{1}{3}x + 2$



8. $y = -3x + 5$



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



Need help? Check out this related video:

https://www.youtube.com/watch?v=vo-CXaCf1I4

2.2 Too Big or Not Too Big, That is the Question

A Solidify Understanding Task

As Carlos is considering the amount of money available for purchasing cat pens and dog runs (see below) he realizes that his father's suggestion of boarding "the same number of each, perhaps 12 cats and 12 dogs" is too big. Why?

- *Start-up Costs*: Carlos and Clarita plan to invest much of the $1280 they earned from their last business venture to purchase cat pens and dog runs. It will cost $32 for each cat pen and $80 for each dog run.

1. Find at least 5 more combinations of cats and dogs that would be "too big" based on this *Start-up Cost* **constraint.** Plot each of these combinations as points on a coordinate grid using the same color for each point.

2. Find at least 5 combinations of cats and dogs that would not be "too big" based on this *Start-up Cost* constraint. Plot each of these combinations as points on a coordinate grid using a different color for the points than you used in #1.

3. Find at least 5 combinations of cats and dogs that would be "just right" based on this *Start-up Cost* constraint. That is, find combinations of cat pens and dog runs that would cost exactly $1280. Plot each of these combinations as points on a coordinate grid using a third color.

4. What do you notice about these three different collections of points?

5. Write an equation for the line that passes through the points representing combinations of cat pens and dog runs that cost exactly $1280. What does the slope of this line represent?

Carlos and Clarita don't have to spend all of their money on cat pens and dog runs, unless it will help them maximize their profit.

6. Shade all of the points on your coordinate grid that **satisfy** the *Start-up Costs* constraint.

7. Write a mathematical rule to represent the points shaded in #6. That is, write an inequality whose **solution set** is the collection of points that satisfy the *Start-up Costs* constraint.

In addition to *start-up costs,* Carlos needs to consider how much space he has available, base on the following:

- *Space*: Cat pens will require 6 ft^2 of space, while dog runs require 24 ft^2. Carlos and Clarita have up to 360 ft^2 available in the storage shed for pens and runs, while still leaving enough room to move around the cages.

8. Write an inequality to represent the solution set for the *space* constraint. Shade the solution set for this inequality on a different coordinate grid.

Name: Systems 2.2

Ready, Set, Go!

Ready

Topic: Determining if given values are solutions to an equation

Identify which of the given points are solutions to the following linear equations.

1. $3x + 2y = 12$
   a. (2, 4)
   b. (3, 2)
   c. (4, 0)
   d. (0, 6)

2. $5x - y = 10$
   a. (2, 0)
   b. (3, 0)
   c. (0, -10)
   d. (1, 1)

Find the value that will make each ordered pair a solution to the given equations.

3. $x + y = 6$
   a. (2, __)
   b. (0, __)
   c. (__, 0)

4. $2x + 4y = 8$
   a. (2, __)
   b. (0, __)
   c. (__, 0)

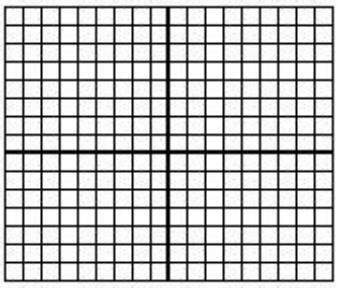
5. $3x - y = 8$
   a. (2, __)
   b. (0, __)
   c. (__, 0)

Set

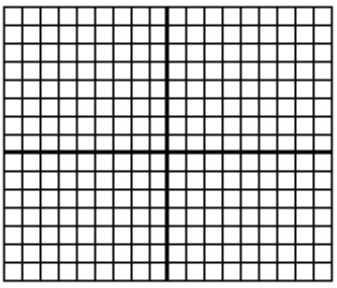
Topic: Graph linear inequalities

Graph the following inequalities on the coordinate plane. Name one point that is a solution to the inequality and one point that is not a solution. Show algebraically and graphically that your points are correct.

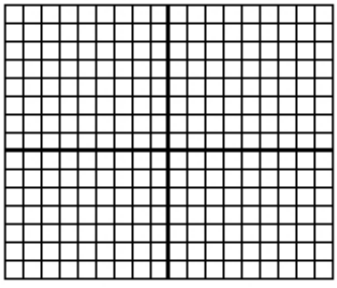
6. $y \leq 3x + 4$



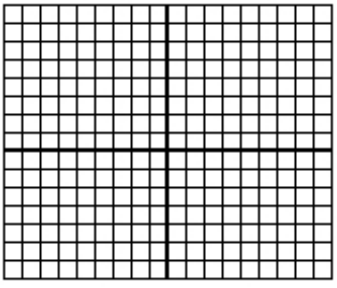
7. $x < 7$



8. $y > \frac{-3}{5}x + 2$



9. $y \geq -6$



Name: Systems | 2.2

Go Topic: Solving inequalities

Follow the directions for each problem below. (Show your work!)

10. $10 - 3x < 28$ a. Solve for x. Then graph the solution on the number line.

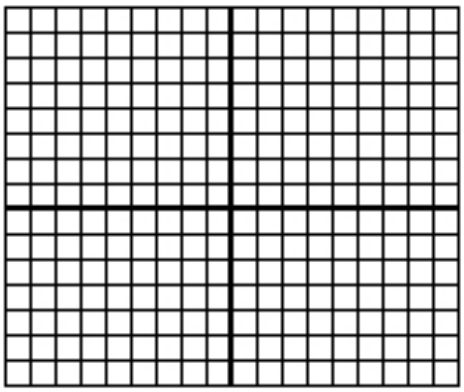
b. Select an x-value from your graph of the solution of the inequality. Replace x in the original inequality $10 - 3x < 28$ with your chosen value. Does the inequality hold true?

c. Select an x-value that is outside of the solution set on your graph. Replace x in the original inequality $10 - 3x < 28$ with your chosen value. Does the inequality still hold true?

11. $4x - 2y \geq 6$

a. Solve for y.

b. Now imagine that your inequality is an equation. In other words, your solution will say y = , instead of y ≥ or y ≤. With the equal sign, it should be the equation of a line. Graph your equation.



c. Find the y – intercept.

d. Find the slope.

e. Select a point that is above the line. (,)
Replace the x and y – values in the inequality $4x - 2y \geq 6$.
Is the inequality still true?

f. Select a point that is below the line. (,)
Replace the x and y – values in the inequality $4x - 2y \geq 6$.
Is the inequality still true?

g. Explain which side of the line should be shaded.

h. Decide whether the line should be solid or dotted. Justify your decision.

Need help? Check out these related videos:

http://www.khanacademy.org/math/algebra/linear-equations-and-inequalitie/v/graphing-linear-inequalities-in-two-variables-2

2.3 Some of One, None of the Other

A Solidify Understanding Task

Carlos and Clarita are comparing strategies for writing equations of the boundary lines for the "Pet Sitter" constraints. They are discussing their work on the *space* constraint.

- *Space*: Cat pens will require 6 ft^2 of space, while dog runs require 24 ft^2. Carlos and Clarita have up to 360 ft^2 available in the storage shed for pens and runs, while still leaving enough room to move around the cages.

Carlos' Method: "I made a table. If I don't have any dogs, then I have room for 60 cats. If I use some of the space for 1 dog, then I can have 56 cats. With 2 dogs, I can boards 52 cats. For each additional dog, I can board 4 fewer cats. From my table I know the y-intercept of my line is 60 and the slope is -4, so my equation is $y = -4x + 60$."

Clarita's Method: "I let x represent the number of dogs, and y the number of cats. Since dog runs require 24 ft^2, $24x$ represents the amount of space used by dogs. Since cat pens require 6 ft^2, $6y$ represents the space used by cats. So my equation is $24x + 6y = 360$."

1. Since both equations represent the same information, they must be equivalent to each other.

   a. Show the steps you could use to turn Clarita's equation into Carlos' equation. Explain why you can do each step.

   b. Show the steps you could use to turn Carlos' equation into Clarita's. Explain why you can do each step.

2. Use both Carlos' and Clarita's methods to write the equation of the boundary line for the *start-up costs* constraint.

   - *Start-up Costs*: Carlos and Clarita plan to invest much of the $1280 they earned from their last business venture to purchase cat pens and dog runs. It will cost $32 for each cat pen and $80 for each dog run.

3. Show the steps you could use to turn Clarita's *start-up costs* equation into Carlos' equation. Explain why you can do each step.

4. Show the steps you could use to turn Carlos' *start-up costs* equation into Clarita's. Explain why you can do each step.

In addition to writing an equation of the boundary lines, Carlos and Clarita need to graph their lines on a coordinate grid.

Carlos' equations are written in **slope-intercept form**. Clarita's equations are written in **standard form**. Both forms are ways of writing **linear equations**.

Both Carlos and Clarita know they only need to plot two points in order to graph a line.

Carlos' strategy: How might Carlos use his slope-intercept form, $y = -4x + 60$, to plot two points on his line?

Clarita's strategy: How might Clarita use her standard form, $24x + 6y = 360$, to plot two points on her line? (Clarita is really clever, so she looks for the two easiest points she can find.)

Name: Systems | 2.3

Ready, Set, Go!

Ready

Topic: Determining points that satisfy equations and solving systems of equations

Three points are given. Each point is a solution to at least one of the equations. Find the point that satisfies <u>both</u> equations. (This is the solution to the system!) Justify that the point is a solution to both equations and that the others are not.

1. $\begin{cases} y = 2x - 3 \\ y = -x + 3 \end{cases}$
   a. (-2 , 5)
   b. (2 , 1)
   c. (4 , 5)

2. $\begin{cases} y = 3x + 3 \\ y = -x + 3 \end{cases}$
   a. (-1 , 0)
   b. (6 , -3)
   c. (0 , 3)

3. $\begin{cases} y = 2 \\ y = -4x - 6 \end{cases}$
   a. (7 , 2)
   b. (2 , -14)
   c. (-2 , 2)

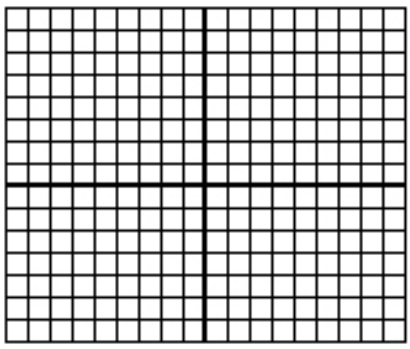
4. $\begin{cases} y = 2x + 4 \\ x + y = -5 \end{cases}$
   a. (1 , 6)
   b. (-3 , -2)
   c. (-3 , 2)

Set

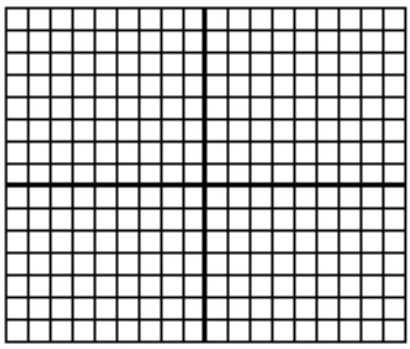
Topic: Graphing linear equations from standard form using intercepts

Graph the following equations by finding the intercepts.

5. $5x - 2y = 10$

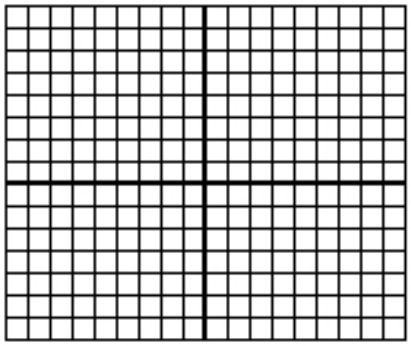


6. $3x - 6y = 24$

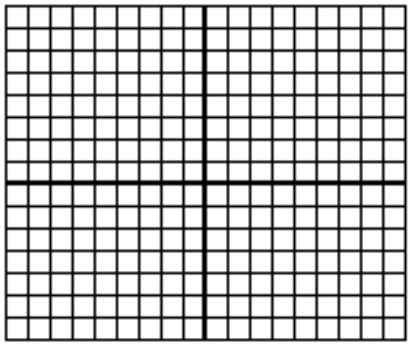


Name: Systems 2.3

7. $6x + 2y = 18$



8. $-2x + 7y = -14$



Go

Topic: Adding and multiplying fractions

Add. Reduce your answers but leave as improper fractions when applicable.

9. $\frac{3}{4} + \frac{1}{8}$

10. $\frac{3}{5} + \frac{7}{10}$

11. $\frac{2}{3} + \frac{1}{4}$

12. $\frac{4}{7} + \frac{8}{21}$

Multiply. Reduce your answers but leave as improper fractions when applicable.

13. $\frac{3}{4} \times \frac{2}{9}$

14. $\frac{4}{7} \times \frac{7}{10}$

15. $\frac{5}{4} \times \frac{2}{9}$

16. $\frac{3}{7} \times \frac{8}{21}$

Need help? Check out these video lessons.

http://www.youtube.com/watch?v=cuNpXve18Pc

http://www.youtube.com/watch?v=6zixwWZ88tk

http://www.youtube.com/watch?v=oHNR0FK_lDE

2.4 Pampering and Feeding Time

A Practice Understanding Task

Carlos and Clarita have been worried about space and start-up costs for their pet sitters business, but they realize they also have a limit on the amount of time they have for taking care of the animals they board. To keep things fair, they have agreed on the following time constraints.

- *Feeding Time*: Carlos and Clarita estimate that cats will require 6 minutes twice a day—morning and evening—to feed and clean their litter boxes, for a total of 12 minutes per day for each cat. Dogs will require 10 minutes twice a day to feed and walk, for a total of 20 minutes per day for each dog. Carlos can spend up to 8 hours each day for the morning and evening feedings, but needs the middle of the day off for baseball practice and games.

- *Pampering Time*: The twins plan to spend 16 minutes each day brushing and petting each cat, and 20 minutes each day bathing or playing with each dog. Clarita needs time off in the morning for swim team and evening for her art class, but she can spend up to 8 hours during the middle of the day to pamper and play with the pets.

Write inequalities for each of these additional time constraints. Shade the solution set for each constraint on separate coordinate grids.

Name: Systems 2.4

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Ready, Set, Go!

Ready

Topic: Substitution and Solving Equations

Determine whether $h = 3$ is a solution to each problem.

1. $3(h-4) = -3$

2. $3h = 2(h+2) - 1$

3. $2h - 3 = h + 6$

4. $3h > -3$

5. $\frac{3}{5} = h \times \frac{1}{5}$

Determine the value of *x* that makes each equation true.

6. $4x - 2 = 8$

7. $3(x+5) = 20$

8. $2x + 3 = 2x - 5$

Set

Topic: Creating equations, solving real world problems, solve systems of equations

A phone company offers a choice of three text-messaging plans. Plan A gives you unlimited text messages for $10 a month; Plan B gives you 60 text messages for $5 a month and then charges you $0.05 for each additional message; and Plan C has no monthly fee but charges you $0.10 per message.

9. Write an equation for the monthly cost of each of the three plans.

10. If you send 30 messages per month, which plan is cheapest?

11. What is the cost of each of the three plans if you send 50 messages per month?

12. Determine the values for which each plan is the cheapest?

Name: Systems 2.4

Go

Topic: Solve literal equations

Re-write each of the following equations for the indicated variable.

13. $3x + 5y = 30$ for y

14. $24x + 6y = 360$ for x

15. $\frac{1280 - 80d}{32} = c$ for d

16. $C = \frac{5}{9}(F - 32)$ for F

17. $y = mx + b$ for b

18. $Ax + By = C$ for y

Need help? Check out these related videos.

What does it mean to be a solution?
http://patrickjmt.com/an-intro-to-solving-linear-equations-what-does-it-mean-to-be-a-solution/
http://patrickjmt.com/solving-linear-equations/

Solving for a variable.
http://www.khanacademy.org/math/algebra/solving-linear-equations/v/solving-for-a-variable

2.5 All For One, One For All

A Solidify Understanding Task

Carlos and Clarita have found a way to represent combinations of cats and dogs that satisfy each of their individual "Pet Sitter" constraints, but they realize that they need to find combinations that satisfy all of the constraints simultaneously. Why?

1. Begin by listing the **system of inequalities** you have written to represent the *start-up costs* and *space* "Pet Sitter" constraints.

2. Find at least 5 combinations of cats and dogs that would satisfy both of the constraints represented by this system of inequalities. How do you know these combinations work?

3. Find at least 5 combinations of cats and dogs that would satisfy one of the constraints, but not the other. For each combination, explain how you know it works for one of the inequalities, but not for other?

4. Shade a region on a coordinate grid that would represent the **solution set to the system of inequalities.** Explain how you found the region to shade.

5. Rewrite your systems of inequalities to include the additional constraints for *feeding time* and *pampering time*.

6. Find at least 5 combinations of cats and dogs that would satisfy all of the constraints represented by this new system of inequalities. How do you know these combinations work?

7. Find at least 5 combinations of cats and dogs that would satisfy some of the constraints, but not all of them. For each combination, explain how you know it works for some inequalities, but not for others?

8. Shade a region of a coordinate grid that would represent the solution set to the system of inequalities consisting of all 4 "Pet Sitter" constraints. Explain how you found the region to shade.

9. Shade a region in quadrant 1 of a coordinate grid that would represent all possible combinations of cats and dogs that satisfy the 4 "Pet Sitter" constraints. This set of points is referred to as the **feasible region** since Carlos and Clarita can feasibly board any of the combinations of cats and dogs represented by the points in this region without exceeding any of their constraints on time, money or space.

10. How is the feasible region shaded in #9 different from the solution set to the system of inequalities shaded in #8?

Name: Systems 2.5

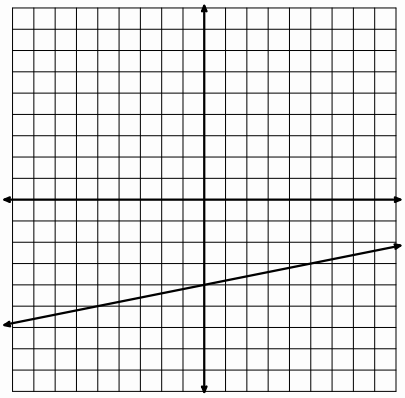
Ready, Set, Go!

Ready

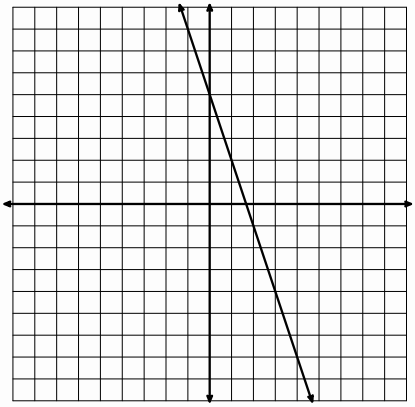
Topic: Graphing two variable inequalities

For each inequality and graph, pick a point and use it to determine which half-plane should be shaded, then shade the correct half-plane.

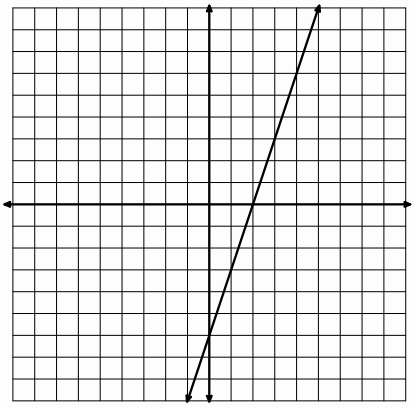
1. $y \leq \frac{1}{5}x - 4$



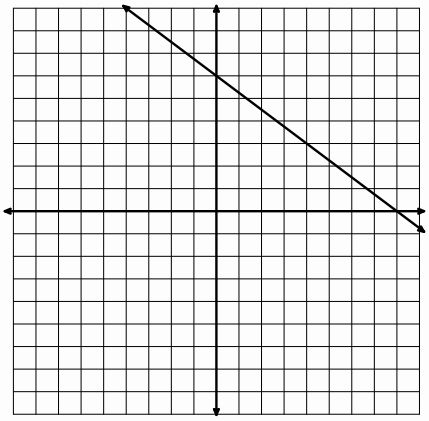
2. $y > -3x + 5$



3. $5x - 2y \leq 10$



4. $3x + 4y > 24$



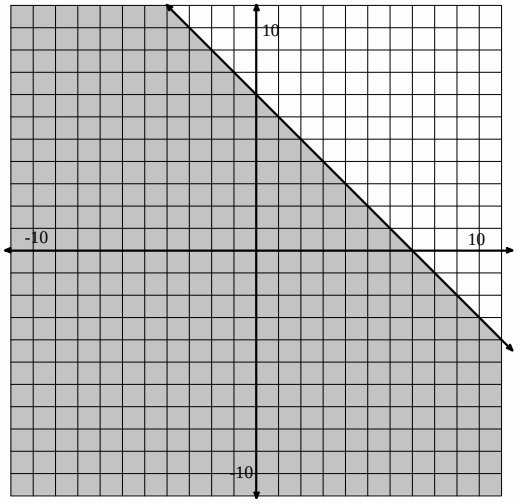
Name: Systems 2.5

Set

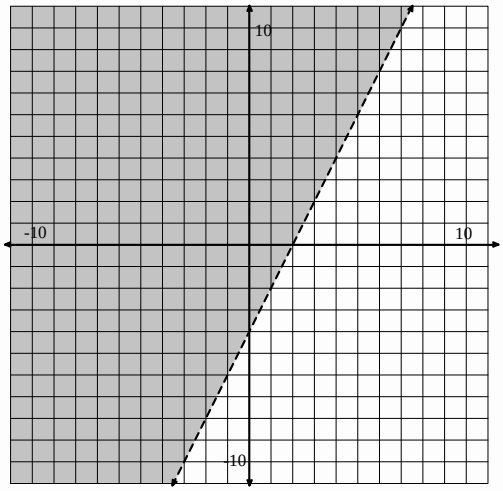
Topic: Writing two variable inequalities

Given the graph with the regions that are shaded write the inequality or system of inequalities.

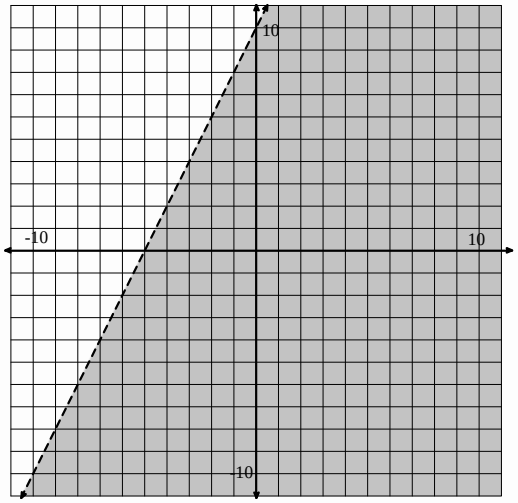
5.



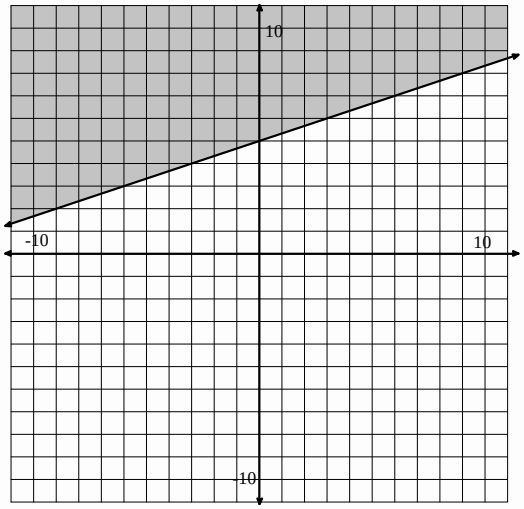
6.



7.



8.



Name: Systems | 2.5

Go

Topic: Proportional relationships

For each proportional relationship below, one representation is provided. Show the remaining representations and explain any connections you notice between representations.

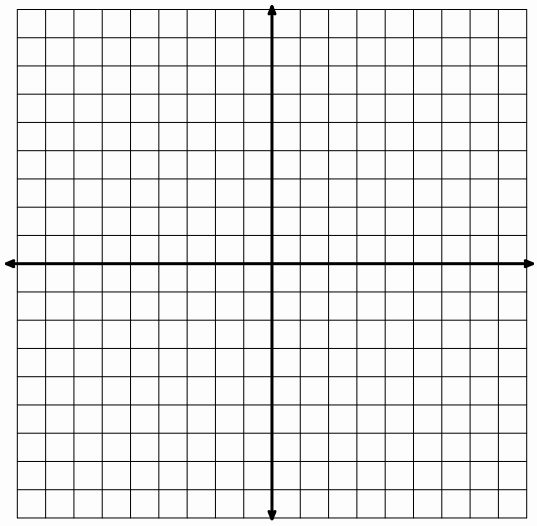
9. **Equation**:

Table

Days	Cost
1	8
2	16
3	24
4	32

Create a context

Graph



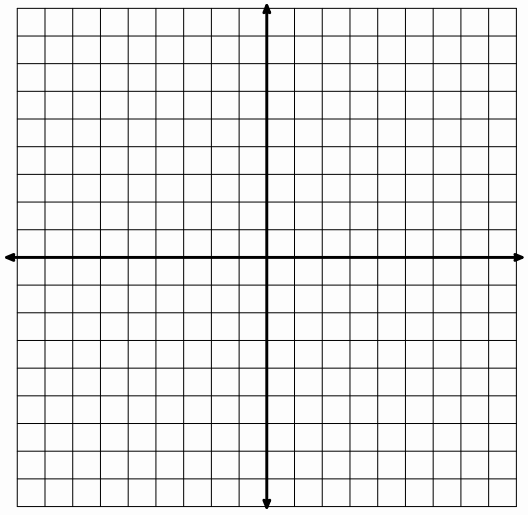
10. **Equation**:

Table

Create a context

Claire earns $9 per week allowance.

Graph

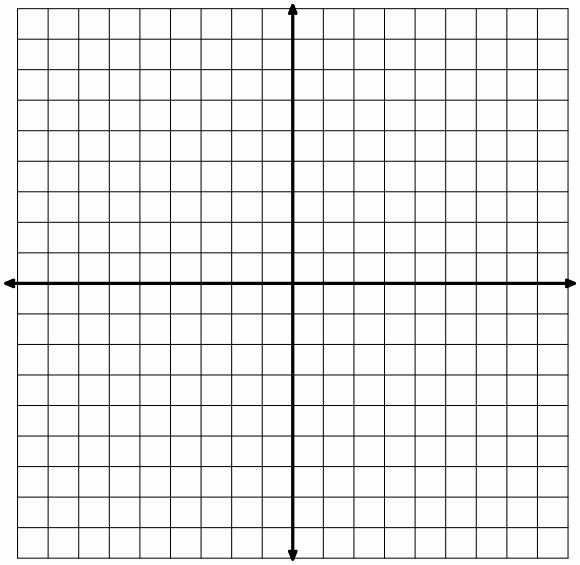


Name: Systems 2.5

11. **Equation**: $y = 3x$

Table

Graph



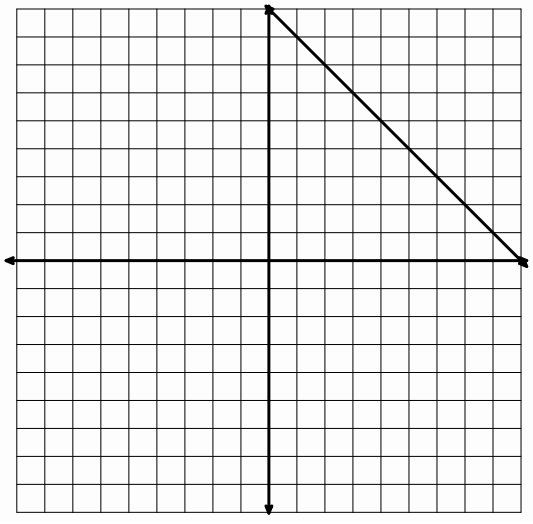
Create a context

12. **Equation**:

Table

Days	Cost

Graph



Create a context

Need Help? Check out these related videos.

http://www.khanacademy.org/math/algebra/linear-equations-and-inequalitie/v/graphing-linear-inequalities-in-two-variables-3

2.6 Get to the Point!

A Solidify Understanding Task

Carlos and Clarita need to clean the storage shed where they plan to board the pets. They have decided to hire a company to clean the windows. After collecting the following information, they have come to you for help deciding which window cleaning company they should hire.

- *Sunshine Express Window Cleaners* charges $50 for each service call, plus $10 per window.
- *"Pane"less Window Cleaners* charges $25 for each service call, plus $15 per window.

1. Which company would you recommend, and why? Prepare an argument to convince Carlos and Clarita that your recommendation is reasonable. (It is always more convincing if you can support your claim in multiple ways. How might you support your recommendation using a table? A graph? Algebra?)

Your presentation to Carlos reminds him of something he has been thinking about—how to find the coordinates of the points where the boundary lines in the "Pet Sitter" constraints intersect. He would like to do this algebraically since he thinks guessing the coordinates from a graph might be less accurate.

2. Write equations for the following two constraints.

   - *Space*
   - *Start-up Costs*

   Find where the two lines intersect algebraically. Record enough steps so that someone else can follow your strategy.

3. Now find the point of intersection for the two time constraints.

   - *Feeding Time*
   - *Pampering Time*

Name: Systems | 2.6

Ready, Set, Go!

Ready

Topic: Determine patterns

Find the next two values in the pattern. Describe how you determined these values.

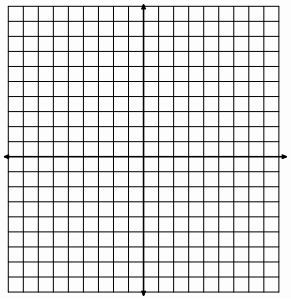
1. 3, 6, 9, 12, ___, ___ Description:
2. 3, 6, 12, 24, ___, ___ Description:
3. 24, 20, 16, 12, ___, ___ Description:
4. 24, 12, 6, 3, ___, ___ Description:

Set

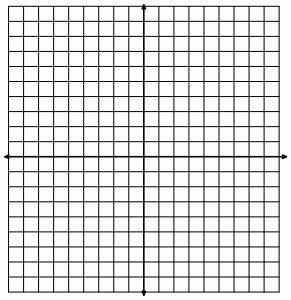
Topic: Solve systems of equations using substitution

For questions 5-8 solve the system of equations using substitution. Check your work by graphing.

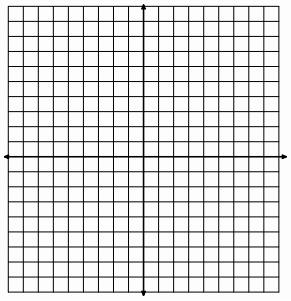
5. $\begin{cases} x + 2y = 9 \\ 3x + 5y = 20 \end{cases}$



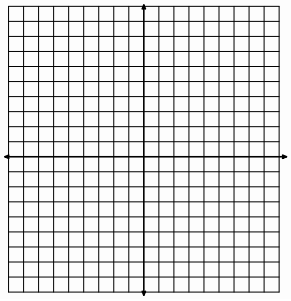
6. $\begin{cases} -4y + 8x = 16 \\ 3y + 21x = 15 \end{cases}$



7. $\begin{cases} x + 2y = -1 \\ 3x + 5y = -1 \end{cases}$



8. $\begin{cases} y = 2x - 3 \\ x + y = -5 \end{cases}$



9. Tickets to a show cost $10 in advance and $15 at the door. If 120 tickets are sold for a total of $1390, how many of the tickets were bought in advance?

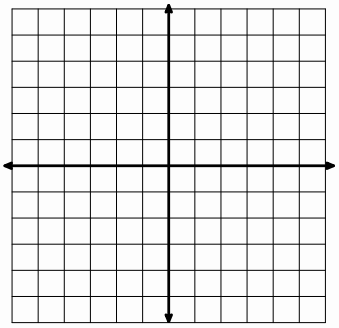
Name: Systems | 2.6

Go

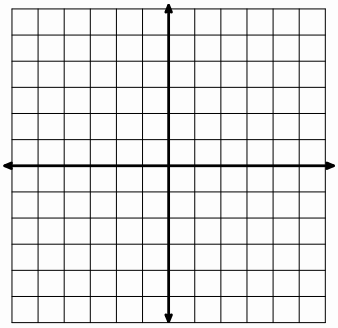
Topic: Graph two variable inequalities

Graph the following inequalities.

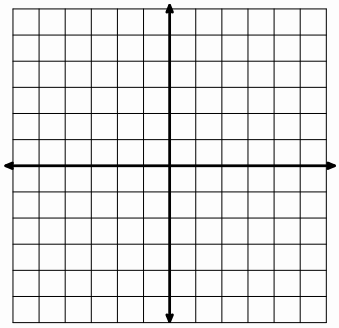
10. $y \leq 3x - 4$



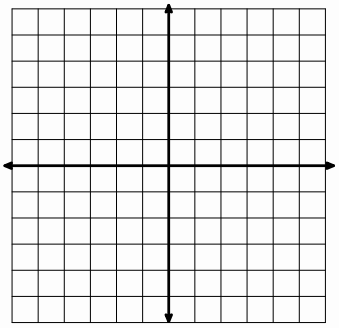
11. $y \leq -2x + 3$



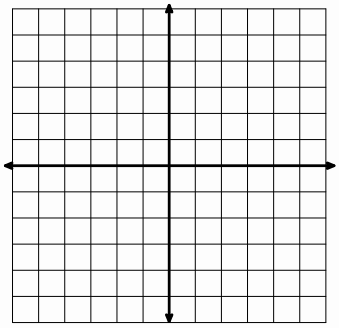
12. $y \geq 4x - 3$



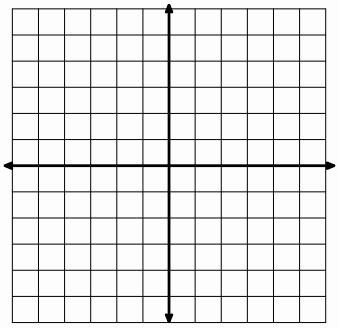
13. $3x + 4y < 12$



14. $6x + 8y \leq 24$



15. $5x + 43 \leq 15$



Need help? Check out these related videos.

http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/solving-systems-by-substitution-3

http://www.khanacademy.org/math/algebra/linear-equations-and-inequalitie/v/solving-and-graphing-linear-inequalities-in-two-variables-1

http://www.khanacademy.org/math/algebra/linear-equations-and-inequalitie/v/graphing-inequalities-2

2.7 Shopping for Cats and Dogs

A Develop Understanding Task

Clarita is upset with Carlos because he has been buying cat and dog food without recording the price of each type of food in their accounting records. Instead, Carlos has just recorded the total price of each purchase, even though the total cost includes more that one type of food. Carlos is now trying to figure out the price of each type of food by reviewing some recent purchases. See if you can help him figure out the cost of particular items for each purchase, and be prepared to explain your reasoning to Carlos.

1. One week Carlos bought 3 bags of *Tabitha Tidbits* and 4 bags of *Figaro Flakes* for $43.00. The next week he bought 3 bags of *Tabitha Tidbits* and 6 bags of *Figaro Flakes* for $54.00. Based on this information, figure out the price of one bag of each type of cat food. Explain your reasoning.

2. One week Carlos bought 2 bags of *Brutus Bites* and 3 bags of *Lucky Licks* for $42.50. The next week he bought 5 bags of *Brutus Bites* and 6 bags of *Lucky Licks* for $94.25. Based on this information, figure out the price of one bag of each type of dog food. Explain your reasoning.

3. Carlos purchased 6 dog leashes and 6 cat brushes for $45.00 for Clarita to use while pampering the pets. Later in the summer he purchased 3 additional dog leashes and 2 cat brushes for $19.00. Based on this information, figure out the price of each item. Explain your reasoning.

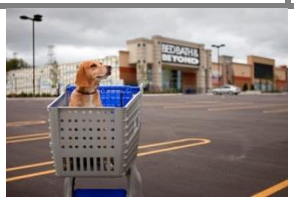
4. One week Carlos bought 2 packages of dog bones and 4 packages of cat treats for $18.50. Because the finicky cats didn't like the cat treats, the next week Carlos returned 3 unopened packages of cat treats and bought 2 more packages of dog bones. After being refunded for the cat treats, Carlos only had to pay $1.00 for his purchase. Based on this information, figure out the price of each item. Explain your reasoning.

5. Carlos has noticed that because each of his purchases have been somewhat similar, it has been easy to figure out the cost of each item. However, his last set of receipts has him puzzled. One week he tried out cheaper brands of cat and dog food. On Monday he purchased 3 small bags of cat food and 5 small bags of dog food for $22.75. Because he went through the small bags quite quickly, he had to return to the store on Thursday to buy 2 more small bags of cat food and 3 more small bags of dog food, which cost him $14.25. Based on this information, figure out the price of each bag of the cheaper cat and dog food. Explain your reasoning.

Summarize the strategies you have used to reason about the price of individual items in the problems given above. What are some key ideas that seem helpful?

Name: Systems 2.7

Ready, Set, Go!



Ready

Topic: Exponents

Write the following in exponential notation.

1. $4 \times 4 \times 4 \times 4 \times 4$
2. $3x \cdot 3x \cdot 3x \cdot 3x$

Find each value.

3. 2^3
4. 3^3
5. 2^5
6. $(-2)^3$
7. 4^3

Set

Topic: Solving systems

8. Nadia and Peter visit the candy store. Nadia buys three candy bars and four fruit roll-ups for $2.84. Peter also buys three candy bars, but can only afford one additional fruit roll-up. His purchase costs $1.79. What is the cost of a candy bar and a fruit roll-up individually?

9. A farmer noticed that his chickens were loose and were running around with the cows in the cow pen. He quickly counted 100 heads and 270 legs. How many chickens did he have and how many cows?

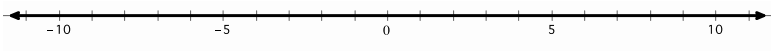
Name: Systems | 2.7

Go

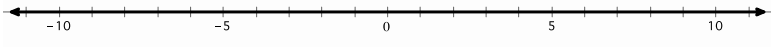
Topic: Solve one variable inequalities.

Solve the following inequalities. Write the solution set in *interval notation* and graph the solution set on a number line.

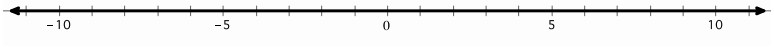
10. $4x + 10 < 2x + 14$



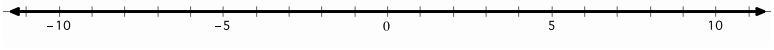
11. $2x + 6 > 55 - 5x$



12. $2(\frac{x}{4} + 3) > 6(x - 1)$



13. $9x + 4 \leq -2(x + \frac{1}{2})$



Solve each inequality. Give the solution in *inequality notation* and *set notation*.

14. $-\frac{x}{3} > -\frac{10}{9}$

15. $5x > 8x + 27$

16. $\frac{x}{4} > \frac{5}{4}$

17. $3x - 7 \geq 3(x - 7)$

18. $2x < 7x - 36$

19. $5 - x < 9 + x$

Need help? Check out these related videos?

Exponential notation:
http://www.khanacademy.org/math/algebra/exponents-radicals/v/understanding-exponents

Solving inequalities:
http://www.khanacademy.org/math/algebra/solving-linear-inequalities/v/solving-inequalities
http://www.khanacademy.org/math/algebra/solving-linear-inequalities/v/multi-step-inequalities-2

Set notation and interval notation:
http://patrickjmt.com/using-interval-notation-to-express-inequalities-ex1/

2.8 Can You Get to the Point, Too?

A Solidify Understanding Task

Part 1

In "Shopping for Cats and Dogs," Carlos found a way to find the cost of individual items when given the purchase price of two different combinations of those items. He would like to make his strategy more efficient by writing it out using symbols and algebra. Help him formalize his strategy by doing the following:

- For each scenario in "Shopping for Cats and Dogs" write a **system of equations** to represent the two purchases.
- Show how your strategies for finding the cost of individual items could be represented by manipulating the equations in the system. Write out intermediate steps symbolically, so that someone else could follow your work.
- Once you find the price of one of the items in the combination, show how you would find the price of the other item.

Part 2

Writing out each system of equations reminded Carlos of his work with solving systems of equations graphically. Show how each scenario in "Shopping for Cats and Dogs" can be represented graphically, and how the cost of each item shows up in the graphs.

Part 3

Carlos also realized that the algebraic strategy he created in part 1 could be used to find the points of intersection for the "Pet Sitters" constraints. Use the **elimination of variables** method developed in part 1 to find the point of intersection for each of the following pairs of "Pet Sitter" constraints.

- *Start-up costs* and *space* constraints
- *Pampering time* and *feeding time* constraints
- Any other pair of "Pet Sitter" constraints of your choice

Name: Systems | 2.8

Ready, Set, Go!

Ready

Topic: Evaluate exponents

Simplify and evaluate the following.

1. 3^{-2}
2. $(0.5)^{-2}$
3. 2^4
4. 4^{-2}

Write the following expression three different ways (one way can include the simplified value).

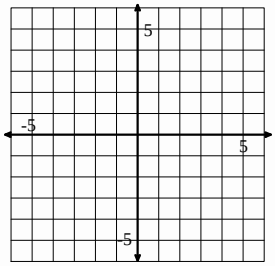
5. $(2^3)(4)$
6. $(3^3)(2^3)$

Set

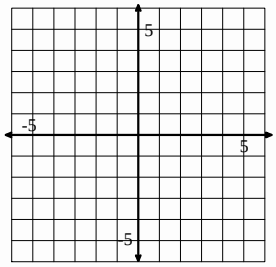
Topic: Solve systems of equations

Solve the following systems of equations using *elimination* of variables, then justify graphically.

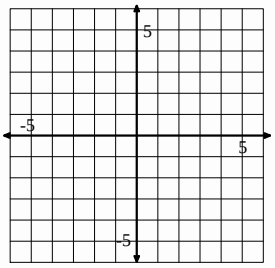
7. $\begin{cases} 2x + 0.5y = 3 \\ x + 2y = 8.5 \end{cases}$



8. $\begin{cases} 3x + 5y = -1 \\ x + 2y = -1 \end{cases}$



9. $\begin{cases} 3x + 5y = -3 \\ x + 2y = -\frac{4}{3} \end{cases}$



10. A 150-yard pipe is cut to provide drainage for two fields. If the length of one piece (a) is three yards less than twice the length of the second piece (b), what are the lengths of the two pieces?

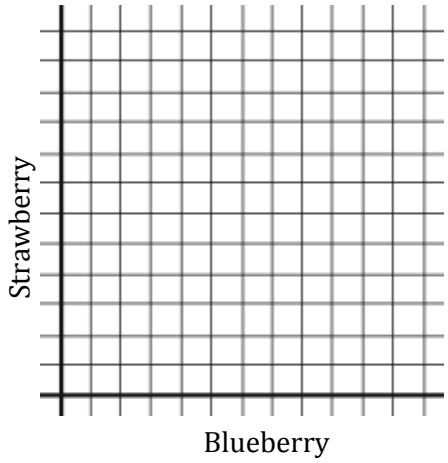
Name: Systems | 2.8

Go

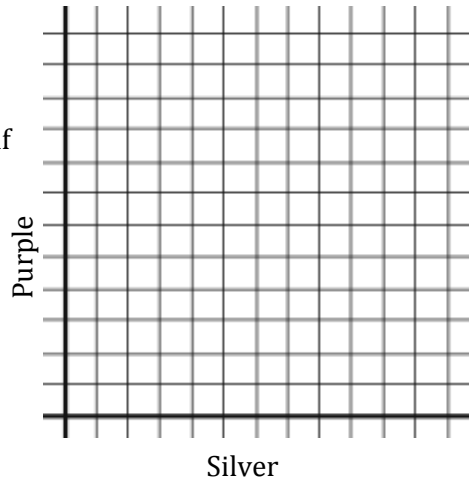
Topic: Graph two variable linear inequalities

Graph the following linear inequalities on the graphs below. Include constraints.

11. Ben has enough money to buy up to eight yogurts. If his favorite flavors are blueberry and strawberry, what are all the possible combinations he can buy? Graph the inequality that shows all possible combinations of his favorite flavors.



12. Peggy is buying a balloon bouquet. Her favorite colors are silver and purple. The silver balloons are $1 and the purple balloons are $0.80. Graph an inequality that shows how many of each color balloon she can put in her bouquet if she doesn't spend more than $20.



Need help? Check out these related videos.

Negative exponents
http://patrickjmt.com/negative-exponents/
http://www.khanacademy.org/math/algebra/ck12-algebra-1/v/zero--negative--and-fractional-exponents

Solving systems by elimination
http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/solving-systems-by-elimination-2

Solving systems by graphing
http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/solving-linear-systems-by-graphing

2.9 Food for Fido and Fluffy

A Solidify Understanding Task

Carlos and Clarita have found two different cat foods that seem to appeal to even the most finicky of cats: *Tabitha Tidbits* and *Figaro Flakes.* Each ounce of *Tabitha Tidbits* contains 2 grams of protein, 4 grams of carbohydrates and 4 grams of fat. Each ounce of *Figaro Flakes* contains 3 grams of protein, 4 grams of carbohydrates and 2 grams of fat. Since *Tabitha Tidbits* is fairly expensive, while *Figaro Flakes* is very cheap, the twins have decided to create a new cat food by mixing the two. After studying some nutritional guidelines for cats, Carlos and Clarita have decided to create a mixture based on the following constraints.

- *Amount of Protein*: Each meal should contain at least 12 grams of protein.
- *Amount of Carbohydrates:* Each meal should contain more than 16 grams of carbohydrates.
- *Amount of Fats:* Each meal should contain no more than 18 grams of fat.
- *Size of a Feeding:* Each meal should consist of less than 10 ounces of food.

For the work that follows, let *T* represent the number of ounces of *Tabitha Tidbits* in a meal and let *F* represent the number of ounces of *Figaro Flakes.*

1. Write an inequality for each of the constraints.

2. On separate coordinate grids, graph the solution set for each of the inequalities you wrote in #1. How do you know on which side of the boundary line you should shade the half-plane that represents the solution set?

3. Decide if the boundary line for each inequality represented in #2 should be a solid line or a dotted line. Which words or phrases in the constraints suggested a solid line? A dotted line?

4. Find at least 5 combinations of *Tabitha Tidbits* and *Figaro Flakes* Carlos and Clarita can mix together to create a nutritious cat meal. Show that these points lie within a feasible region for these constraints.

5. *Brutus Bites* is a brand of dog food that contains 4 grams of protein and 6 grams of fat per ounce. *Lucky Licks* is another brand of dog food that contains 12 grams of protein and 4 grams of fat per ounce. Carlos wants to make a meal for dogs that contains at least 8 grams of protein and no more than 6 grams of fat. Write and solve a system of inequalities that Carlos can use to determine a combination of *Brutus Bites* and *Lucky Licks* that will satisfy these constraints.

Name: Systems | 2.9

Ready, Set, Go!

Ready

Topic: Solving two variable inequalities

1. A theater wants to take in at least $2000 for a certain matinee. Children's tickets cost $5 each and adult tickets cost $10 each.

a. Write an inequality describing the number of tickets that will allow the theater to meet their goal of $2000.

b. If the theater has a maximum of 350 seats, write an inequality describing the number of both types of tickets the theater can sell.

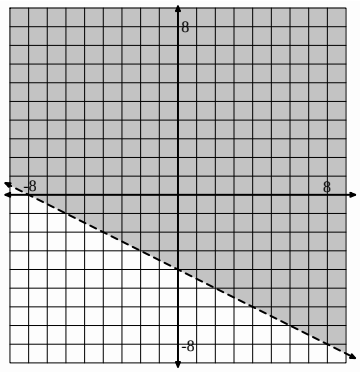
c. Find the number of children and adult tickets that can be sold so that all seats are sold and the $2000 goal is reached.

Set

Topic: Writing equations of two variable inequalities

Given the graph with the regions that are shaded write the inequality or system of inequalities.

2.



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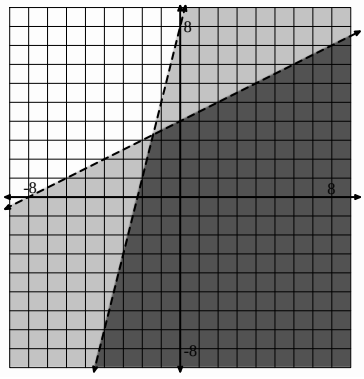

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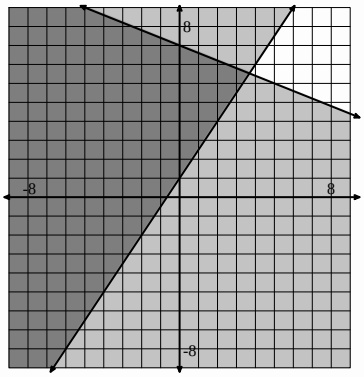


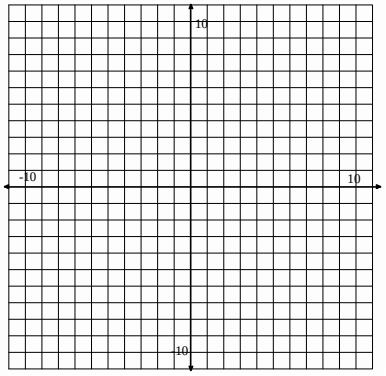
Name: Systems | 2.9

Go

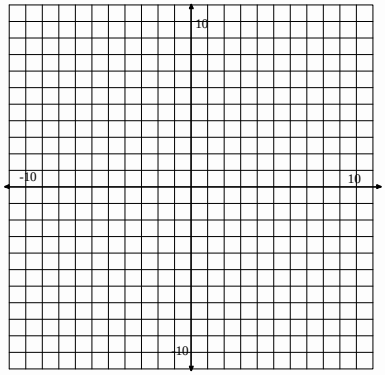
Topic: Graph two variable inequalities

Graph each set of inequalities below. Include the shaded region of both, plus indicate the region that is true for all inequalities.

5. $\begin{cases} x - y < -6 \\ 2y \geq 3x + 18 \end{cases}$



6. $\begin{cases} 5x - y \geq 5 \\ 2y - x \geq -10 \end{cases}$



Solve the following systems of equations.

7. Nadia and Peter visit the candy store. Nadia buys three candy bars and four fruit roll-ups for $2.84. Peter also buys three candy bars, but can only afford one additional fruit roll-up. His purchase costs $1.79. What is the cost of a candy bar and a fruit roll-up individually?

8. $\begin{cases} 5x - 10y = 15 \\ 3x - 2y = 3 \end{cases}$

9. $\begin{cases} 5x - y = 10 \\ 3x - 2y = -1 \end{cases}$

Need help? Check out these related videos.

http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/graphing-systems-of-inequalities-2

2.10 Taken Out of Context

A Practice Understanding Task

Write a shopping scenario similar to those in "Shopping for Cats and Dogs" to fit each of the following systems of equations. Then use the elimination of variables method you invented in "Can You Get to the Point, Too" to solve the system. Some of the systems may have interesting or unusual solutions. See if you can explain them in terms of the shopping scenarios you wrote.

1. $\begin{cases} 3x+4y=23 \\ 5x+3y=31 \end{cases}$

2. $\begin{cases} 2x+3y=14 \\ 4x+6y=28 \end{cases}$

3. $\begin{cases} 3x+2y=20 \\ 9x+6y=35 \end{cases}$

4. $\begin{cases} 4x+2y=8 \\ 5x+3y=9 \end{cases}$

Three of Carlos' and Clarita's friends are purchasing school supplies at the bookstore. Stan buys a notebook, three packages of pencils and two markers for $7.50. Jan buys two notebooks, six packages of pencils and five markers for $15.50. Fran buys a notebook, two packages of pencils and two markers for $6.25. How much do each of these three items cost?

Explain in words or with symbols how you can use your intuitive reasoning about these purchases to find the price of each item.

Name: Systems | 2.10

Ready, Set, Go!

Ready

Topic: Systems of Inequalities

For each of the systems of inequalities, determine if the given coordinates are solutions to the system.

1. $\begin{cases} y \le 3x - 5 \\ y \ge x + 2 \end{cases}$

   a. (6 , 10)

   b. (1 , 4)

   c. (8 , 15)

2. $\begin{cases} y > -2x + 9 \\ y \ge 5x - 6 \end{cases}$

   a. (-2 , -5)

   b. (-1 , 12)

   c. (5 , 0)

3. $\begin{cases} y < -\frac{1}{2}x + 9 \\ y > 6x - 10 \end{cases}$

   a. (-2 , -5)

   b. (7 , 3)

   c. (-8 , 10)

Set

Topic: Determine the number of solutions in a system of equations

Express each equation in slope-intercept form. *Without graphing*, state whether the system of equations has zero, one or infinite solutions. How do you know?

4. $\begin{cases} 3x - 4y = 13 \\ y = -3x - 7 \end{cases}$

5. $\begin{cases} 3x - 3y = 3 \\ x - y = 1 \end{cases}$

6. $\begin{cases} 0.5x - y = 30 \\ 0.5x - y = -30 \end{cases}$

7. $\begin{cases} 4x - 2y = -2 \\ 3x + 2y = -12 \end{cases}$

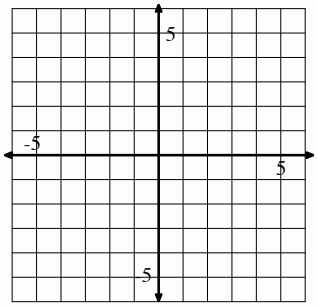
Name: Systems | 2.10

Go

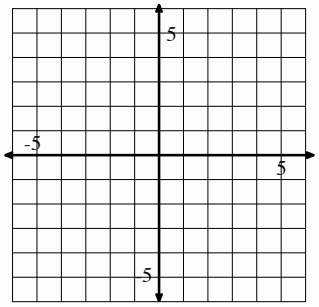
Topic: Graph two variable inequalities

Graph the following inequalities. Be sure to label your axes and scale. Justify the region you shade by showing three points in the region as being solutions to the problem. Show a point you have tested to prove your shaded region is accurate.

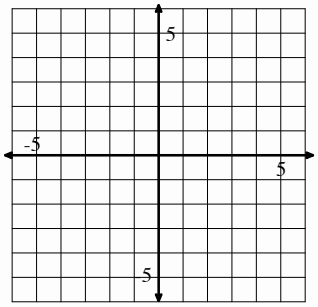
8. $3x - 4y \geq 12$



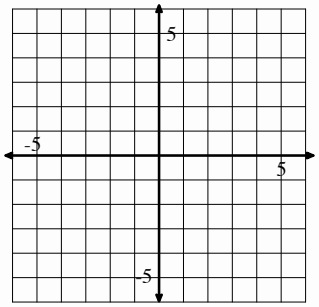
9. $x + 6y < 6$



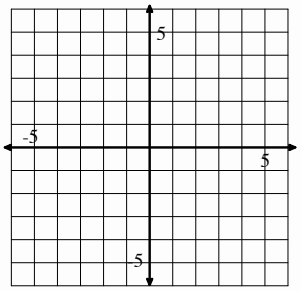
10. $6x + 5y > 1$



11. $x - \frac{1}{2}y \geq 3$



12. On the same set of axes, graph $y < x + 2$ and $y > x + 5$. What values do these two have in common?

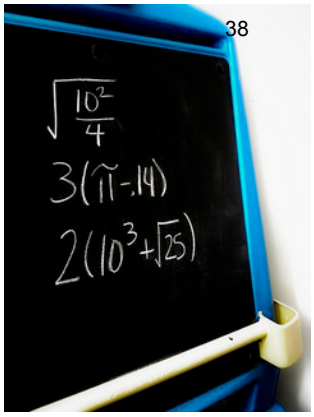


Need help? Check out these related videos

Testing a solution to an equation
http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/testing-a-solution-for-a-system-of-equations

Number of solutions
http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/special-types-of-linear-systems

Solving inequalities
http://www.khanacademy.org/math/algebra/solving-linear-inequalities/v/solving-inequalities



2.11 More Things Taken Out of Context

A Practice Understanding Task

Solve the following systems of inequalities:

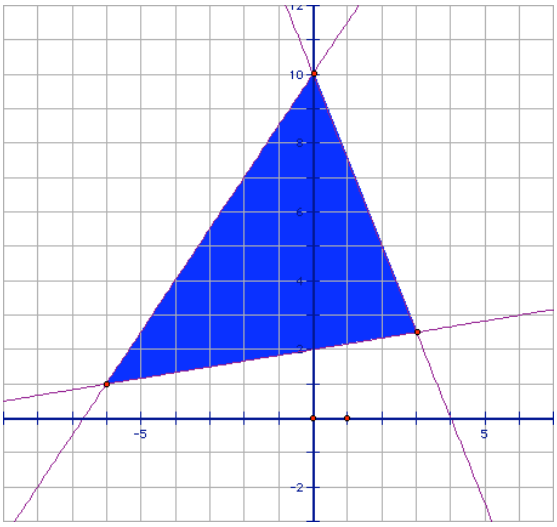
1. $\begin{cases} -5x + 3y \le 45 \\ 2x + 3y > 24 \end{cases}$

2. $\begin{cases} -10x + 6y \le 90 \\ 6x + 9y > 36 \end{cases}$

3. Is the point (-3, 10) a solution to the system in problem #1? Why or why not?

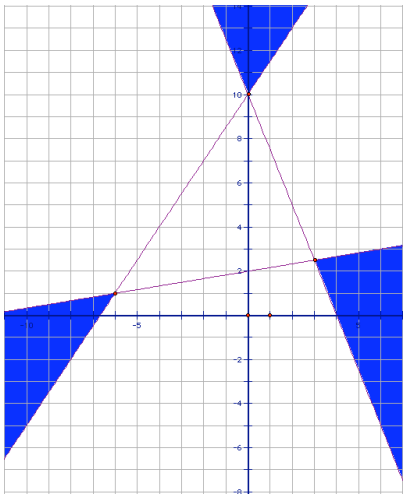
4. How are the inequalities representing the boundaries of the solution sets in problems #1 and #2 similar to each other? What accounts for these similarities?

5. Write the system of inequalities whose solution set is shown below:



6. Amanda is examining Frank's work on #5, when she exclaims, "You have written all of your inequalities backwards. The solution set to your system would look like this."

What do you think about Amanda's statement?



Name: More Things Taken out of Context | 2.11

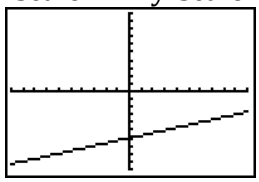
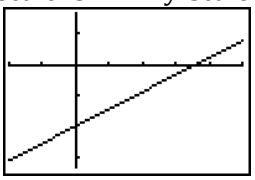
Ready, Set, Go!

Ready

Topic: Determine a good viewing window for graphs

When sketching a graph of a function, it is important that we see important points. For linear functions, we want a window that shows important information related to the story. Often, this means including both the x- and y-intercepts.

Example: $g(x) = \frac{1}{3}x - 6$

Window: [-10, 10] by [-10,10]	Window: [-10, 25] by [-10, 5]
x- scale: 1 y-scale: 1	x-scale: 5 y-scale: 5
	
NOT a good window	Good window

For the following equations, state a window that would be satisfactory for the given equation. Then sketch a graph in the boxes provided.

1. $f(x) = 3x - 100$

x: [,] by y: [,]

x-scale: y-scale:

2. $5x + 7y = 15$

x: [,] by y: [,]

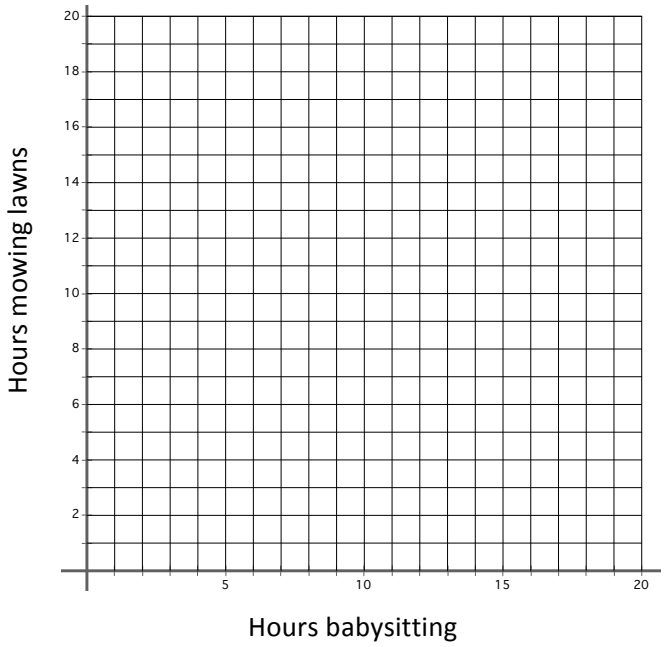
x-scale: y-scale:

Name: More Things Taken out of Context | 2.11

Set

Topic: Creating and solving two variable inequalities

3. Patty makes $8 per hour mowing lawns and $12 per hour babysitting. She wants to make at least $100 per week but can work no more than 12 hours a week. Write and graph a system of linear inequalities. Finally, list 2 possible combinations of hours that Patty could work at each job.



Go

Topic: Solve systems of equations

Solve each system of equations using any method you prefer

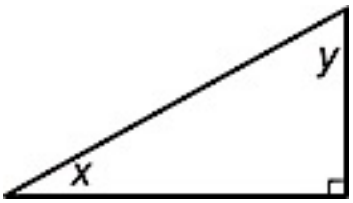
4. $\begin{cases} 3x + 5y = -3 \\ x + 2y = -\frac{4}{3} \end{cases}$

5. $\begin{cases} x - y = -\frac{12}{5} \\ 2x + 5y = -2 \end{cases}$

Name: More Things Taken out of Context | 2.11

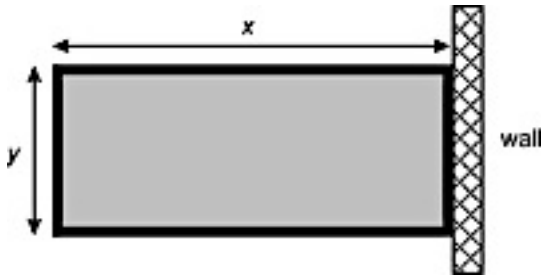
Create a system of equations and use it to solve the following questions.

6. Of the two non-right angles in a right triangle, one measures twice as many degrees as the other. What are the angles?

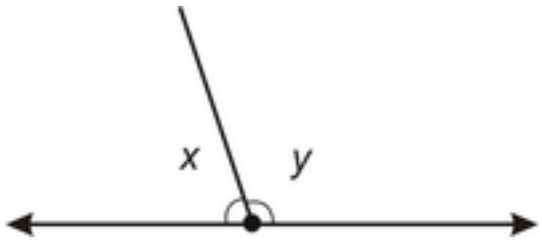


7. The sum of two numbers is 70 and the difference is 11. What are the numbers?

8. A rectangular field is enclosed by a fence on three sides and a wall on the fourth side. The total length of the fence is 320 yards. If the field has a total perimeter of 400 yards, what are the dimensions of the field?



9. A ray cuts a line forming two angles. The difference between the two angles is $18°$. What does each angle measure?



Need Help? Check out these related videos:

http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/system-of-inequalities-application

2.12 Pet Sitters Revisited

A Develop Understanding Task

Carlos and Clarita have successfully found a way to represent *all* of the combinations of cats and dogs that they can board based on *all* of the following constraints.

- *Space*: Cat pens will require 6 ft^2 of space, while dog runs require 24 ft^2. Carlos and Clarita have up to 360 ft^2 available in the storage shed for pens and runs, while still leaving enough room to move around the cages.

- *Feeding Time*: Carlos and Clarita estimate that cats will require 6 minutes twice a day—morning and evening—to feed and clean their litter boxes, for a total of 12 minutes per day for each cat. Dogs will require 10 minutes twice a day to feed and walk, for a total of 20 minutes per day for each dog. Carlos can spend up to 8 hours each day for the morning and evening feedings, but needs the middle of the day off for baseball practice and games.

- *Pampering Time*: The twins plan to spend 16 minutes each day brushing and petting each cat, and 20 minutes each day bathing or playing with each dog. Clarita needs time off in the morning for swim team and evening for her art class, but she can spend up to 8 hours during the middle of the day to pamper and play with the pets.

- *Start-up Costs*: Carlos and Clarita plan to invest much of the $1280 they earned from their last business venture to purchase cat pens and dog runs. It will cost $32 for each cat pen and $80 for each dog run.

Now they are trying to determine how many of each type of pet they should plan to accommodate. Of course, Carlos and Clarita want to make as much money as possible from their business, so they need to pay attention to both their daily income as well as their daily costs. They plan to charge $8 per day for boarding each cat and $20 per day for each dog. They estimate that each cat will require $2.00 per day in food and supplies, and that each dog will require $4.00 per day in costs.

After surveying the community regarding the pet boarding needs, Carlos and Clarita are confident that they can keep all of their boarding spaces filled for the summer.

So the question is, how many of each type of pet should they prepare for in order to make as much money as possible?

What combination of cats and dogs do you think will make the most money? What recommendations would you give to Carlos and Clarita, and what argument would you use to convince them that your recommendation is reasonable?

To get started on this task, you might want to look for collections of points where the daily profit is the same. For example, can you find a collection of points where for each point the daily profit is $120? What about $180?

Name: Systems | 2.12

Ready, Set, Go!

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Ready

Topic: Solve exponential equations

Find the value of *x* for each situation.

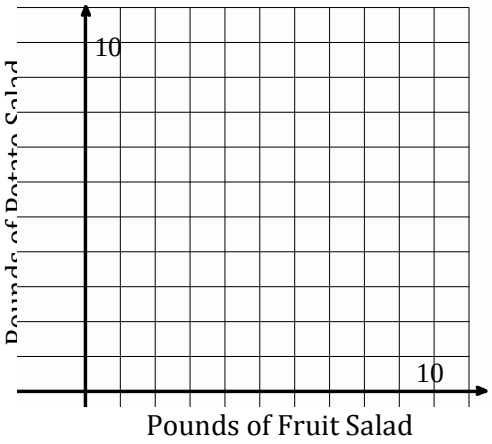
1. $2^x = 8$
2. $3^x = 27$
3. $2^x = 4$
4. $(-2)^x = -8$

Set

Topic: Create and solve two variable inequalities

5. Jane is buying fruit salad and potato salad for a picnic. Fruit salad costs $2.00 per pound and potato salad costs $4.00 per pound. Jane needs to buy at least 6 pounds of salads and she doesn't want to spend more than $20. Write and graph a system of linear inequalities. Also, list 2 possible combinations of salad Jane could buy.

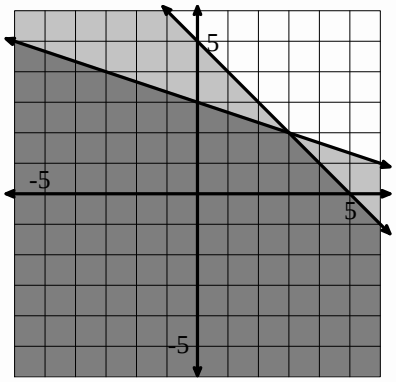
Let x = pounds of fruit salad and
y = pounds of potato salad.



Go

Topic: Find the solution region of the following systems of inequalities.

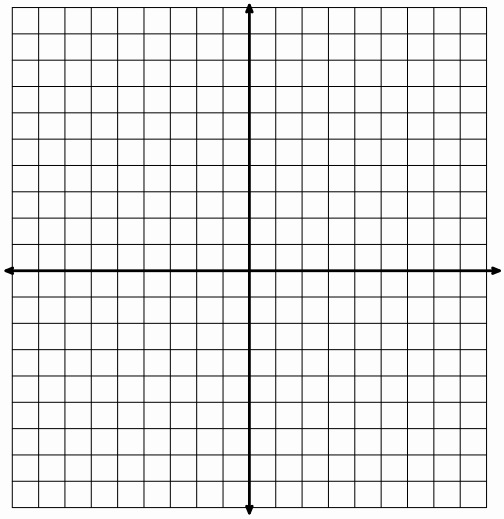
6. Write the system of inequalities that is represented in the graph to the right.



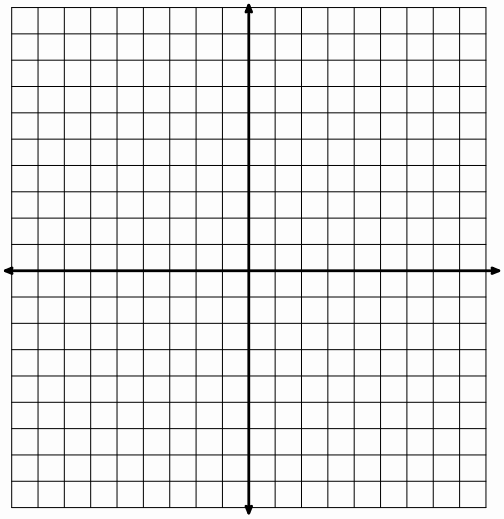
Name: Systems 2.12

Graph each set of inequalities and determine the solution region.

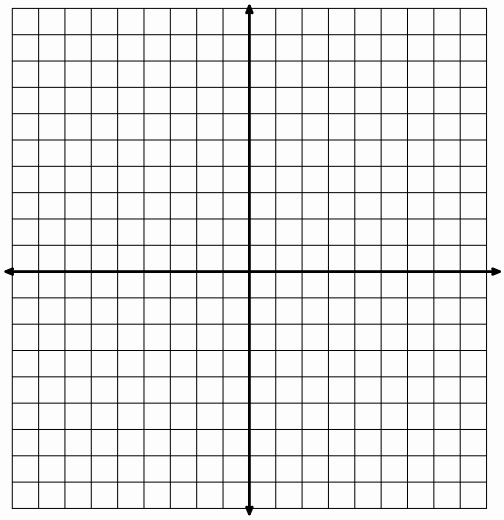
7. $\begin{cases} x - y < -6 \\ -2y \geq 3x - 18 \end{cases}$



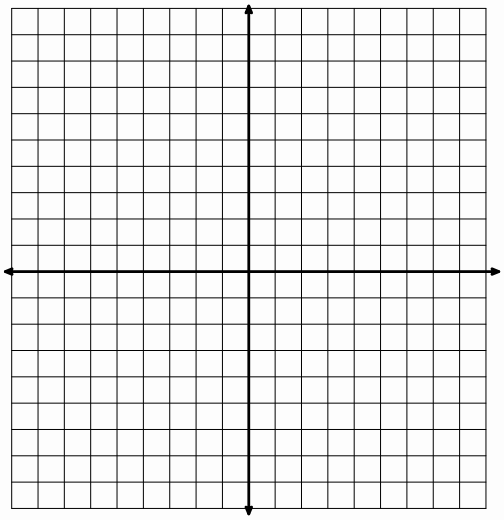
8. $\begin{cases} 5x - y \geq 5 \\ 2y - x \geq 10 \end{cases}$



9. $\begin{cases} 5x + 2y \geq -10 \\ 3x - 2y \leq 18 \\ 3x - 9y \geq 27 \end{cases}$



10. $\begin{cases} 2x - 3y \leq 24 \\ x + 4y \leq 8 \\ 3x + y \geq -3 \end{cases}$



Need help? Check out these related videos.

Exponents http://patrickjmt.com/exponents-intro-to-evaluating-a-few-truefalse-questions/

Rules for exponents http://patrickjmt.com/basic-exponent-properties/

Solving a system of inequalities http://www.khanacademy.org/math/algebra/ck12-algebra-1/v/systems-of-linear-inequalities

2.13H To Market with Matrices

A Solidify Understanding Task

Carlos learned about matrices when Elvira, the manager of the school cafeteria, was asked to substitute teach during one of the last days of school before summer vacation. Now that he has worked out a strategy for solving systems of equations by elimination of variables, he is wondering if matrices can help him keep track of his work.

Carlos is reconsidering the following scenario from "Shopping for Cats and Dogs", while trying to record his thinking using matrices.

> *One week Carlos purchased 6 dog leashes and 6 cat brushes for $45.00 for Clarita to use while pampering the pets. Later in the summer he purchased 3 additional dog leashes and 2 cat brushes for $19.00. What is the price of each item?*

Carlos realizes that he can represent this scenario using the following matrix:

$$\begin{array}{c} \\ \textit{purchase}\ 1 \\ \textit{purchase}\ 2 \end{array} \begin{array}{c} \begin{array}{ccc} \textit{leashes} & \textit{brushes} & \textit{total} \end{array} \\ \begin{bmatrix} 6 & 6 & \$45.00 \\ 3 & 2 & \$19.00 \end{bmatrix} \end{array}$$

He also realizes that he can represent the cost of each item with a matrix that looks like this:

$$\begin{array}{c} \\ \textit{purchase}\ 1 \\ \textit{purchase}\ 2 \end{array} \begin{array}{c} \begin{array}{ccc} \textit{leashes} & \textit{brushes} & \textit{total} \end{array} \\ \begin{bmatrix} 1 & 0 & \$4.00 \\ 0 & 1 & \$3.50 \end{bmatrix} \end{array}$$

So, now he is trying to find a sequence of matrices that can fill in the gaps between the first matrix and the last. He knows from his previous work with solving systems of equations that he can do any of the following manipulations with equations—and he realizes that each of these manipulations would give him a new row of numbers in a corresponding matrix.

- Replace an equation in the system with a constant multiple of that equation
- Replace an equation in the system with the sum or difference of the two equations
- Replace an equation with the sum of that equation and a multiple of the other

1. Help Carlos find a sequence of matrices that starts with the matrix that represents the original purchases, and ends with the matrix that represents purchasing one leash or purchasing one brush. For each matrix in your sequence, write out the justification that allows you to write that matrix based on the three manipulations we can perform on the equations in a system. For example, the following matrix transformation can be justified by writing "I replaced the first row of the matrix by multiplying the first row by $\frac{1}{6}$."

$$\begin{bmatrix} 6 & 6 & 45.00 \\ 3 & 2 & 19.00 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 1 & 7.50 \\ 3 & 2 & 19.00 \end{bmatrix}$$

2. Find and justify a sequence of matrices that could be used to solve the following scenario.

   One week Carlos tried out cheaper brands of cat and dog food. On Monday he purchased 3 small bags of cat food and 5 small bags of dog food for $22.75. Because he went through the small bags quite quickly, he had to return to the store on Thursday to buy 2 more small bags of cat food and 3 more small bags of dog food, which cost him $14.25. Based on this information, can you figure out the price of each bag of the cheaper cat and dog food?

Name: To Market with Matrices **2.13H**

Ready, Set, Go!

Ready

Topic: Solving Systems by Substitution and Elimination

Solve each system of equations using any algebraic method.

1. $\begin{cases} 3x - y = 1 \\ 3x + 2y = 16 \end{cases}$

2. $\begin{cases} x + 2y = 5 \\ 3x + 5y = 14 \end{cases}$

3. $\begin{cases} 4x + 2y = -8 \\ x - 2y = -7 \end{cases}$

4. $\begin{cases} 2x + 3y = 2 \\ 3x - 4y = -14 \end{cases}$

5. $\begin{cases} x + 2y = 11 \\ x - 4y = 2 \end{cases}$

6. $\begin{cases} 2x + y = 0 \\ 5x + 3y = 1 \end{cases}$

Name: To Market with Matrices | 2.13H

Set

Topic: Row reductions in Matrices

7. Create a matrix to match each step in the solving of the system of equations given. Also, write a description of what happened to the equation and the matrix between steps.

	System of Equations	Description	Matrix
Given System	$\begin{cases} 3x + 2y = 40 \\ x - 7y = -2 \end{cases}$		$\left[\begin{array}{cc\|c} 3 & 2 & 40 \\ 1 & -7 & -2 \end{array}\right]$
	↓	$-3R_2 \rightarrow R_2$	↓
Step 1	$\begin{cases} 3x + 2y = 40 \\ -3x + 21y = 6 \end{cases}$	↓	$\left[\begin{array}{cc\|c} & 2 & 40 \\ -3 & & 6 \end{array}\right]$
	↓		↓
Step 2	$\begin{cases} 3x + 2y = 40 \\ 0x + 23y = 46 \end{cases}$	↓	$\left[\begin{array}{cc\|c} & & 40 \\ 0 & & \end{array}\right]$
	↓		↓
Step 3	$\begin{cases} 3x + 2y = 40 \\ 0x + y = 2 \end{cases}$	↓	$\left[\begin{array}{cc\|c} & & \\ & & \end{array}\right]$
	↓		↓
Step 4	$\begin{cases} 3x + 0y = 36 \\ 0x + y = 2 \end{cases}$	↓	$\left[\begin{array}{cc\|c} & & \\ & & \end{array}\right]$
	↓		↓
Step 5	$\begin{cases} x + 0y = 12 \\ 0x + y = 2 \end{cases}$		$\left[\begin{array}{cc\|c} & & \\ & & \end{array}\right]$

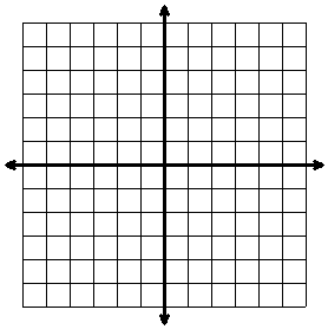
Name: To Market with Matrices **2.13H**

Go

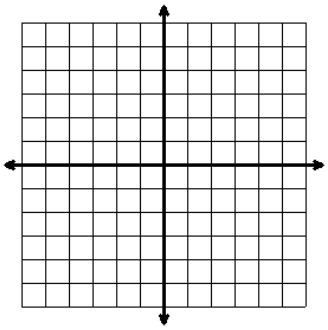
Topic: Solving Systems of Equations by Graphing

Solve each system of equations by graphing.

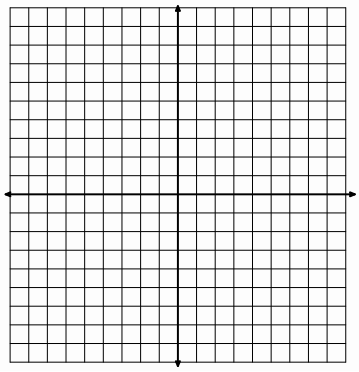
8. $\begin{cases} y = 3x - 3 \\ y = -3x + 3 \end{cases}$



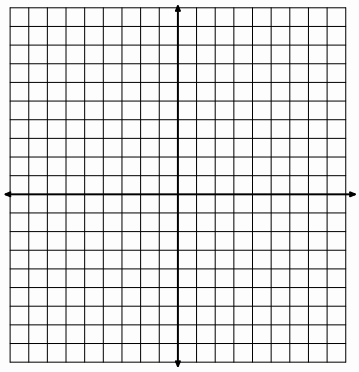
9. $\begin{cases} y = 4x - 1 \\ y = -x + 4 \end{cases}$



10. $\begin{cases} y = -2x + 7 \\ -3x + y = -8 \end{cases}$



11. $\begin{cases} 4x - y = 7 \\ 3x + 2y = 8 \end{cases}$



Need help? Check out these related videos:

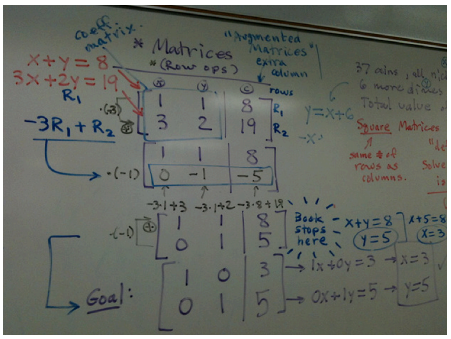
http://www.khanacademy.org/math/algebra/ck12-algebra-1/v/solving-linear-systems-by-substitution

http://patrickjmt.com/row-reducing-a-linear-system-of-equations/

http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/v/graphings-systems-of-equations

2.14H Solving Systems with Matrices

A Practice Understanding Task



In the task "To Market with Matrices" you developed a strategy for solving systems of linear equations using matrices. An efficient and consistent way to carry out this strategy can be summarized as follows:

To row reduce a matrix:

- Perform elementary row operations to yield a "1" in the first row, first column.
- Create zeros in all of the other rows of the first column by adding the first row times a constant to each other row.
- Perform elementary row operations to yield a "1" in the second row, second column.
- Create zeros in all of the other rows of the second column by adding the second row times a constant to each other row.
- Perform elementary row operations to yield a "1" in the third row, third column.
- Create zeros in all of the other rows of the third column by adding the third row times a constant to each other row.
- Continue this process until the first m × m entries form a square matrix with 1s in the diagonal and 0s everywhere else.

Practice this strategy by creating a sequence of matrices for each of the following that begins with the given matrix and ends with the left portion of the matrix (the first m × m entries) in row-reduced form. Write a description of what you did to get from one matrix to another in each step of your sequence of matrices.

1. $\begin{bmatrix} 2 & 4 & 0 \\ 3 & 5 & -2 \end{bmatrix}$

2. $\begin{bmatrix} 4 & -2 & 2 \\ 1 & 3 & 11 \end{bmatrix}$

3. $\begin{bmatrix} 4 & -2 & 1 & 3 \\ 2 & 1 & -1 & 1 \\ 3 & -1 & 2 & 7 \end{bmatrix}$

4. Each of the above matrices represents a system of equations. For each problem, write the system of equations represented by the original matrix. Determine the solution for each system using the row-reduced matrix you obtained, and then check the solutions in the original system.

5. Solve the following problem by using a matrix to represent the system of equations described in the scenario, and then changing the matrix to row-reduced form to obtain the solution.

   Three of Carlos' and Clarita's friends are purchasing school supplies at the bookstore. Stan buys a notebook, three packages of pencils and two markers for $7.50. Jan buys two notebooks, six packages of pencils and five markers for $15.50. Fran buys a notebook, two packages of pencils and two markers for $6.25. How much do each of these three items cost?

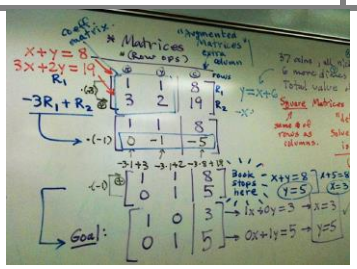
6. Create a linear system that is either dependent (both equations in the system represent the same line) or inconsistent (the equations in the system represent non-intersecting lines). What happens when you try to row reduce the 2×3 matrix that represents this linear system of equations?

Name: Solving Systems with Matrices | 2.14H

Ready, Set, Go!

Ready

Topic: Solving systems of equations using matrices.



1. In an earlier assignment you worked the following problem:

   "*A theater wants to take in $2000 for a certain matinee. Children's tickets cost $5 each and adult tickets cost $10 each. If the theater has a maximum of 350 seats, write a system of equations that can be solved to determine the number of both children and adult tickets the theater can sell.*"

   Set up a matrix that goes with the situation described above.

Set

Assume that the matrices below represent linear systems of equations. Practice the strategy you used for reducing a given matrix so that the left portion of the matrix (the 2 rows and first 2 columns of entries) has ones on the diagonal. Write a description of what you did to get from one matrix to another in each step of your sequence of matrices.

2. $\left[\begin{array}{cc|c} 3 & 2 & -6 \\ 1 & 2 & 2 \end{array}\right] R_1 - R_2 \to R_2 \left[\begin{array}{cc|c} 3 & 2 & -6 \\ 2 & 0 & -8 \end{array}\right] R_2 \div 2 \to R_2 \left[\begin{array}{cc|c} 3 & 2 & -6 \\ 1 & 0 & -4 \end{array}\right] \rightarrow$

3. $\left[\begin{array}{cc|c} -3 & 1 & -12 \\ 2 & 3 & -14 \end{array}\right] 3R_1 - R_2 \to R_2 \left[\begin{array}{cc|c} -3 & 1 & -12 \\ -11 & 0 & 22 \end{array}\right] \rightarrow$

4. $\left[\begin{array}{cc|c} 7 & 2 & 24 \\ 8 & 2 & 30 \end{array}\right] \rightarrow$

5. $\left[\begin{array}{cc|c} 5 & 1 & 9 \\ 10 & -7 & -18 \end{array}\right] \rightarrow$

Name: Solving Systems with Matrices **2.14H**

Go

Topic: Solving systems of equations

Solve the following systems of equations with a method of your choice.

6. $\begin{cases} x - y = 11 \\ 2x + y = 19 \end{cases}$

7. $\begin{cases} 8x + y = -16 \\ -3x + y = -5 \end{cases}$

8. $\begin{cases} -4x + 9y = 9 \\ x - 3y = -6 \end{cases}$

9. $\begin{cases} -7x + y = -19 \\ -2x + 3y = -19 \end{cases}$

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http://www.khanacademy.org/math/algebra/ck12-algebra-1/v/solving-linear-systems-by-substitution

http://www.khanacademy.org/math/algebra/ck12-algebra-1/v/solving-systems-of-equations-by-elimination