QUESTIONS???

HOMEWORK...

Page 248: #1, #2, #3, #5

NOTE:

Create a model means graph the solution region

a) x – # of apples
y – # of oranges
$x \in W$ $y \in W$

1. Baskets of fruit are being prepared to sell.
   - Each basket contains at least 5 apples and at least 6 oranges.
   - Apples cost 20¢ each, and oranges cost 35¢ each. The budget allows no more than $7, in total, for the fruit in each basket.

   Answer each part below to create a model that could be used to determine the combination of apples and oranges that will result in the maximum number of pieces of fruit in a basket.

   a) What are the two variables in this situation? Describe any restrictions.

   b) Write a system of linear inequalities to represent each constraint:
      i) the number of apples in each basket
      ii) the number of oranges in each basket
      iii) the cost of each basket (in cents)

   c) Graph the system.

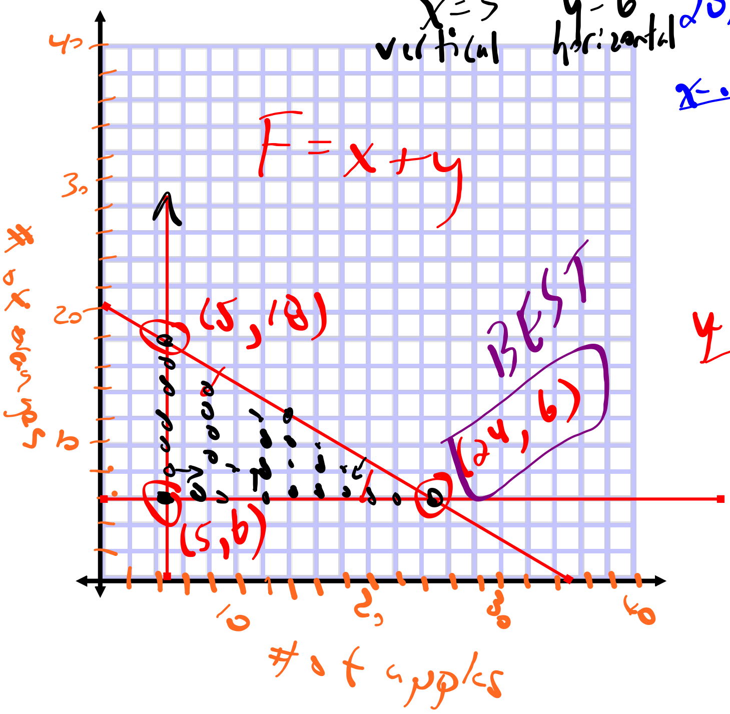
   d) Write the objective function that represents how the quantity to be maximized relates to the variables.

D) $F = x + y$

inequation

$x \geq 5$
$y \geq 6$

$20x + 35y \leq 700$



$20x + 35y = 700$

x-int $\frac{20x}{20} + \cancel{35(0)} = \frac{700}{20}$

$x = 35$

$(35, 0)$

y int $\cancel{20(0)} + \frac{35y}{35} = \frac{700}{35}$

$y = 20$

$(0, 20)$

GOAL

Solve optimization problems.

EXPLORE...

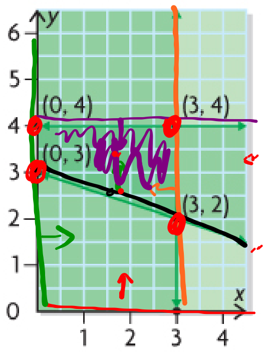
• The following system of linear inequalities has been graphed below:

System of linear inequalities:

$y \geq 0$
$x \geq 0$ Quad I
$y \leq 4$
$x \leq 3$
$3y \geq -x + 9$

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

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



Test (0,0)

LS ≥ RS

$3(0)$ | $-0+9$

$0 \ngeq 9$ No

a) For each objective function, what points in the feasible region represent the minimum and maximum values?
i) $T = 5x + y$
ii) $T = x + 5y$
b) What do you notice about the optimal points for the two objective functions? Why do you think this happened?

SAMPLE ANSWER

a) i) For $T = 5x + y$,

If (x, y) is...	Then...	
(3, 2)	$T = 5(3) + 2$ $T = 17$	
(3, 4)	$T = 5(3) + 4$ $T = 19$	maximum
(0, 3)	$T = 5(0) + 3$ $T = 3$	minimum
(0, 4)	$T = 5(0) + 4$ $T = 4$	

ii) For $T = x + 5y$,

If (x, y) is...	Then...	
(3, 2)	$T = 3 + 5(2)$ $T = 13$	minimum
(3, 4)	$T = 3 + 5(4)$ $T = 23$	maximum
(0, 3)	$T = 0 + 5(3)$ $T = 15$	
(0, 4)	$T = (0) + 5(4)$ $T = 20$	

b) I noticed that the values of the coefficients of the variables and the values of the variables themselves all contribute to the value of the objective function. For $T = 5x + y$, the x-value is multiplied by 5 and the y-value is multiplied by 1. For $T = x + 5y$, the x-value is multiplied by 1 and the y-value is multiplied by 5. In each case, the greater the coordinate that is multiplied by 5, the greater the value of the objective function is. The converse is true for the least values.

EXAMPLE #2...

The following model represents an optimization problem. Determine the maximum solution.

Restrictions: $x \varepsilon R \text{ and } y \varepsilon R$

Constraints: $y \leq 1;\ 2y \geq -3x + 2;\ y \geq 3x - 8$

Objective Function: $D = -4x + 3y$

$y = 1$ horizontal

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

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

$y = 3x - 8$

LS	$\geq$ RS
0	$3(0) - 8$
$\geq$	-8

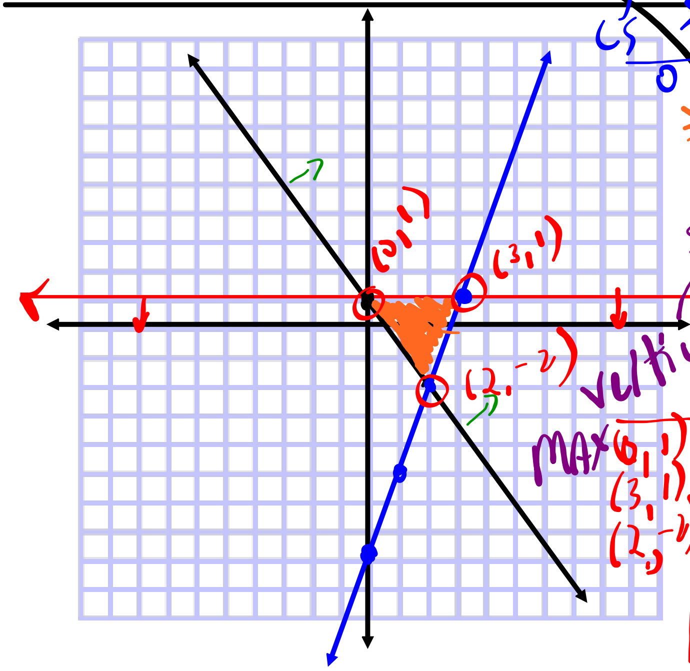
yes

sub

Test (0,0)

LS	$\geq$ RS
$2(0)$	$-3(0) + 2$
0 $\geq$	2

NO



vertices

	$D = -4x + 3y$
MAX (0,1)	$-4(0) + 3(1) = 3$
(3,1)	$-4(3) + 3(1) = -9$
(2,-2)	$-4(2) + 3(-2) = -14$

EXAMPLE of an OPTIMIZATION Problem...

Mick and Keith make MP3 covers to sell, using beads and stickers.

- At most 45 covers with stickers and 55 bead covers can be made per day.
- Mick and Keith can make 45 or more covers, in total, each day.
- It costs \$0.75 to make a cover with stickers, \$1.00 to make one with beads.

Let x represent the number of covers with stickers and let y represent the number of bead covers.

Let C represent the cost of making the covers.

RESTRICTIONS: $x \in W \quad y \in W$

CONSTRAINTS: $x + y \geq 45 \quad x \leq 45 \quad y \leq 55$

OBJECTIVE FUNCTION: $C = 0.75x + 1.00y$

a) Graph the solution set.

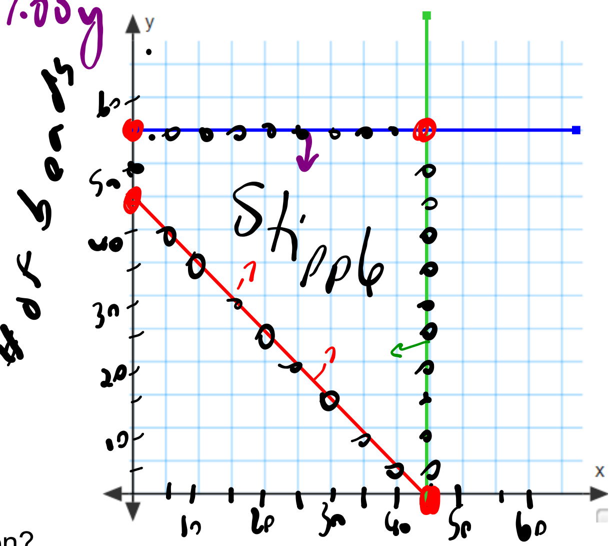
$x + y = 45$

x-int $x + 0 = 45$ $(45, 0)$

y-int $0 + y = 45$ $(0, 45)$

$x = 45$ vertical

$y = 55$ horizontal



# of stickers

b) What are the vertices of the feasible region?

$(0,45)$ $(0,55)$ $(45,0)$ $(45,55)$

c) Which point would result in the maximum value of the objective function?

$(45,55)$

d) Which point would result in the minimum value of the objective function?

$(45,0)$

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             88.75
.75(45)
             33.75
1(45)
                45
1(55)
                55
```

HOMEWORK...

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