Lesson 14: Linear Programming Story Problems (3.6)

By the end of the lesson, you will be able to:

~ Solve Linear Programming Story Problems

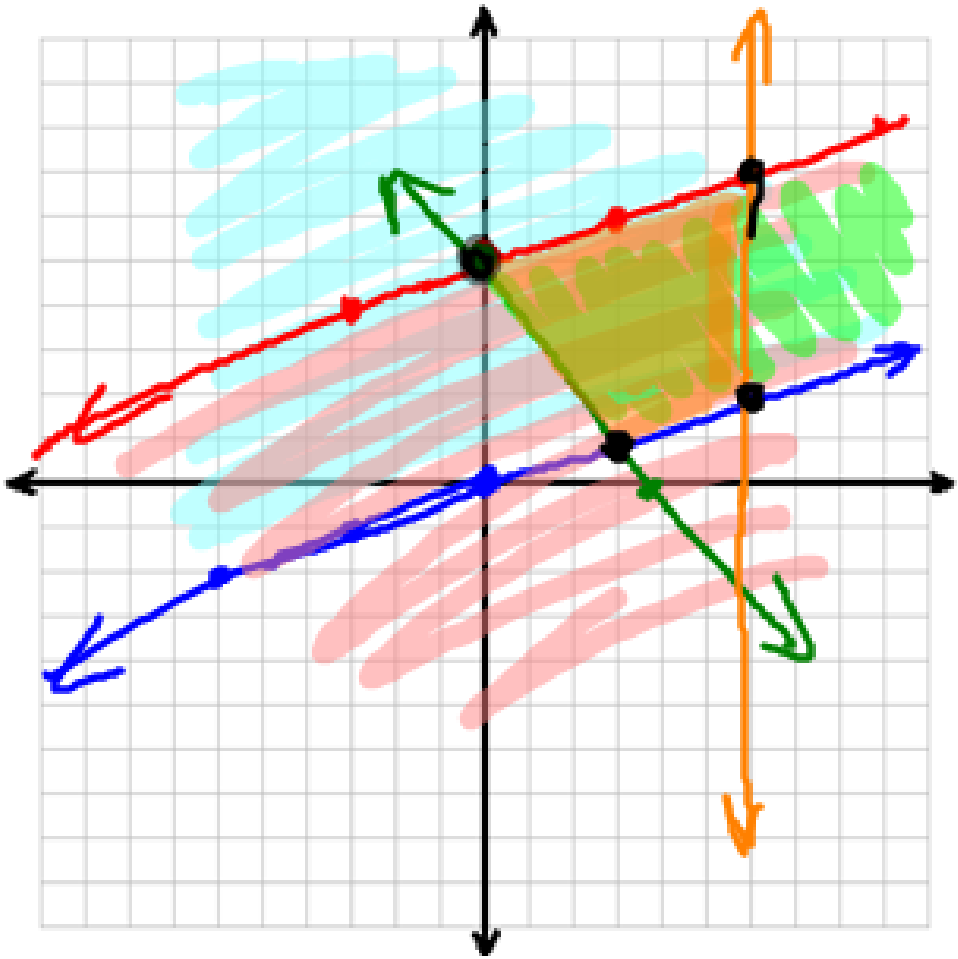
~Review~

Graph the system of inequalities. Name the coordinates of the vertices of the feasible region. Find the maximum and minimum values of the given function for this region.

$$x - 3y \leq 0$$
$$x - 3y \geq -15$$
$$4x + 3y \geq 15$$
$$x \leq 6$$

$$f(x, y) = 5x + 2y$$

(0,5) (6,2)
(3,1) (6,7)



Lesson 14: Linear programming story problems (3.6)

~Review~

$x - 3y \leq 0$

x-int: (0, 0)

y-int: (0, 0)

$\frac{-3y}{-3} \leq \frac{-x}{-3}$

$y \geq \frac{1}{3}x$

Test: (1, 1)

$1 - 3 \leq 0$

$-2 \leq 0$ ✓

$x - 3y \geq -15$

x-int: (-15, 0)

y-int: (0, 5)

$\frac{-3y}{-3} \geq \frac{-x-15}{-3}$

$y \leq \frac{1}{3}x + 5$

Test (0, 0)

$0 - 0 \geq -15$

$0 \geq -15$ ✓

$4x + 3y \geq 15$

x-int: $(\frac{15}{4}, 0)$

y-int: (0, 5)

$y \geq -\frac{4}{3}x + 5$

Test (0, 0)

$0 + 0 \geq 15$

$0 \geq 15$

✗

$x \leq 6$

~Review~

Graph the system of inequalities. Name the coordinates of the vertices of the feasible region. Find the maximum and minimum values of the given function for this region.

$$x - 3y \leq 0$$
$$x - 3y \geq -15$$
$$4x + 3y \geq 15$$
$$x \leq 6$$
$$f(x, y) = 5x + 2y$$

(X,Y)	5X+2Y	F(X,Y)
(0,5)	5(0)+2(5) = 10	f(0,5)=10
(3,1)	5(3)+2(1) = 17	f(3,1)=17
(6,2)	5(6)+2(2) = 34	f(6,2)=34
(6,7)	5(6)+2(7)=44	f(6,7)=44

The max is 44 at (6,7).
The min is 10 at (0,5).

Linear Programming Story Problems

Example 1:

Rosalyn works no more than 20 hours a week during the school year. She is paid $10 an hour for tutoring geometry students and $7 an hour for delivering pizzas for Pizza King. She wants to spend at least 3 hours but no more than 8 hours a week tutoring. Find Rosalyn's maximum earnings.

1st- define our variables:

x = number of hours tutoring
y = number of hours delivering

Example 1 continued:

Rosalyn works no more than 20 hours a week during the school year. She is paid $10 an hour for tutoring geometry students and $7 an hour for delivering pizzas for Pizza King. She wants to spend at least 3 hours but no more than 8 hours a week tutoring. Find Rosalyn's maximum earnings.

2nd- set up the constraints (inequalities)

for total hours worked: $x + y \leq 20$

for hours tutoring: $3 \leq x \leq 8$ or $x \geq 3$ $x \leq 8$

for hours delivering: $y \geq 0$ $y \leq 20$

3rd- write an equation for her weekly profit and label it f(x,y)

$$f(x,y) = 10x + 7y$$

Lesson 14: Linear programming story problems (3.6)

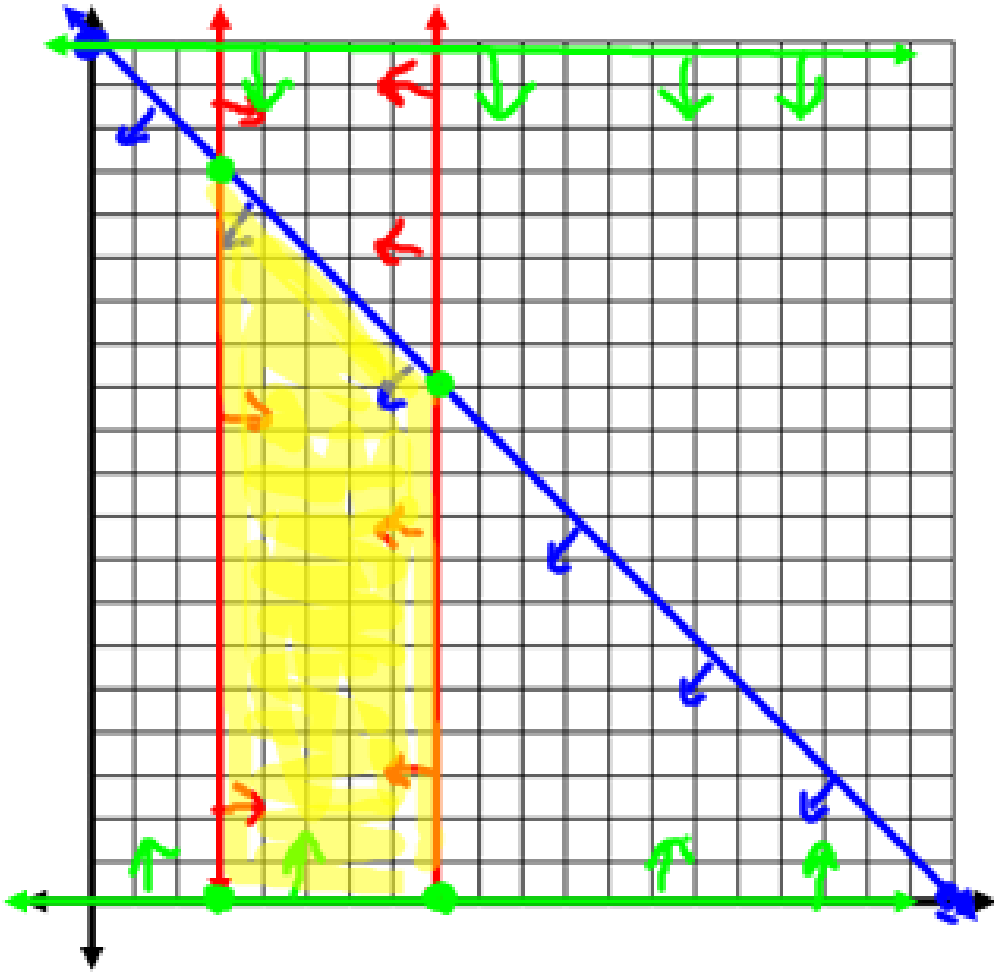
Example 1 continued:

4th- graph all constraints (inequalities)

$x + y \leq 20$ x-int: (20,0) y-int: (0,20) Test: (0,0) $0 \leq 20$ ✓

$x \geq 3$ $x \leq 8$

$y \geq 0$ $y \leq 20$



5th- identify vertices of the feasible region.

(3,0) (8,0)

(3,17) (8, 12)

Lesson 14: Linear programming story problems (3.6)

- Find X and Y int so you can get the correct Calculator Window.
- Also, solve for y so you can enter the equation in the calculator to graph and find vertices.

Example 1 continued:

6th - find max of Rosalyn's weekly earnings.

(X,Y)	10X+7Y	F(X,Y)	
(3,0)	10(3)+7(0)=30	f(3,0)=30	
(3,17)	10(3)+7(17)=	f(3,17)=119	
(8,0)	10(8)+7(0)=	f(8,0)=80	
(8,12)	10(8)+7(12)=	f(8,12)=164	✱ max

Rosalyn's max. earnings for the week is $164.

Linear Programming Story Problems

Example 2:

The Northern Wisconsin Paper Mill can make notebook paper or newsprint. The mill can produce at most 200 units of paper a day. At least 10 units of notebook paper and 80 units of newspaper are required daily by regular customers. If the profit on a unit of notebook paper is $500 and the profit on a unit of newsprint is $350, how many units of each paper should the manager have the mill produce each day to maximize profits?

1st- define our variables:

x = units of notebook paper

y = units of newsprint

Example 2 continued:

The Northern Wisconsin Paper Mill can make notebook paper or newsprint. The mill can produce at most 200 units of paper a day. At least 10 units of notebook paper and 80 units of newspaper are required daily by regular customers. If the profit on a unit of notebook paper is $500 and the profit on a unit of newsprint is $350, how many units of each paper should the manager have the mill produce each day to maximize profits?

2nd- set up the constraints (inequalities)

For total amount of paper: $x + y \leq 200$

For units of Notebook paper: $x \geq 10$

For units of newspaper: $y \geq 80$

3rd- write an equation for the mill's daily profit and label it f(x,y)

$f(x,y) = 500x + 350y$

Lesson 14: Linear programming story problems (3.6)

Example 2 continued:

4th- graph all constraints (inequalities)

$x + y \leq 200$ Test: (0,0) $0 \leq 200$

x int: (200, 0)

y int: (0, 200)

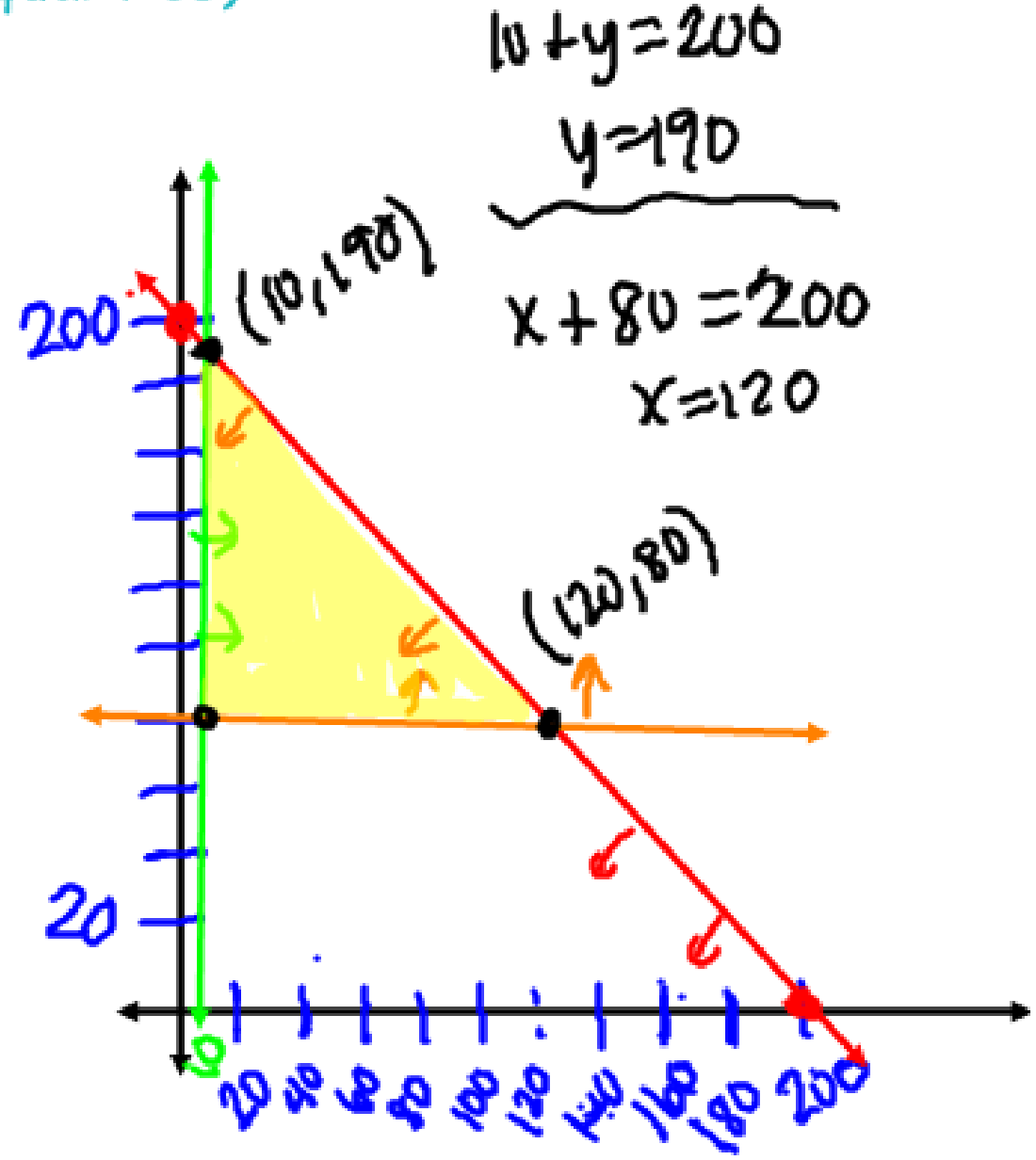
$x \geq 10$

$y \geq 80$

5th- identify vertices of the feasible region.

(10, 80) (120, 80)

(10, 190)



Lesson 14: Linear programming story problems (3.6)

- Find X and Y int so you can get the correct Calculator Window.
- Also, solve for y so you can enter the equation in the calculator to graph and find vertices.

Example 2 continued:

6th - find the amount of each paper to produce to maximize profit.

(x, y)	$500x + 350y$	$f(x,y) =$
$(10, 80)$	$500(10) + 350(80)$	$f(10, 80) = 33{,}000$
$(10, 190)$	$500(10) + 350(190)$	$f(10, 190) = 71{,}500$
$(120, 80)$	$500(120) + 350(80)$	$f(120, 80) = 88{,}000$ *

To maximize their profit of $88,000, the paper company needs to make 120 units of notebook paper and 80 units of newsprint.

Linear Programming Story Problems

Example 3:

As a receptionist for a veterinarian, one of Dolores Alvarez's tasks is to schedule appointments. She allots 20 minutes for a routine office visit and 40 minutes for a surgery. The veterinarian cannot do more than 6 surgeries per day. The office has 7 hours available for appointments. If an office visit costs $55 and most surgeries cost $125, find a combination of office visits and surgeries that will maximize the income the veterinarian practice receives per day.

1st- define our variables:

x = # of visits
y = # of surgeries

Example 3 continued:

As a receptionist for a veterinarian, one of Dolores Alvarez's tasks is to schedule appointments. She allots 20 minutes for a routine office visit and 40 minutes for a surgery. The veterinarian cannot do more than 6 surgeries per day. The office has 7 hours available for appointments. If an office visit costs $55 and most surgeries cost $125, find a combination of office visits and surgeries that will maximize the income the veterinarian practice receives per day. $7 hrs = 420 min$

2nd- set up the constraints (inequalities)

Total time for appointments: $20x + 40y \leq 420$

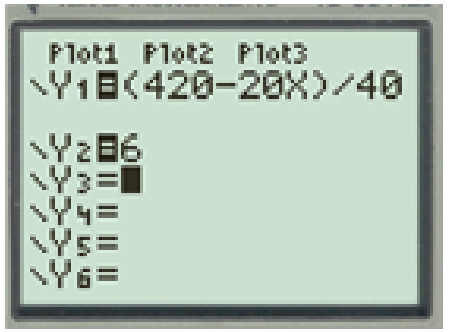
for office visits: $x \geq 0$

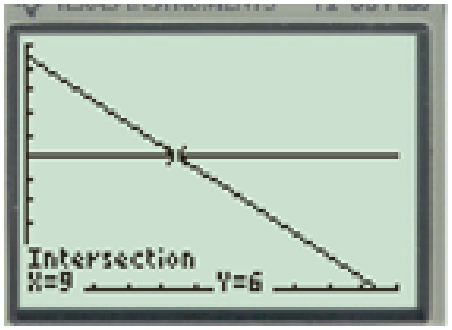
for surgeries: $y \leq 6$ $y \geq 0$

3rd- write an equation for the veterinarian's daily profit and label it f(x,y) $f(x,y) = 55x + 125y$

Lesson 14: Linear programming story problems (3.6)

Example 3 continued:





4th- graph all constraints (inequalities)

$20x + 40y \leq 420 \longrightarrow y \leq \frac{(420 - 20x)}{40}$

x-int: (21, 0)

y-int: (0, 10.5)

$x \geq 0$

$y \geq 0 \quad y \leq 6$

5th- identify vertices of the feasible region.

(0, 0) (9, 6)

(21, 0)

(0, 6)

Lesson 14: Linear programming story problems (3.6)

- Find X and Y int so you can get the correct Calculator Window.
- Also, solve for y so you can enter the equation in the calculator to graph and find vertices.

Calc Window

$X_{min} = 0$

$X_{max} = 22$

$X_{scl} = 2$

$y_{min} = 0$

$y_{max} = 11$

$y_{scl} = 1$

Example 3 continued:

6th - find how many visits and surgeries will maximize profit.

(x, y)	55x + 125y	f(x, y) =
(0, 0)	55(0) + 125(0)	f(0, 0) = 0
(0, 6)	55(0) + 125(6)	f(0, 6) = 750
(21, 0)	55(21) + 125(0)	f(21, 0) = 1155
(9, 6)	55(9) + 125(6)	f(9, 6) = 1245

The max profit is $1245. They would need to schedule 9 office visits and 6 surgeries to get their max profit.

Lesson 14: Linear Programming Story Problems (3.6)

By the end of the lesson, you will be able to:

~ Solve Linear Programming Story Problems

Can you?

Lesson 14: Linear Programming Story Problems (3.6)

Homework:

Assignment 14

You want to make jars of tomato sauce and jars of salsa from your left over Tomatoes and onions. A jar of tomato sauce requires 10 tomatoes and 1 onion, and a jar of salsa requires 5 tomatoes and $\frac{1}{4}$ an onion. You have 180 tomatoes and 15 onions to use. You'll make a profit of $2 on every jar of tomato sauce and a profit of $1.50 on every jar of salsa sold. How many jars of each should you make to maximize profit? What would your max profit be?

LINEAR PROGRAMMING STORY PROBLEMS

A local herb shop is producing 2 perfumes: gentle rose and rich gardenia. the owner, who has equipment that can make up to 3000 oz of perfume, cannot afford to spend more than $9000. gentle rose is 2 oz and cost $3 to make with a profit over cost of $4. Rich gardenia is 1.5 oz and cost $6 with a profit over cost of $5. how many bottle of each perfume should be made for max profit and what is the max profit?

1ST- DEFINE OUR VARIABLES:

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

FOR TOTAL OZ OF PERFUME:

FOR TOTAL COST OF PERFUME:

FOR BOTTLES OF GENTLE ROSE:

FOR BOTTLES OF RICH GARDENIA:

LINEAR PROGRAMMING STORY PROBLEMS

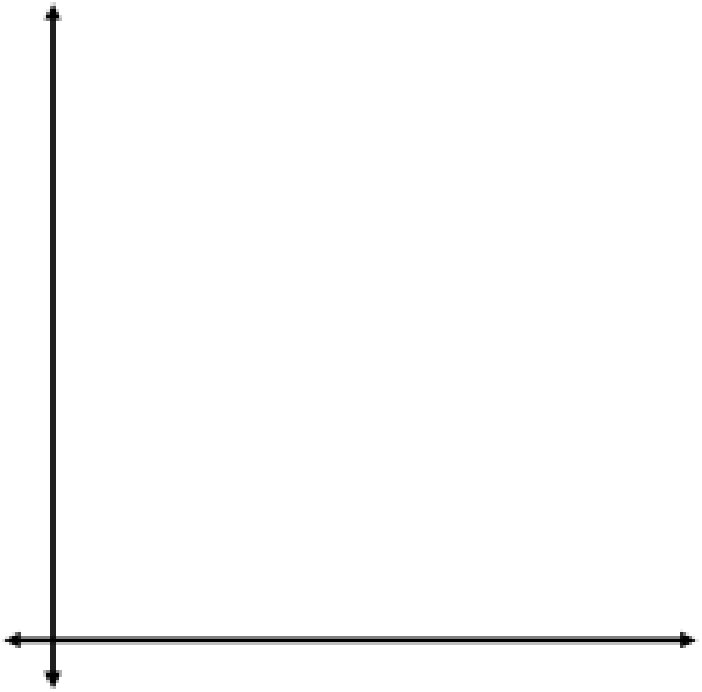
A local herb shop is producing 2 perfumes: gentle rose and rich gardenia. the owner, who has equipment that can make up to 3000 oz of perfume, cannot afford to spend more than $9000. gentle rose is 2 oz and cost $3 to make with a profit over cost of $4. Rich gardenia is 1.5 oz and cost $6 with a profit over cost of $5. how many bottle of each perfume should be made for max profit and what is the max profit?

3RD- WRITE AN EQUATION FOR THE HERB SHOP'S PROFIT AND LABEL IT F(X,Y)

LINEAR PROGRAMMING STORY PROBLEMS

4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

5TH- IDENTIFY VERTICES OF THE FEASIBLE REGION AND FIND THE AMOUNT OF EACH PERFUME TO PRODUCE TO MAXIMIZE PROFIT.



$2X + 1.5Y \leq 3000$

X-INT: ( )

Y-INT: ( )

$3X + 6Y \leq 9000$

X-INT: ( )

Y-INT: ( )

Calculator WINDOW

LINEAR PROGRAMMING STORY PROBLEMS

A LOCAL HERB SHOP IS PRODUCING 2 PERFUMES: GENTLE ROSE AND RICH GARDENIA. THE OWNER, WHO HAS EQUIPMENT THAT CAN MAKE UP TO $\leq$ 3000 OZ OF PERFUME, CANNOT AFFORD TO SPEND MORE THAN $\leq$ $9000. GENTLE ROSE IS 2 OZ AND COST $3 TO MAKE WITH A PROFIT OVER COST OF $4. RICH GARDENIA IS 1.5 OZ AND COST $6 WITH A PROFIT OVER COST OF $5. HOW MANY BOTTLE OF EACH PERFUME SHOULD BE MADE FOR MAX PROFIT AND WHAT IS THE MAX PROFIT?

1ST- DEFINE OUR VARIABLES:

x = Gentle Rose (Bottles) y = Rich Gardenia (Bottles)

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

FOR TOTAL OZ OF PERFUME: $2x + 1.5y \leq 3000$

~~total~~ cost: $3x + 6y \leq 9000$

FOR OZ OF GENTLE ROSE: $x \geq 0$

FOR OZ OF RICH GARDENIA: $y \geq 0$

LINEAR PROGRAMMING STORY PROBLEMS

A LOCAL HERB SHOP IS PRODUCING 2 PERFUMES: GENTLE ROSE AND RICH GARDENIA. THE OWNER, WHO HAS EQUIPMENT THAT CAN MAKE UP TO 3000 OZ OF PERFUME, CANNOT AFFORD TO SPEND MORE THAN $9000. GENTLE ROSE IS 2 OZ AND COST $3 TO MAKE WITH A PROFIT OVER COST OF $4. RICH GARDENIA IS 1.5 OZ AND COST $6 WITH A PROFIT OVER COST OF $5. HOW MANY BOTTLE OF EACH PERFUME SHOULD BE MADE FOR MAX PROFIT AND WHAT IS THE MAX PROFIT?

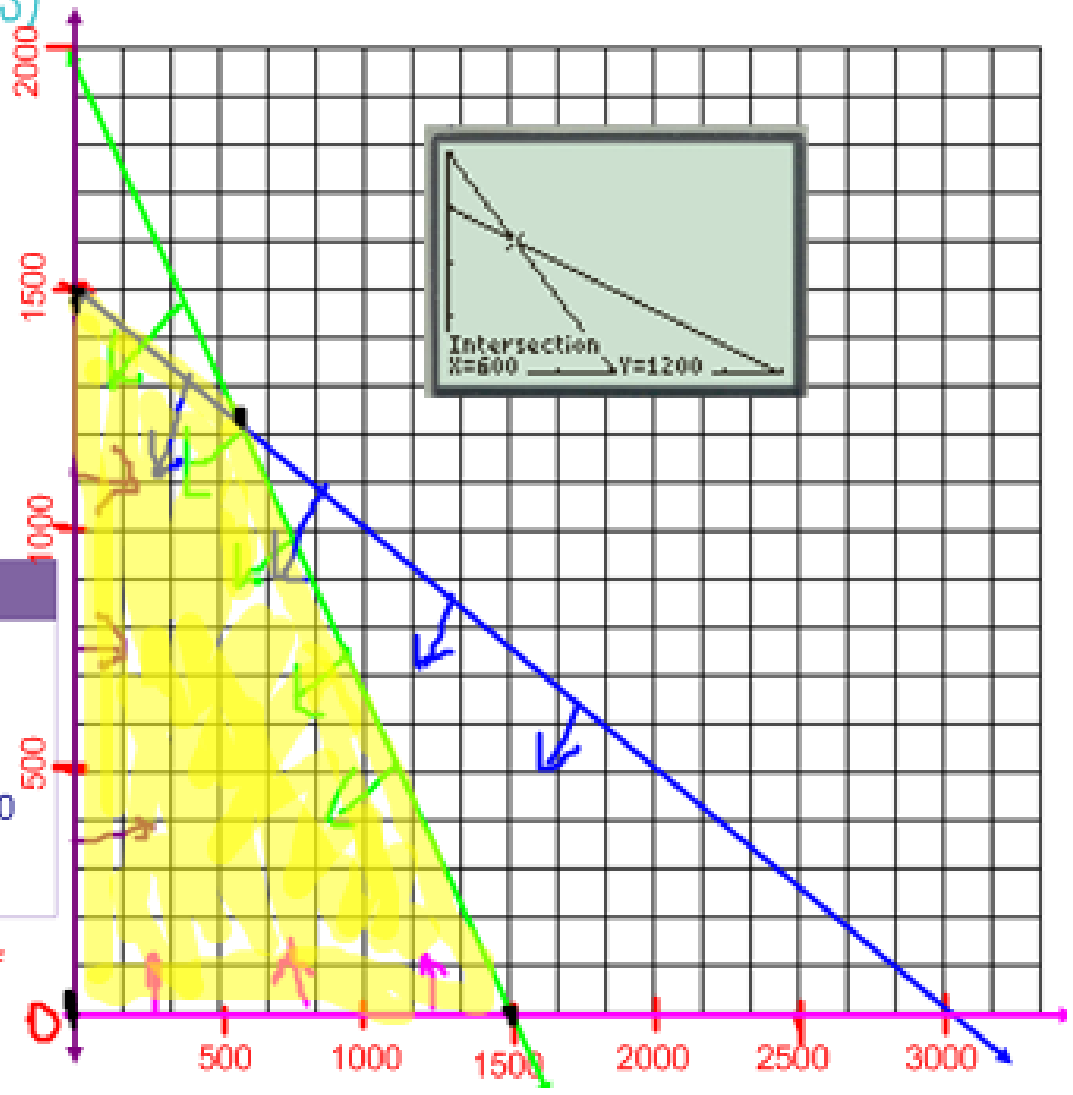
3RD- WRITE AN EQUATION FOR THE HERB SHOP'S PROFIT AND LABEL IT F(X,Y)

$$f(x,y) = 4x+5y$$

LINEAR PROGRAMMING STORY PROBLEMS

4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

$f(x,y)=4x+5y$



5TH- IDENTIFY VERTICES OF THE FEASIBLE REGION AND FIND THE AMOUNT OF EACH PERFUME TO PRODUCE TO MAXIMIZE PROFIT.

(X,Y)	[illegible]	F(X,Y)
(0,0)	4(0) + 5(0) =	f(0,0)=0
(1500, 0)	4(1500) + 5(0) =	f(1500,0)=6000
(600, 1200)	4(600) + 5(1200) =	f(600, 1200)=8400
(0,1500)	4(0) + 5(1500) =	f(0,1500)=7500

The maximum profit is $8400 by making 600 bottles of Gentle Rose and 1200 bottles of Rich Gardenia.

$2x + 1.5y \leq 3000$

x-int: $(1500, 0)$

$2x = 3000$

y-int: $(0, 2000)$

$\frac{1.5y}{1.5} = \frac{3000}{1.5}$

$y = 2000$

$\frac{1.5y}{1.5} \leq \frac{3000 - 2x}{1.5}$

$y \leq \frac{3000 - 2x}{1.5}$

$3x + 6y \leq 9000$

x-int: $(3000, 0)$

$\frac{3x}{3} = \frac{9000}{3}$

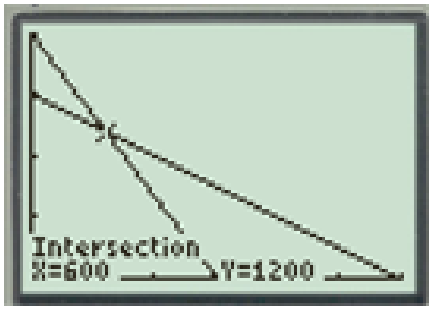
y-int: $(0, 1500)$

$\frac{6y}{6} = \frac{9000}{6}$

$y = 1500$

$6y \leq 9000 - 3x$

$y \leq \frac{9000 - 3x}{6}$



Xmax = 3000
Xmin = 0
Xscl = 500
Ymax = 2000
Ymin = 0
Yscl = 500