

LESSON 14: LINEAR PROGRAMMING STORY PROBLEMS (3.6)

~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.

$$X - 3Y < 0$$

$$X - 3Y > -15$$

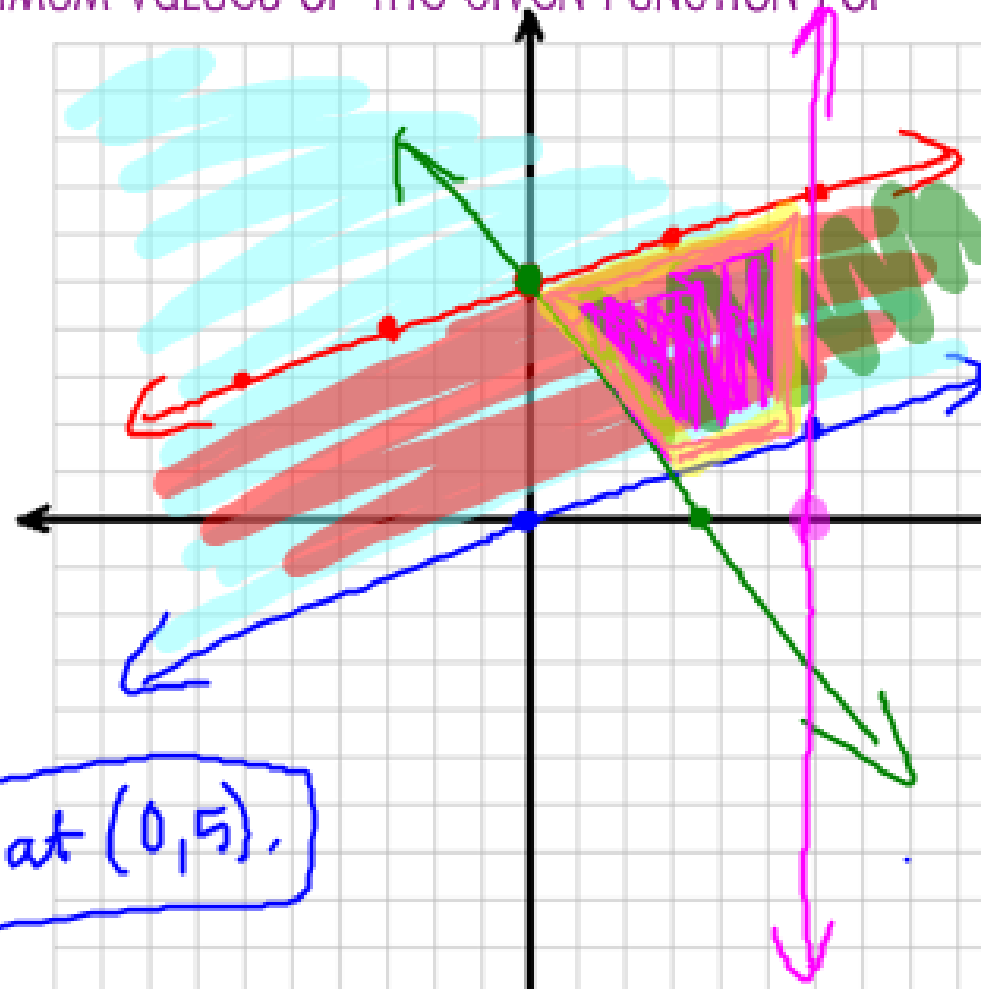
$$4X + 3Y > 15$$

$$X < 6$$

$$F(X,Y) = 5X + 2Y$$

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

Max is 44 at (6,7). Min is 10 at (0,5).



$$X - 3Y < 0$$

$$x\text{-int: } (0, 0)$$

$$y\text{-int: } (0, 0)$$

$$\text{Pick } x=6 \quad (6, 2)$$

$$\begin{array}{r} 6 - 3y = 0 \\ -6 \quad -6 \\ \hline -3y = -6 \\ -3 \quad -3 \\ \hline y = 2 \end{array}$$

$$-3y = -6$$

$$y = 2$$

Test (-1, -1)

$$-1 - 3(-1) \leq 0$$

$$-1 + 3 \leq 0$$

$$2 \leq 0$$

X

$$X - 3Y > -15$$

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

$$y\text{-int: } (0, 5)$$

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

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

Test (0, 0)

$$0 - 3(0) \geq -15$$

$$0 \geq -15$$

✓

$$4X + 3Y > 15$$

$$x\text{-int: } (3\frac{3}{4}, 0)$$

$$\frac{4x}{4} = \frac{15}{4}$$

$$x = \frac{15}{4}$$

$$x = 3\frac{3}{4}$$

$$y\text{-int: } (0, 5)$$

$$\frac{3y}{3} = \frac{15}{3}$$

$$y = 5$$

Test (0, 0)

$$0 + 0 \geq 15$$

$$0 \geq 15 \quad X$$

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LINEAR PROGRAMMING STORY PROBLEMS

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:

LET'S SAY THAT X=NUMBER OF HOURS TUTORING AND Y=NUMBER OF HOURS DELIVERING

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

FOR TOTAL HOURS WORKED: $x + y \leq 20$

FOR HOURS TUTORING: $x \geq 3$ $x \leq 8$

FOR HOURS DELIVERING: $y \geq 0$

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LINEAR PROGRAMMING STORY PROBLEMS

3RD- WRITE AN EQUATION FOR HER WEEKLY PROFIT AND LABEL IT $F(X,Y)$

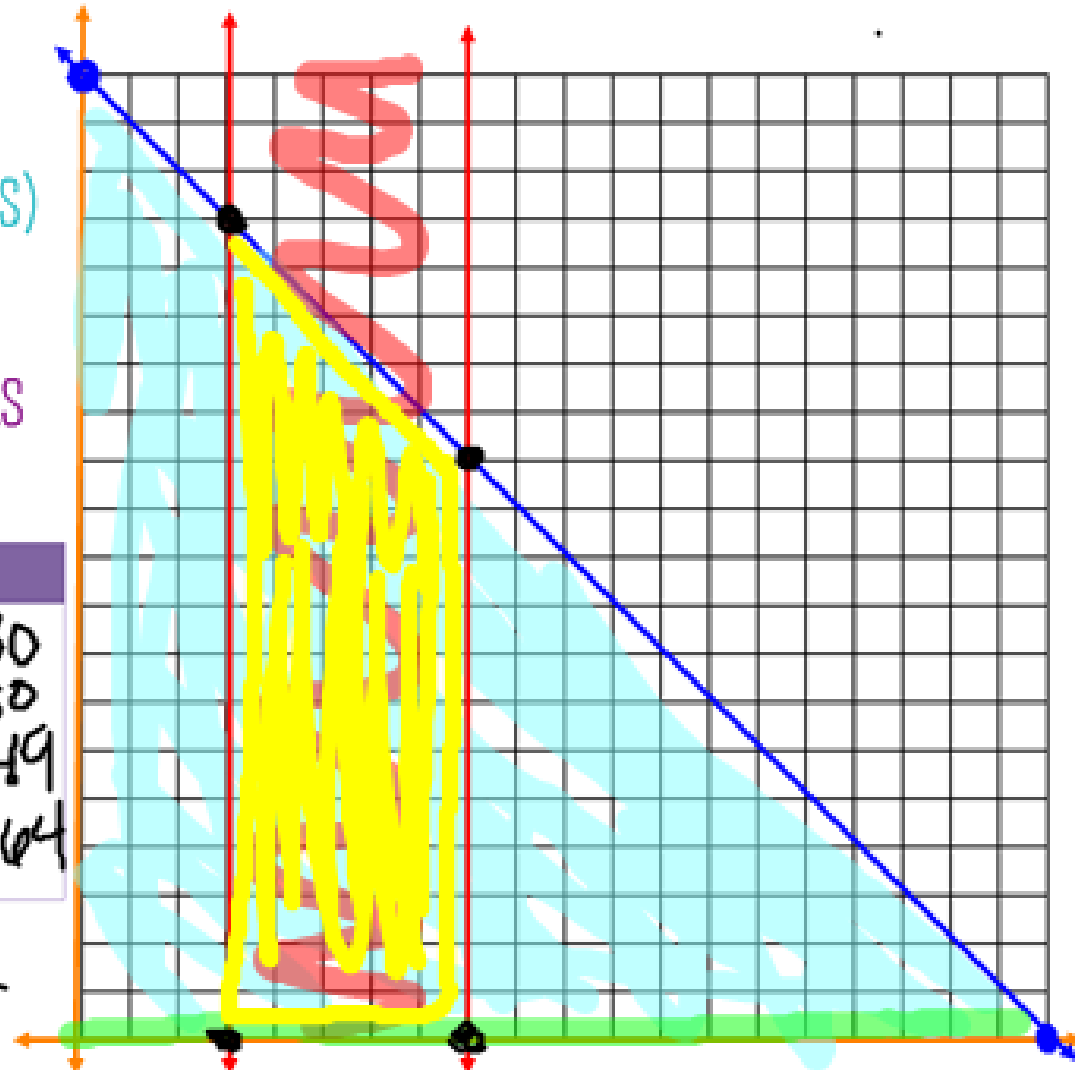
$$f(x,y) = 10x + 7y$$

4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

5TH- IDENTIFY VERTICES OF THE FEASIBLE REGION AND FIND MAXIMUMS AND MINIMUMS OF ROSALYN'S WEEKLY EARNINGS.

(X,Y)	$10X+7Y$	$F(X,Y)$
(3,0)	$10(3)+7(0)$	$f(3,0)=30$
(8,0)	$10(8)+7(0)$	$f(8,0)=80$
(3,17)	$10(3)+7(17)$	$f(3,17)=149$
(8,12)	$10(8)+7(12)$	$f(8,12)=164$

Rosalyn's max profit is \$164
working 8 hrs tutoring & 12 hrs
delivering pizzas.



$$x + y \leq 20$$

$$x \geq 3$$

$$x \leq 8$$

$$y \geq 0$$

$$x\text{-int: } (20, 0)$$

$$\underline{y\text{-int: } (0, 20)}$$

$$\text{Test } (0, 0)$$

$$0 + 0 \leq 20$$

$$0 \leq 20$$

✓

LESSON 14: LINEAR PROGRAMMING STORY PROBLEMS (3.6)

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:

$x =$ bottles of Gentle Rose $y =$ bottles Rich Gardenia

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

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

FOR TOTAL COST OF PERFUME: $3x + 6y \leq 9000$

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

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

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

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

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LINEAR PROGRAMMING STORY PROBLEMS

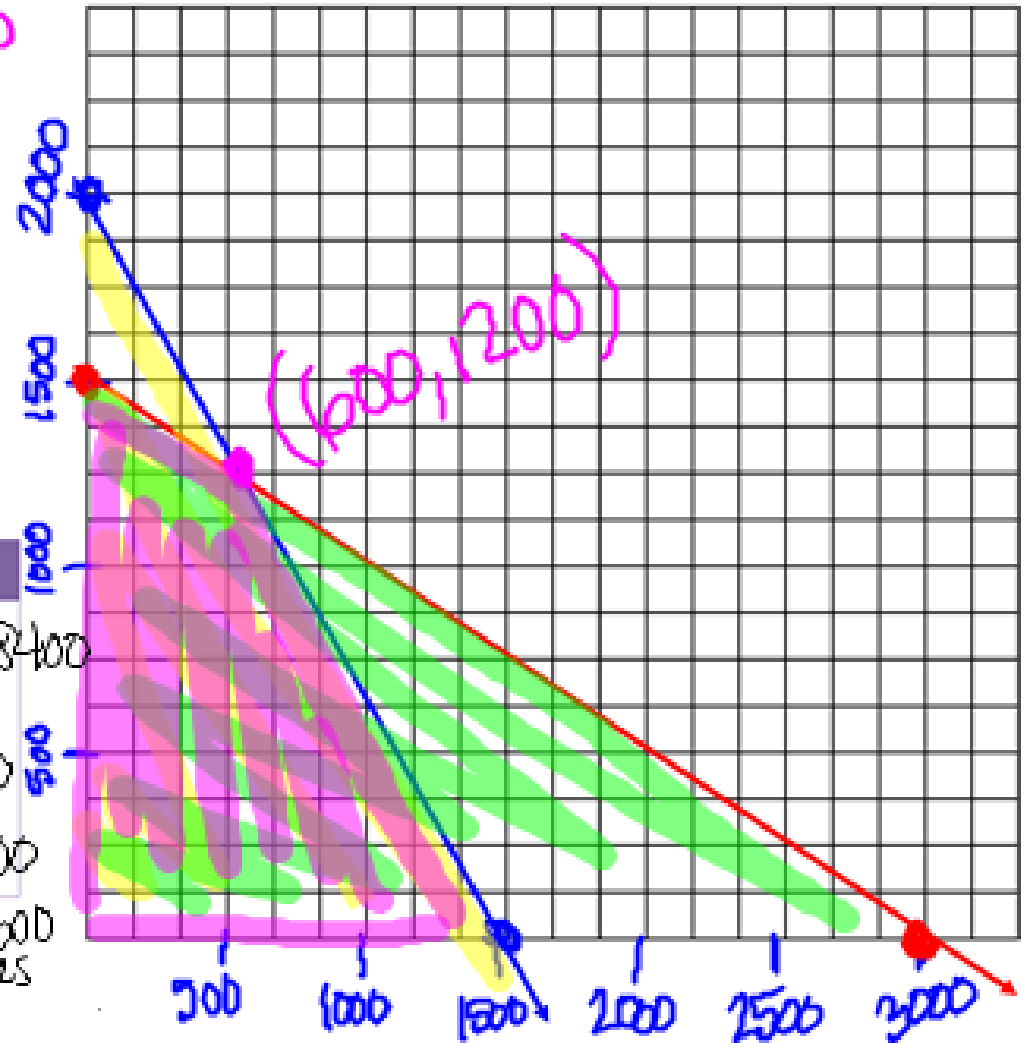
4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

$$\begin{array}{l}
 2x + 1.5y \leq 3000 \\
 0 + 0 \leq 3000 \\
 0 \leq 3000
 \end{array}
 \left|
 \begin{array}{l}
 3x + 6y \leq 9000 \\
 0 + 0 \leq 9000 \\
 0 \leq 9000
 \end{array}
 \right.$$

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

(X,Y)	$4x + 5y$	$F(X,Y)$
$(600, 1200)$	$4(600) + 5(1200)$	$f(600, 1200) = 8400$
$(0, 0)$	$4(0) + 5(0)$	$f(0, 0) = 0$
$(0, 1500)$	$4(0) + 5(1500)$	$f(0, 1500) = 7500$
$(1500, 0)$	$4(1500) + 5(0)$	$f(1500, 0) = 6000$

max profit of \$8400 by making 600 bottles of Gentle Rose and 1200 bottles of Rich Gardenia.



$$2x + 1.5y \leq 3000$$

$$x\text{-int: } (1500, 0)$$

$$\frac{2x}{2} \leq \frac{3000}{2}$$

$$x \leq 1500$$

$$y\text{-int: } (0, 2000)$$

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

$$y \leq 2000$$

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

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

$$3x + 6y \leq 9000$$

$$x\text{-int: } (3000, 0)$$

$$3x = 9000$$

$$y\text{-int: } (0, 1500)$$

$$6y \leq 9000$$

$$y \leq 1500$$

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

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

Calc Window

$$x_{\min} = 0$$

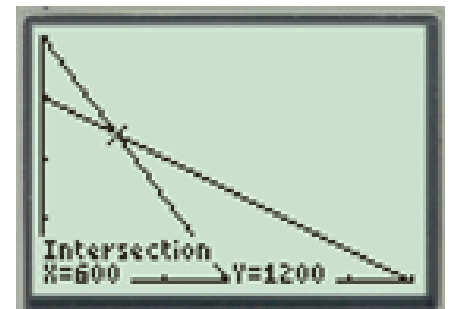
$$x_{\max} = 3000$$

$$x_{\text{sc1}} = 500$$

$$y_{\min} = 0$$

$$y_{\max} = 2000$$

$$y_{\text{sc1}} = 500$$



$$2X + 1.5Y \leq 3000$$

X-INT: ()

Y-INT: ()

$$3X + 6Y \leq 9000$$

X-INT: ()

Y-INT: ()

CALCULATOR
WINDOW

J 14^o

2. min op cost?

How long should each machine run?

$x =$ machine 1 (hrs run)

$y =$ machine 2 (hrs run)

	cost	bolt	nuts
M1	\$2	240	100
M2	\$2.40	160	160
total		<u>≥ 2080</u>	≥ 1520

$$f(x, y) = 2x + 2.40y$$

$$240x + 160y \geq 2080$$

$$100x + 160y \geq 1520$$

$$x \geq 0$$

$$y \geq 0$$

$$x + y \leq 30 \text{ hrs}$$

$$x\text{-int: } (30, 0)$$

$$y\text{-int: } (0, 30)$$

2. cont.

$$240x + 160y \geq 2080$$

$$x\text{-int: } (8.6, 0)$$

$$\frac{240x \geq 2080}{240 \quad 240}$$
$$x \geq 8.6$$

$$y\text{-int: } (0, 13)$$

$$\frac{160y \geq 2080}{160 \quad 160}$$
$$y \geq 13$$

$$\frac{160y \geq 2080 - 240x}{160}$$

$$y \geq \frac{(2080 - 240x)}{160}$$

$$100x + 160y \geq 1520$$

$$x\text{-int: } (15.2, 0)$$

$$y\text{-int: } (0, 9.5)$$

$$160y \geq 1520 - 100x$$

$$y \geq \frac{(1520 - 100x)}{160}$$

$$y \leq 30 - x$$

Cole Wind

$$x_{\min} = 0$$

$$x_{\max} = 30$$

$$x_{\text{sel}} = 2$$

$$y_{\min} = 0$$

$$y_{\max} = 30$$

$$y_{\text{sel}} = 2$$

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3. Max profit?
How many of each calc?

$x = \text{Scientific}$

$y = \text{graphing}$

$$x \geq 110 \quad x \leq 200$$

$$y \geq 80 \quad y \leq 170$$

$$x + y \geq 200$$

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

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LINEAR PROGRAMMING STORY PROBLEMS

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:

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

FOR TOTAL AMOUNT OF PAPER:

FOR UNITS OF NOTEBOOK PAPER:

FOR UNITS OF NEWSPAPER:

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3RD- WRITE AN EQUATION FOR THE MILL'S DAILY PROFIT AND LABEL IT $F(x,y)$

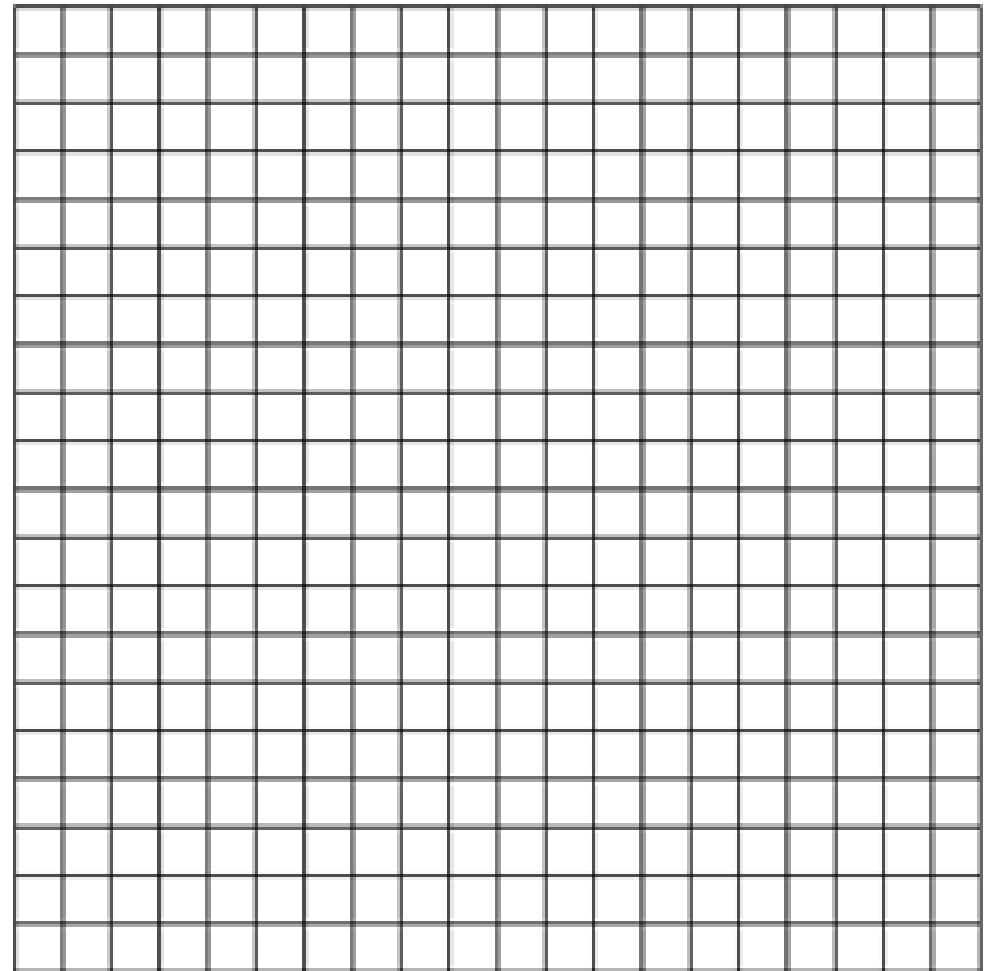
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LINEAR PROGRAMMING STORY PROBLEMS

4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

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

(X,Y)	$10X+7Y$	$F(X,Y)$



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LINEAR PROGRAMMING STORY PROBLEMS

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:

2ND- SET UP THE CONSTRAINTS (INEQUALITIES)

TOTAL TIME FOR APPOINTMENTS:

FOR OFFICE VISITS:

FOR SURGERIES:

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3RD- WRITE AN EQUATION FOR THE VETERINARIAN'S DAILY PROFIT AND LABEL IT $F(x,y)$

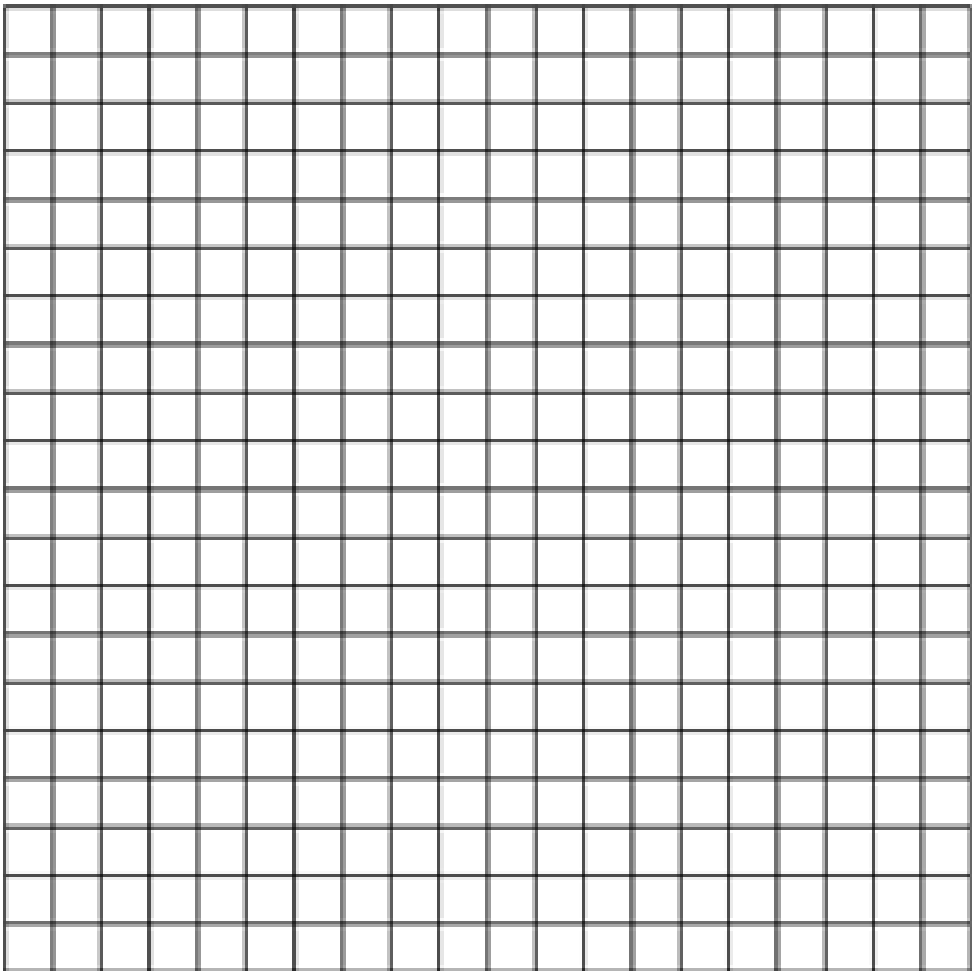
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LINEAR PROGRAMMING STORY PROBLEMS

4TH- GRAPH ALL CONSTRAINTS (INEQUALITIES)

5TH- IDENTIFY VERTICES OF THE FEASIBLE REGION AND FIND HOW MANY VISITS AND SURGERIES WILL MAXIMIZE PROFIT.

(X,Y)	$10X+7Y$	$F(X,Y)$



~JOURNAL #14~

DUE AT THE BEGINNING OF NEXT CLASS

~ASSIGNMENT #14~

DUE AT THE END OF NEXT CLASS