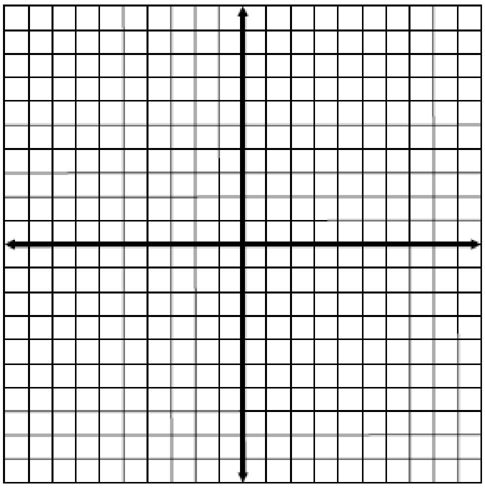
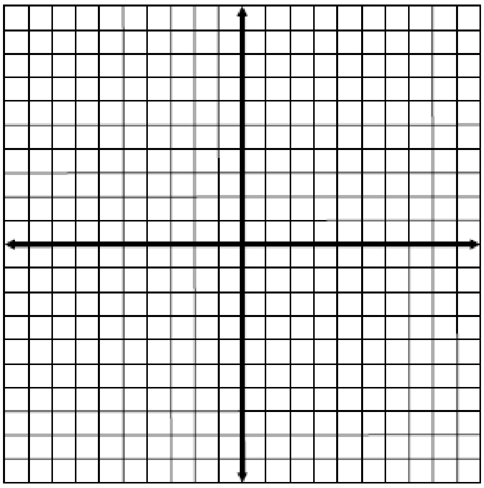
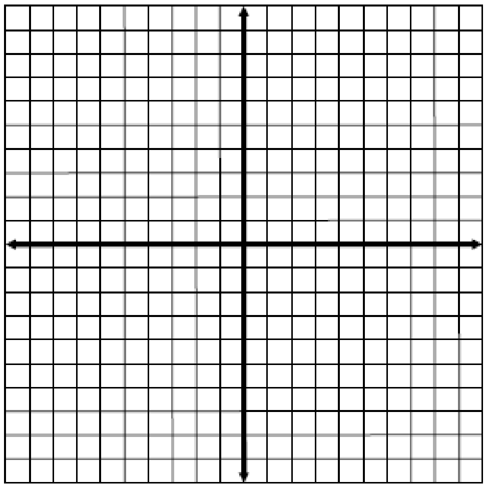
Chapter 5 – Systems of Linear Inequalities
Grade 10 Review – Linear Equations

RF1: Model and solve problems that involve systems of linear inequalities in two variables.

1. Recall the equations for lines when written in y = mx + b form, where m = slope and b = y-intercept.

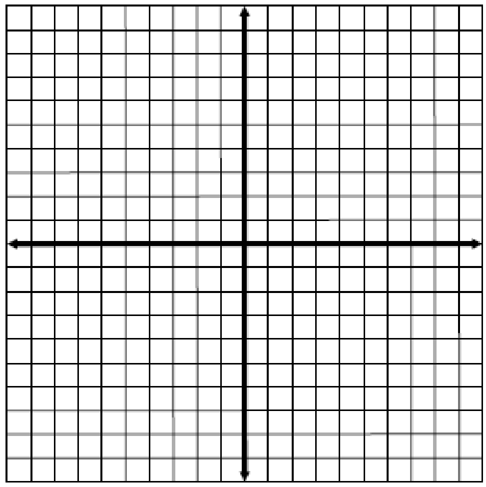




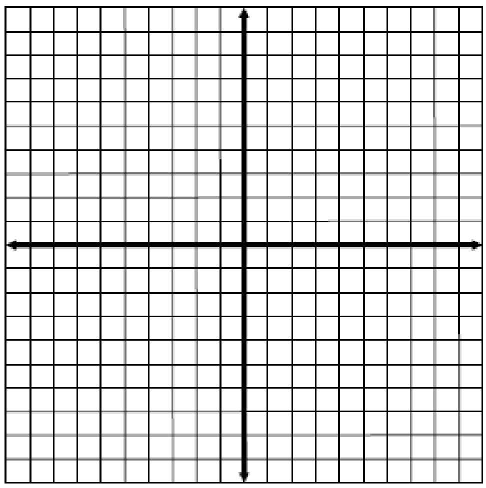


Standard Form: Ax + By = C

$4x - 2y = -8$



$x + 3y = 3$



Inequalities...

When we solve linear equations, we find one unique solution that satisfies the equation. For example, for 2x + 1 = 7, the only solution that works is x = 3. However for inequalities, there can be a range of solutions that satisfy it.

How to read and interpret linear inequality statements.

$x > -5$

$x \leq 6$

To solve inequalities, follow the following algebraic steps. The one rule you must remember however is that:

___

True or False?

5 < 10 T / F

Add 6: T / F

Subtract 2: T / F

Multiply by 4; T / F

Divide by 5: T / F

Add -7: T / F

Multiply by -2: T / F

Divide by -10: T / F

To graph the inequalities, remember:

1.

2.

Example #1: Inequalities in one variable.

Solve and Graph:

$2x - 1 \leq 11$

$-\frac{3}{4}y - 3 < 3$

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Chapter 5 – Systems of Linear Inequalities
Section 5.1 Graphing Linear Inequalities in Two Variables

RF1: Model and solve problems that involve systems of linear inequalities in two variables.

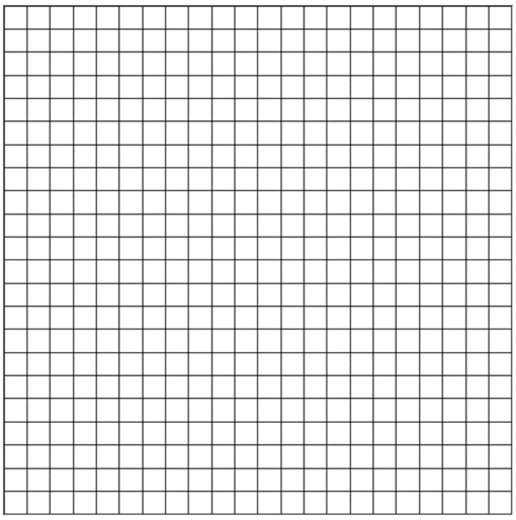
Frank and Joe sell lemonade. They buy lemons for \$.50 each and sugar costs them \$1 for 1kg. They have \$20 to spend on supplies.

a. Give two combinations of lemons and sugar that would total \$20

b. Represent this situation with an equation

c. What is the domain (lemons) and range (sugar) for each?

d) Graph the relationship

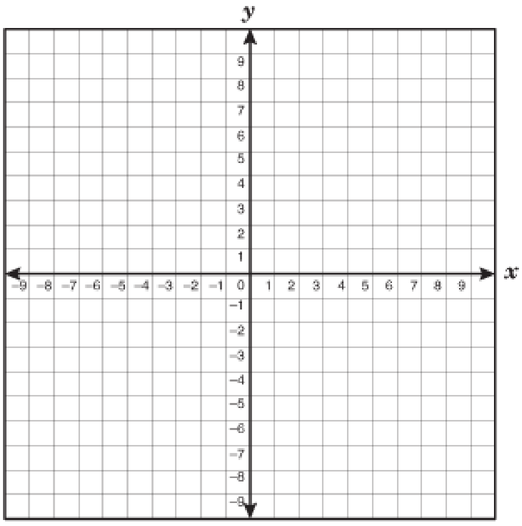


e) What REGION of the graph represents different possibilities, especially if they spend less than \$20

f. Is the solution set represented by the region above the line, below the line, or on the line itself?

g. Is the line solid or dashed?

Look at the graph of $y = x$



The line divides the plane into two half-planes:

· y < x is the region ___________the line.

· y > x is the region ______________the line.

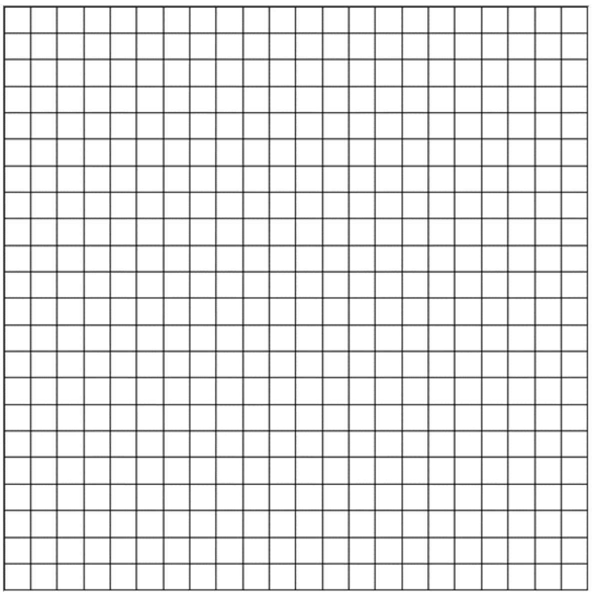
· y = x is the boundary line.

A _____________boundary line is used to represent ≤ or ≥.

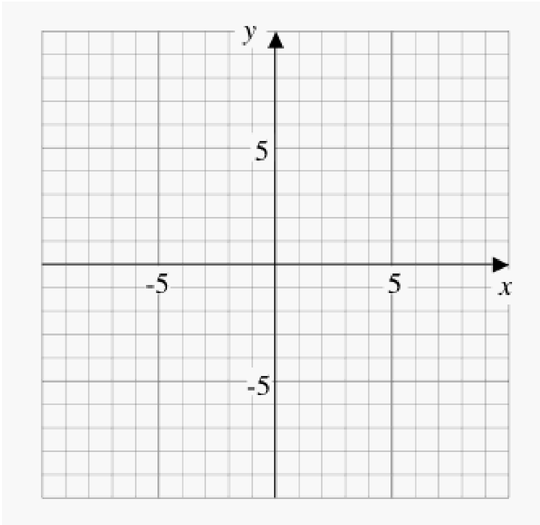
A ___________boundary line is used to represent < or >

To graph an inequality:

Example 1: Graph $4x - 5y \leq 20$

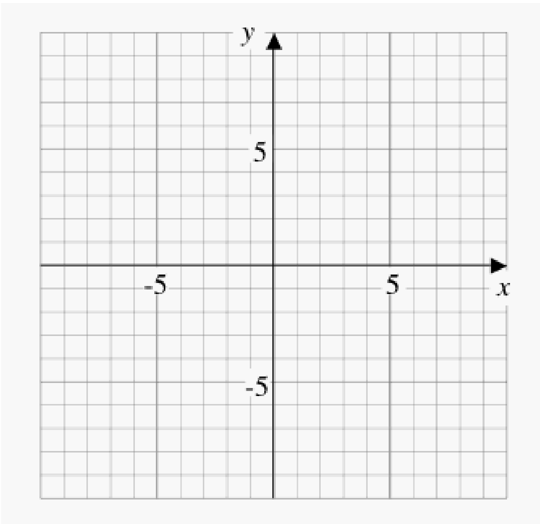


Example 2: Graph the following $y > -\frac{3}{2}x + 3$

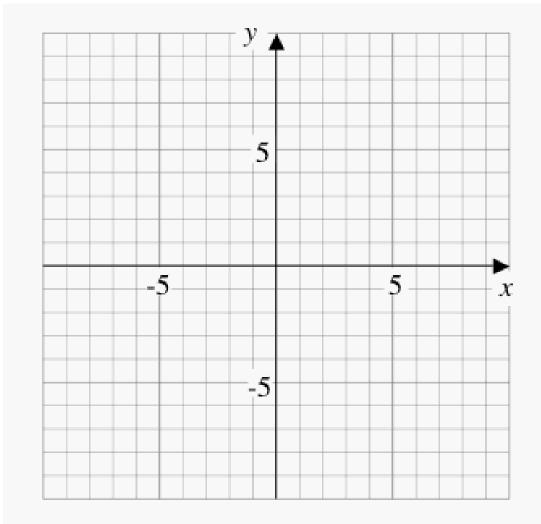


Example 3: Graph the solution set for each linear inequality on a Cartesian plane:

a) $\{(x, y) \mid y > x - 3, x \in R, y \in R\}$



b) $\{(x, y) \mid 2x + 3y \geq 6, x \in I, y \in I\}$



What is the difference??

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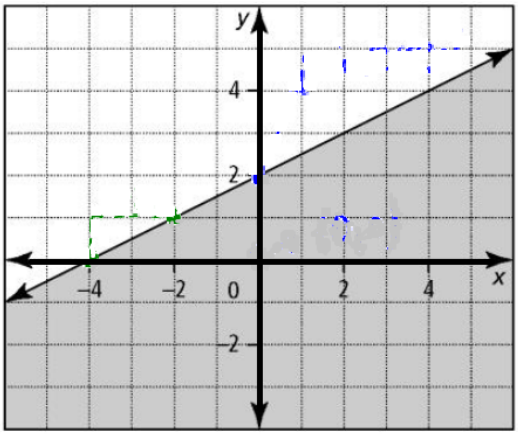
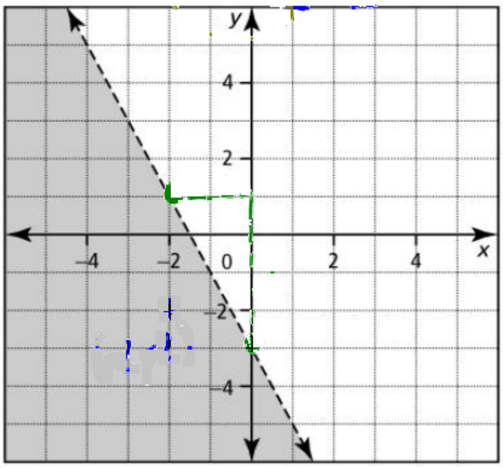
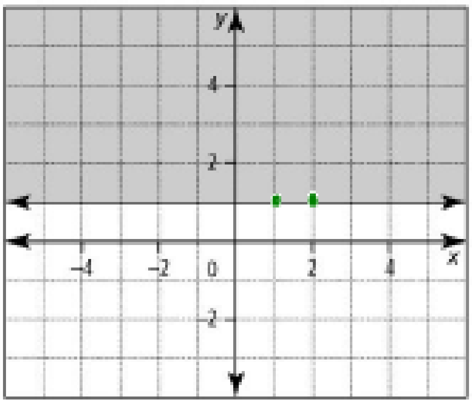
Example 4: Write an inequality to represent each graph:







page 221 # 1, 2 (use 2x+3y>6), 4, 5af,

Chapter 5 – Systems of Linear Inequalities
Section 5.1 Graphing Linear Inequalities in Two Variables

RF1: Model and solve problems that involve systems of linear inequalities in two variables.

Word Problem Examples

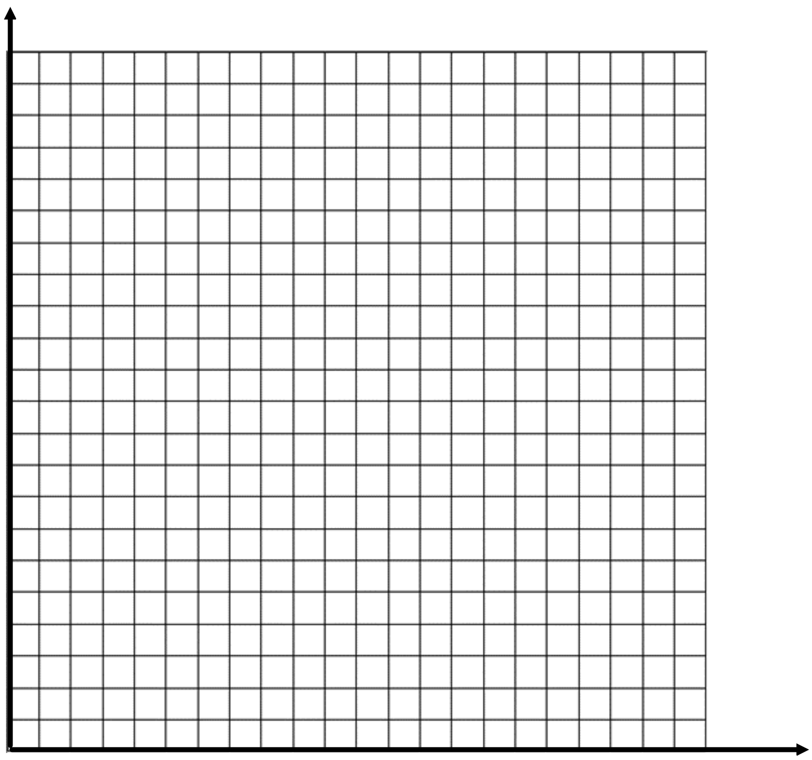
Example 1: Ben is buying snacks for his friends. He has $10.00. The choices are apples for $0.80 and muffins for $1.25.

a) Write an inequality to model this situation. Define your variables.

b) State the restrictions on the variables.

c) Graph the inequality.

d) Why is (5,4.8) not a possible solution?



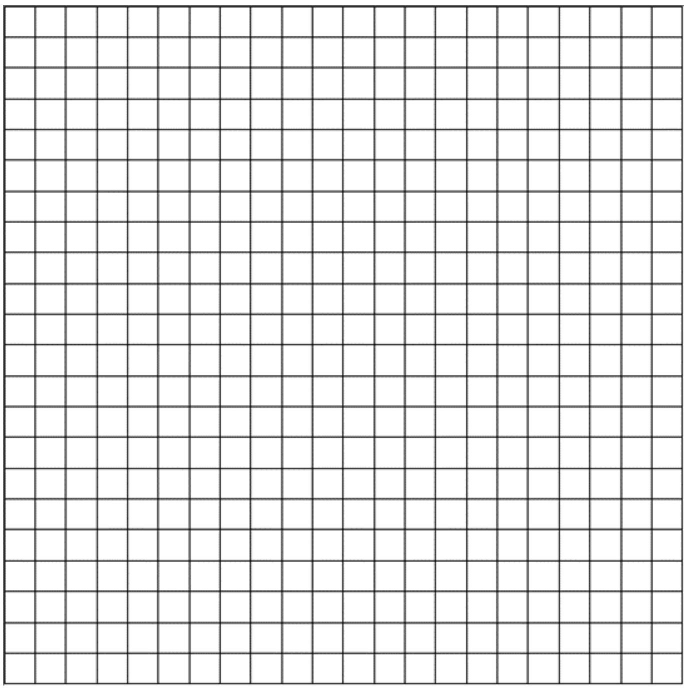
Example 2: A sports store has a net revenue of \$100 on every pair of downhill skis sold and \$120 on every snowboard sold. The manager's goal is to have a net revenue of more than \$600 a day from the sales of these two items. What combinations of ski and snowboard sales will meet or exceed this daily sales goal?

a) Write an inequality to model this situation. Define your variables.

b) State the restrictions on the variables.

c) Graph the inequality.

d) List two possible combinations that are true and explain what they mean.



Homework: page 222 # 9, 10, 12

Chapter 5 – Systems of Linear Inequalities
Section 5.3 Graphing to Solve Systems of Linear Inequalities

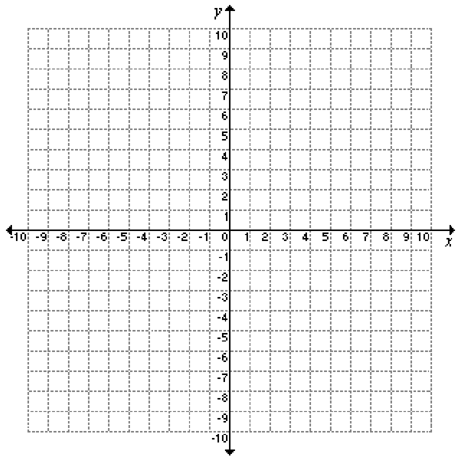
RF1: Model and solve problems that involve systems of linear inequalities in two variables.

For a system of linear equations, the solution is the point where the two lines intersect. (done in NRF10)
For a system of linear inequalities, the solution is the region where the shading for each inequality overlaps.

Example 1: Solve the systems of inequalities by graphing.

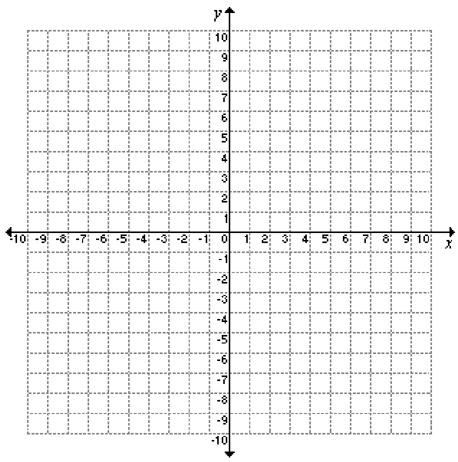
$$y \geq 6x + 1$$
$$x + y \leq 4$$

What are two possible solutions to this system? Prove one of them.



$$y \geq x$$
$$-x + 2y > -4$$

What are two possible solutions to this system? Prove one of them.

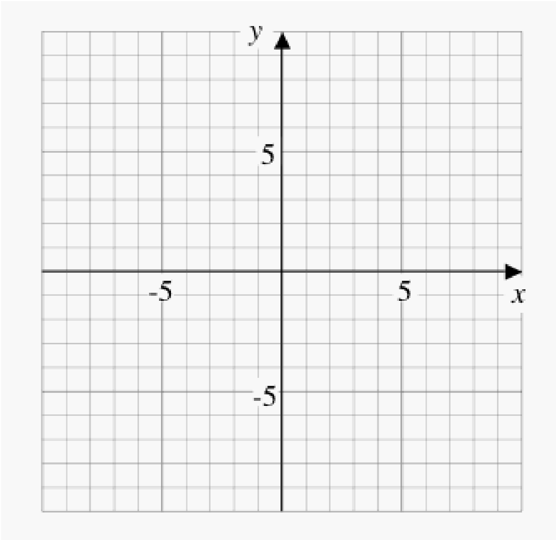


Graph the region defined by these inequalities:

$x \geq 0$

$y \geq 1$

$2x + y < 4$



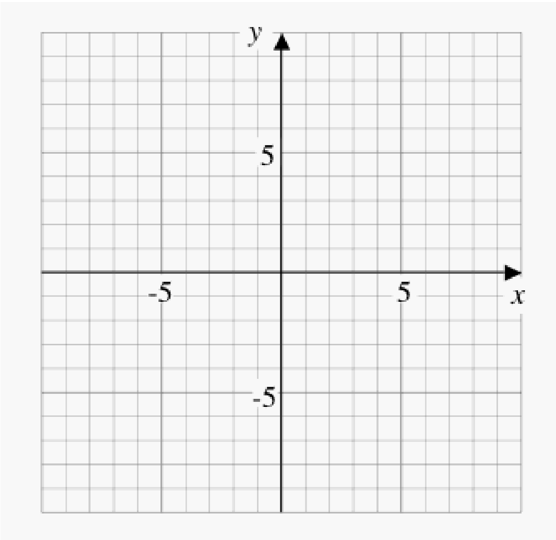
What are three solutions to this system?

Is the point of intersection part of the solution set?

Graph the following system, are the boundry lines and point of intersection part of the solution set?

$\{(x, y) \mid x + y \leq -2, x \in I, y \in I\}$

$\{(x, y) \mid 2y \geq x, x \in I, y \in I\}$



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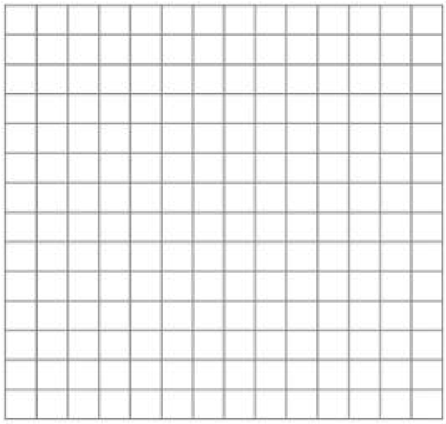
To raise funds to buy new instruments, the band committee has 500 t-shirts to sell. The shirts come in red or blue. Based on sales of the same t-shirts at a fundraiser last year, the committee expects to sell at least twice as many blue t-shirts as red t-shirts.

a. Define the variables and restrictions. Write a system of linear inequalities that models the situation.



b. Graph the system of inequalities.

c. Suggest a combination of t-shirt sales that could be made.

Assignment Pg. 235-7 #2, 4, 6, 10 & 12

Chapter 5- Systems of Linear Inequalities
5.4 Optimization Problems I: Creating the Model
GOAL: *Create models to represent optimization problems*

Example 1: A toy company manufactures two types of toy vehicles: racing cars and sport-utility vehicles.

· Because the supply of materials is limited, no more than 40 racing cars and 60 sport utility vehicles can be made each day.

· However, the company can make 70 or more vehicles, in total, each day.
· It costs $8 to make a racing car and $12 to make a sport-utility vehicle.

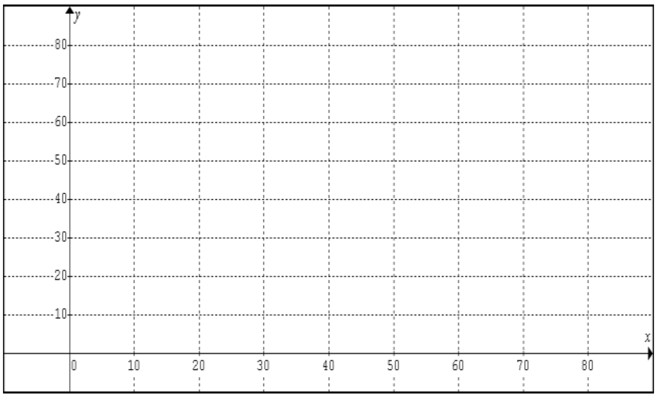
There are many possible combinations of racing cars and sport-utility vehicles that could be made. The company wants to know what combinations will result in the minimum and maximum costs, and what those costs will be.

How can this situation be modelled?
A. What are the two variables in this situation?

B. Write a system of linear inequalities to represent these conditions (constraints):
· The total number of racing cars that can be made:
· The total number of sport-utility vehicles that can be made:
· The total number of vehicles that can be made:

C. What do you know about the restriction on the -values and on the -values (restrictions)?

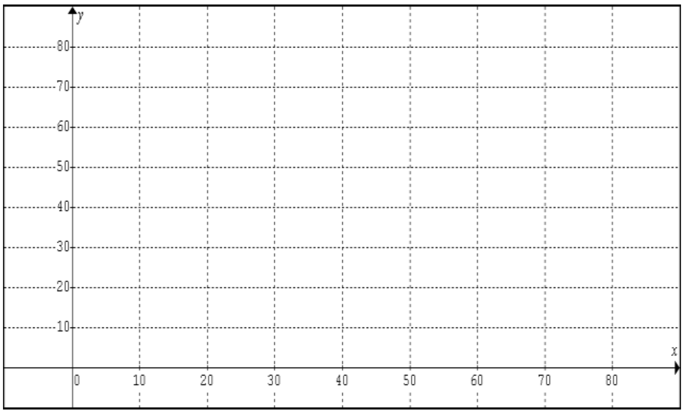
D. Graph the system. Choose at least two points in the solution region that are possible solutions to the system.



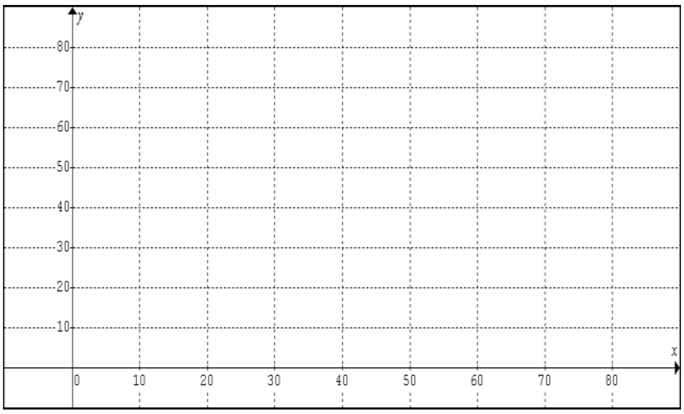
E. What quantity in this situation needs to be minimized and maximized? Write an equation to represent how the two variables relate to this quantity.

F. Each combination below is a possible solution to the system of linear inequalities:
(i) 40 racing cars and 30 sport-utility vehicles
(ii) 10 racing cars and 60 sport-utility vehicles
(iii) 40 racing cars and 60 sport-utility vehicles
Use your equation from part E to calculate the manufacturing cost for each situation. What do you notice?

Example 2: A test is made up of multiple-choice and open-ended questions. It takes up to 2 minutes to do a multiple-choice question and up to 5 minutes for an open ended question. The total time for the test is 80 minutes and you may answer no more than 20 questions. Graph the solution space and label each corner point.



Fred is planning an exercise program where he wants to run and swim every week. He doesn't want to spend more than 12 hours a week exercising and he wants to burn at least 1600 calories a week. Running burns 200 calories an hour and swimming burns 400 calories an hour. Running costs $1 an hour while swimming costs $2 an hour. How many hours should he spend at each sport to keep his costs at a minimum?



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Assignment pg. 248-9 Questions: 2, 3, 4, and 5

Chapter 5- Systems of Linear Inequalities

5.5 Optimization Problems II: Exploring Solutions

GOAL: *Explore the feasible region of a system of linear inequalities.*

Remember from last day:

o An ____________________ problem is a problem in which we find the greatest or least value of functions.
o The system of functions consists of linear inequalities creating an overlapping area of

_________________________.

Our steps look like this:

1) Identify what to _________________.

2) Define the _______________ and restrictions.

3) Write a system of __________________ to describe the constraints and graph.

4) Write an _________________ function for the optimization.

Realize that there are always _________________ solutions within the feasibility region. Our goal

is to identify the ___________________ solution.

A company does custom paint jobs on cars and trucks. Due to the size of the workshop, the company can paint a maximum of 8 cars OR 5 trucks in one day. The total output for the shop cannot exceed 10 vehicles (total) in one day. The company earns $400 for a truck paint job and $250 for a car paint job. How many of each should they book to earn the greatest profit in one day?

What are the variables? Represent them with a letter.

Write out inequalities using these variables.

Graph and determine the Equations

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A BC farmer wants to plant a combination of apple and pear trees that will maximize revenue.

She wants to plant no more than 500 trees altogether.

She wants to plant at least four times as many apple as pear trees

The yield per apple tree is 4 bushels, and the yield per pear tree is 3 bushels.

Apples pay the farmer \$8.75 per bushel and pears pay \$9.50 per bushel

Assignment: p 249: #6,7

Chapter 5- Systems of Linear Inequalities
5.6 – Optimization Problems III: Linear Programming
Goal: Solve optimization problems

The solution to an optimization problem is always found at one of the ___________ of the feasibility region.

____________ __________________ is a mathematical technique used to determine which solutions in the feasibility region result in the optimal solutions of the objective function.
To determine the optimal solution to an optimization problem using linear programming, follow these steps:
1. Create an algebraic model that includes:

· A defining statement of the ________________ used in you model.

· Any ________________on the variables.

· A system of linear ___________________that describe the constraints.

· An ___________________function that shows how the variables are related to the quantity being optimized.

2. Graph the system of inequalities to determine the coordinates of the ____________ of the feasibility region.

3. _________________ the objective function by ________________ the values of the coordinates of each vertex.

4. Verify your solution(s) satisfies the constraints of the problem situation.

REMEMBER:
To solve an optimization problem, use linear programming.

This involves creating algebraic and graphical models of the problem and then using the objective function to determine which vertex of the feasibility region results in the optimal solution.

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Example 1:

Chubby Cubbies Education Technologies (CCET) manufactures packages of pattern blocks and linking cubes.

· CCET can produce at least 60 packages of pattern block and linking cubes per day.

· Due to the amount of material at hand, CCET can produce at most 30 packages of pattern block and 50 packages of linking cubes per day.

· The sale price of the pattern blocks is $7 per pack; the sale price of the linking cubes is $5 per pack.

The company wants to know what combinations will result in the maximum revenue, and what revenue that would be.

Set variables and determine the domain and range Define constraints and objective function

Solve the Inequalities Test point and graph

The optimal combination is:

The maximum revenue is:

Example 2:
L&G Construction is competing for a contract to build a fence.

· The fence will be no longer than 50 yd and will consist of narrow boards that are 6 in. wide and wide boards that are 8 in. wide.

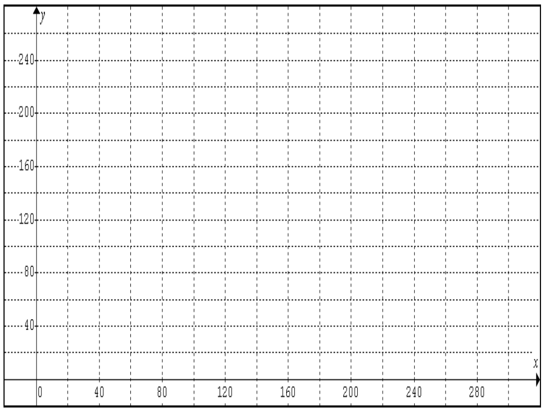
· There must be no fewer than 100 wide boards and no more than 80 narrow boards.
· The narrow boards cost $3.56 each, and the wide boards cost $4.36 each.

Determine the maximum and minimum costs for the lumber to build the fence.

Set variables and determine the domain and range Define constraints and objective function

Solve the Inequalities

Test point and graph



The optimal combinations are:

The maximum and minimum cost is:

pg. 261-263 Q#: 6, 12, 13