Name_____

Date_____ Period_____

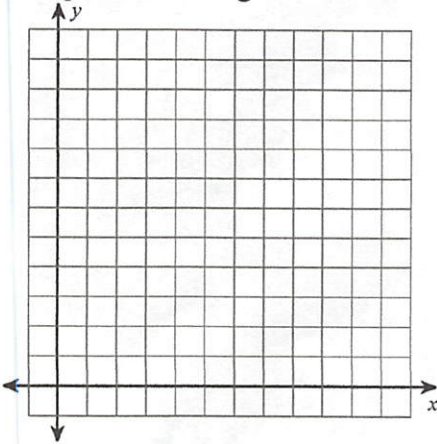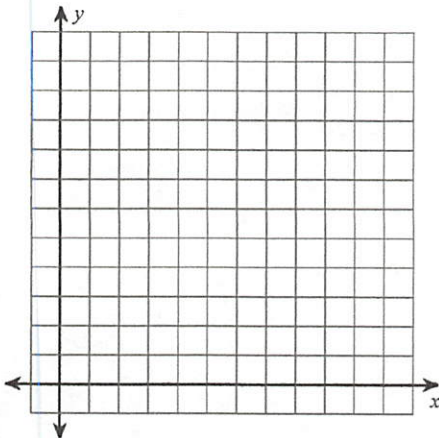**Graph each system of inequalities. Name the coordinates of the vertices of the feasible region. Find the maximum and minimum values of the given function for this region.**

1) A backpack manufacturer produces an internal frame pack and an external frame pack. Let x represent the number of internal frame packs produced in one hour and let y represent the number of external frame packs produced in one hour. Then the inequalities $x + 3y \leq 18$, $2x + y \leq 16$, $x \geq 0$, and $y \geq 0$ describe the constraints for manufacturing both packs.
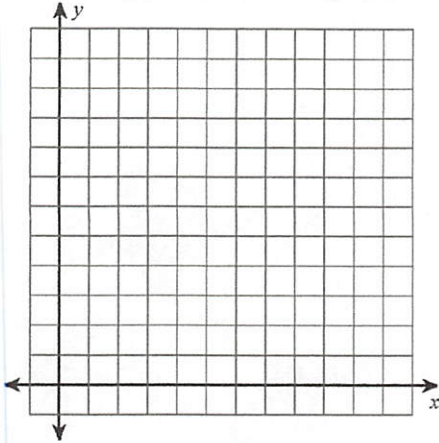
If the company makes a profit of $50 for every internal frame pack and $80 for every external frame pack, write a profit function and determine the maximum profit for manufacturing both backpacks for the given constraints.



2) MANUFACTURING Eighty workers are available to assemble tables and chairs. It takes 5 people to assemble a table and 3 people to assemble a chair. The workers always make at least as many tables as chairs because the tables are easier to make. If x is the number of tables and y is the number of chairs, the system of inequalities that represent what can be assembled is $x > 0$, $y > 0$, $y \leq x$, and $5x + 3y \leq 80$. What is the maximum total number of chairs and tables the workers can make?
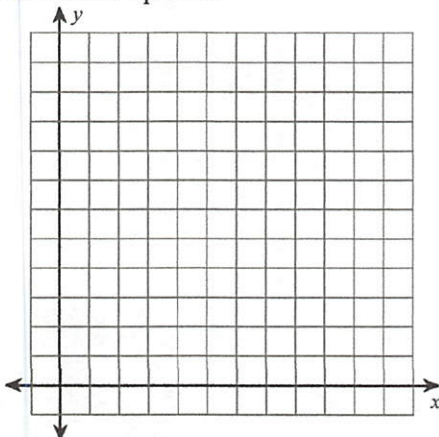
3) FISH An aquarium is 7000 cubic inches. Nathan wants to populate the aquarium with neon tetras and catfish. It is recommended that each neon tetra be allowed 170 cubic inches and each catfish be allowed 700 cubic inches of space. Nathan would like at least one catfish for every 4 neon tetras. Let n be the number of neon tetra and c be the number of catfish. The following inequalities form the feasible region for this situation: $n > 0$, $c > 0$, $4c \geq n$, and $170n + 700c \leq 7000$. What is the maximum number of fish Nathan can put in his aquarium?

4) Superbats Inc. manufactures two different types of wood baseball bats, the Homer-Hitter and the Big Timber. The Homer-Hitter takes 8 hours to trim and turn on the lathe and 2 hours to finish. Each Homer-Hitter sold makes a profit of $17. The Big Timber takes 5 hours to trim and turn on the lathe and 5 hours to finish, and its profit is $29. The total time available for trimming and lathing is 80 hours. The total available time for finishing is 50 hours.
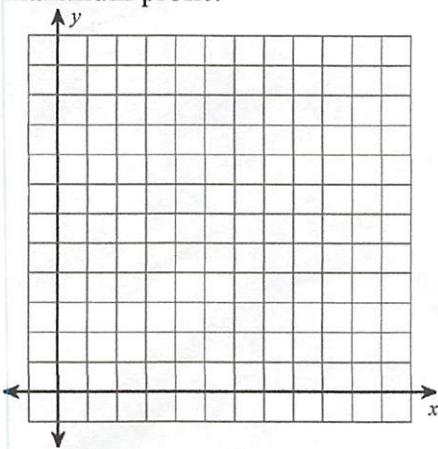
(a) What are your variables and what do they represent?

(b) Write the objective quantity equation.

(c) Write the system of inequalities that describes the constraints.

(d) Graph the system of inequalities and find the vertices.

(e) How many of each type should be produced in order to maximize their profit? What is the maximum profit?
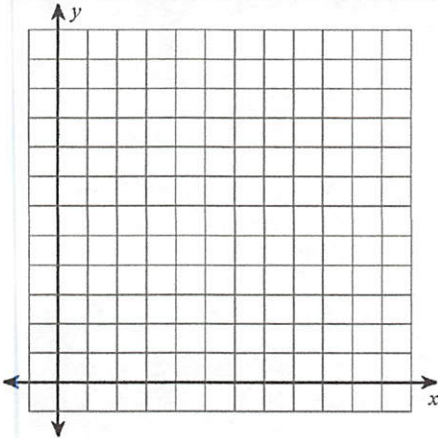
5) Stitches Inc. can make at most 30 jean jackets and 20 leather jackets in a week. It takes a worker 10 hours to make a jean jacket and 20 hours to make a leather jacket. The total number of hours by all of the employees can be no more than 500 hours per week. The profit on a jean jacket is $20, and the profit on a leather jacket is $50.
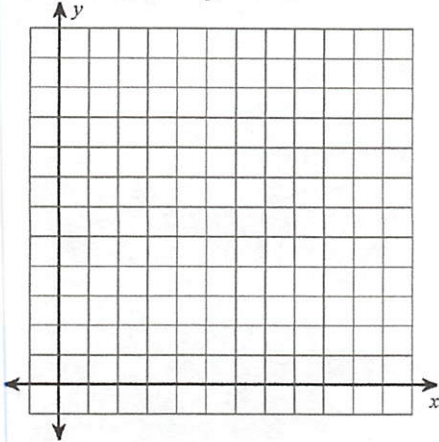
(a) What are your variables and what do they represent?

(b) Write the objective quantity equation.

(c) Write the system of inequalities that describes the constraints.

(d) Graph the system of inequalities and find the vertices.

(e) How many of each type should be produced in order to maximize profit? What is the maximum profit?



6) A snack bar cooks and sells hamburgers and hot dogs during football games. To stay in business, it must sell at least 10 hamburgers but can not cook more than 40. It must also sell at least 30 hot dogs, but can not cook more than 70. The snack bar can not cook more than 90 items total. The profit on a hamburger is 33 cents, and the profit on a hot dog is 21 cents. Low many of each item should it sell to make the maximum profit?

7) You need to buy some filing cabinets. You know that Cabinet X costs $10 per unit, requires six square feet of floor space, and holds eight cubic feet of files. Cabinet Y costs $20 per unit, requires eight square feet of floor space, and holds twelve cubic feet of files. You have been given $140 for this purchase, though you don't have to spend that much. The office has room for no more than 72 square feet of cabinets. How many of which model should you buy, in order to maximize storage volume?
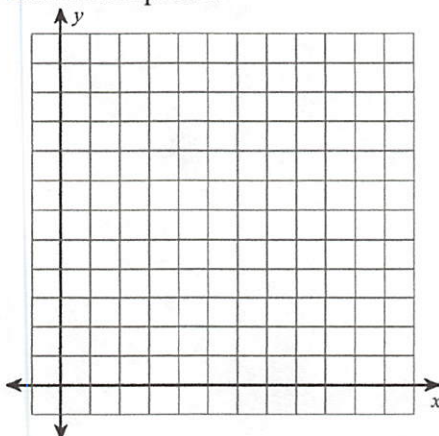
8) TV Electronics Inc. makes console and wide-screen televisions. The equipment in the factory allows for manufacturing at most 450 console televisions and 200 wide-screen televisions in one month.

The cost of making each type of television, as well as the profit for each.

| Television | Cost Per Unit | Profit Per Unit |
| --- | --- | --- |
| Console | $600 | $125 |
| Wide-Screen | $900 | $200 |

During the month of November, the company can spend $360,000 to make these televisions.
(a) What are your variables and what do they represent?

(b) Write the objective quantity equation.

(c) Write the system of inequalities that describes the constraints.

(d) Graph the system of inequalities and find the vertices.

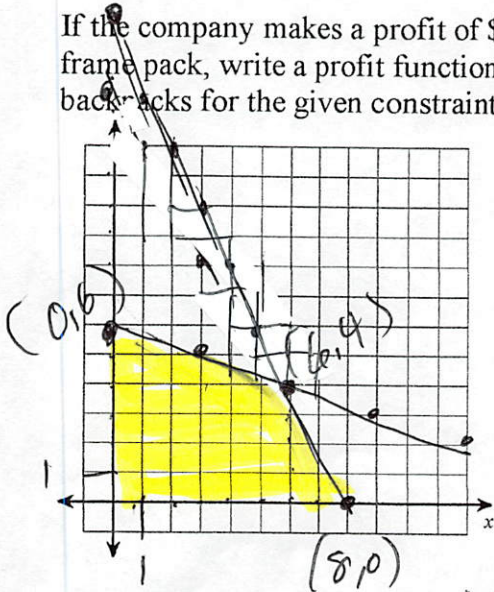(e) How many of each type should be produced in order to maximize profit? What is the maximum profit?

Name ___Key___

## Section 3.3

Date _____ Period_____

**Graph each 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.**

1) A backpack manufacturer produces an internal frame pack and an external frame pack. Let x represent the number of internal frame packs produced in one hour and let y represent the number of external frame packs produced in one hour. Then the inequalities $x + 3y \leq 18$, $2x + y \leq 16$, $x \geq 0$, and $y \geq 0$ describe the constraints for manufacturing both packs.

If the company makes a profit of $50 for every internal frame pack and $80 for every external frame pack, write a profit function and determine the maximum profit for manufacturing both backpacks for the given constraints.



$x + 3y \leq 18 \Rightarrow y \leq -\frac{1}{3}x + 6$

$2x + y \leq 16 \Rightarrow y \leq -2x + 16$

Profit $= 50x + 80y$

$(0,6) = 50(0) + 80(6) = 480$

$(6,4) = 50(6) + 80(4) = 620$ (max)

$(8,0) = 50(8) + 80(0) = 400$

max profit $620

6 internal backpacks
4 external backpacks

2) **MANUFACTURING** Eighty workers are available to assemble tables and chairs. It takes 5 people to assemble a table and 3 people to assemble a chair. The workers always make at least as many tables as chairs because the tables are easier to make. If x is the number of tables and y is the number of chairs, the system of inequalities that represent what can be assembled is $x > 0$, $y > 0$, $y \leq x$, and $5x + 3y \leq 80$. What is the maximum total number of chairs and tables the workers can make?
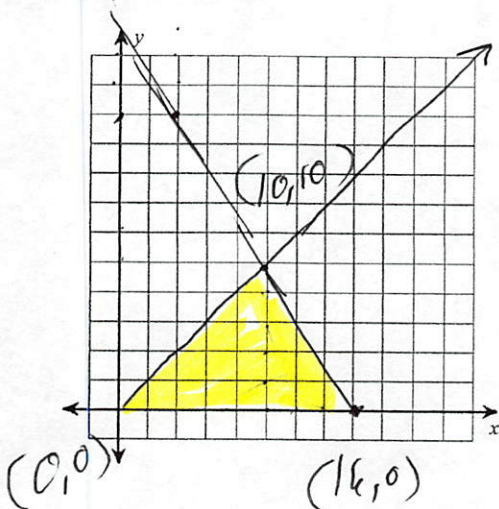


$y \leq x$

$5x + 3y \leq 80 \Rightarrow y \leq -\frac{5}{3}x + \frac{80}{3}$

10 tables
10 chairs

3) FISH An aquarium is 7000 cubic inches. Nathan wants to populate the aquarium with neon tetras and catfish. It is recommended that each neon tetra be allowed 170 cubic inches and each catfish be allowed 700 cubic inches of space. Nathan would like at least one catfish for every 4 neon tetras. Let n be the number of neon tetra and c be the number of catfish. The following inequalities form the feasible region for this situation: $n > 0$, $c > 0$, $4c \geq n$, and $170n + 700c \leq 7000$. What is the maximum number of fish Nathan can put in his aquarium?
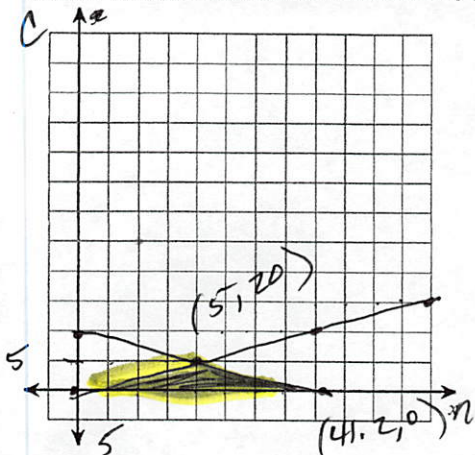


$4c \geq n \Rightarrow c \geq \frac{1}{4}n$

$170n + 700c \geq 7000$

$\Rightarrow c \geq \frac{-17}{70}c + 10$

$170n + 700c = 7000$

$170(4c) + 700c = 7000$

$1380c = 7000$

$c \approx 5$

$n \approx 20$

y-int : $(0,10)$

x-int : $(41.2, 0)$

20 neons
5 catfish

4) Superbats Inc. manufactures two different types of wood baseball bats, the Homer-Hitter and the Big Timber. The Homer-Hitter takes 8 hours to trim and turn on the lathe and 2 hours to finish. Each Homer-Hitter sold makes a profit of $17. The Big Timber takes 5 hours to trim and turn on the lathe and 5 hours to finish, and its profit is $29. The total time available for trimming and lathing is 80 hours. The total available time for finishing is 50 hours.

(a) What are your variables and what do they represent?   x : home hitters   y : Big timber

(b) Write the objective quantity equation.  Profit = $17x + 29y$

(c) Write the system of inequalities that describes the constraints.  $8x + 5y \leq 80 \Rightarrow y \leq -\frac{8}{5}x + 16$

$x \geq 0$
$y \geq 0$

$2x + 5y \leq 50 \Rightarrow y \leq -\frac{2}{5}x + 10$

(d) Graph the system of inequalities and find the vertices.

(e) How many of each type should be produced in order to maximize their profit? What is the maximum profit?
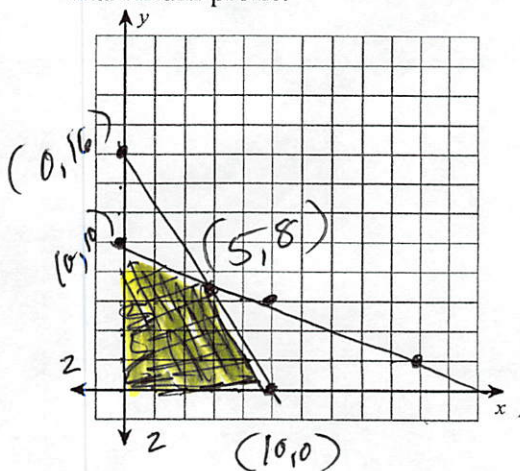


$(8x + 5y = 80) -1$
$2x + 5y = 50$

$-8x - 5y = -80$
$\underline{\phantom{-8x - 5y}}$
$-6x = -30$
$x = 5$

$2(5) + 5y = 50$
$5y = 40$
$y = 8$

max is $317

$P = 17x + 29y$
$17(5) + 29(8) = 317$
$17(0) + 29(10) = 290$
$17(10) + 29(0) = 170$

make
5 home hitters
8 Big timbers

5) Stitches Inc. can make at most 30 jean jackets and 20 leather jackets in a week. It takes a worker 10 hours to make a jean jacket and 20 hours to make a leather jacket. The total number of hours by all of the employees can be no more than 500 hours per week. The profit on a jean jacket is $20, and the profit on a leather jacket is $50.

(a) What are your variables and what do they represent?   $x$: jean jackets   $y$: leather

(b) Write the objective quantity equation. Profit $= 20x + 50y$

(c) Write the system of inequalities that describes the constraints.

$10x + 20y \leq 500$

$\Rightarrow \quad y \leq -\frac{1}{2}x + 25$

$0 \leq x \leq 30$
$0 \leq y \leq 20$

(d) Graph the system of inequalities and find the vertices.

(e) How many of each type should be produced in order to maximize profit?   What is the maximum profit?
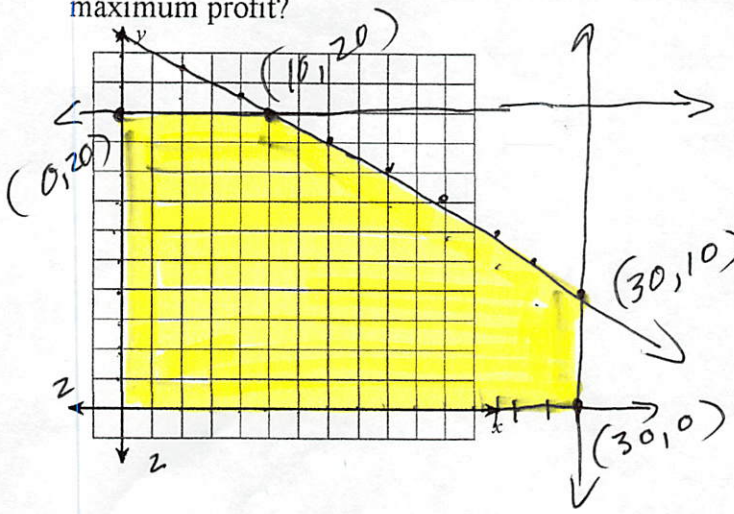


$P = 20x + 50y$

$(0, 20) = 20(0) + 50(20) = 1000$

$(10, 20) = 20(10) + 50(20) = 1200$ max

$(30, 10) = 20(30) + 50(10) = 1100$

$(30, 0) = 20(30) + 50(0) = 600$

$\$1200$ max profit

10 jean jackets
20 leather jackets

6) A snack bar cooks and sells hamburgers and hot dogs during football games. To stay in business, it must sell at least 10 hamburgers but can not cook more than 40. It must also sell at least 30 hot dogs, but can not cook more than 70. The snack bar can not cook more than 90 items total. The profit on a hamburger is 33 cents, and the profit on a hot dog is 21 cents. How many of each item should it sell to make the maximum profit?
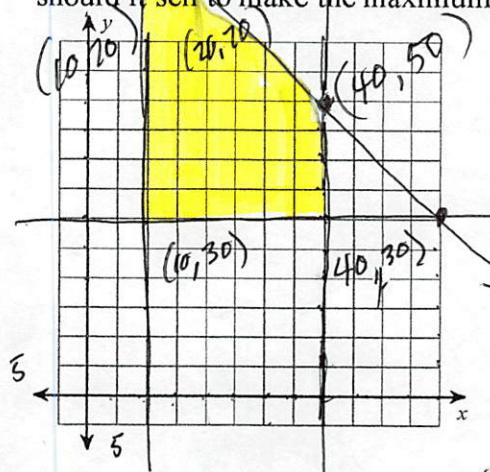


$x$: hamburgers   $y$: hotdogs

$10 \leq x \leq 40$

$30 \leq y \leq 70$

$x + y \leq 90$

Profit $= .33x + .21y$

$(10, 70) \Rightarrow \$18$
$(10, 30) \Rightarrow \$9.60$
$(20, 70) \Rightarrow \$21.30$
$(40, 50) \Rightarrow \$23.70$ max
$(40, 30) \Rightarrow \$19.50$

max profit is $\$23.70$
40 hamburgers
50 hotdogs

7) You need to buy some filing cabinets. You know that Cabinet X costs $10 per unit, requires six square feet of floor space, and holds eight cubic feet of files. Cabinet Y costs $20 per unit, requires eight square feet of floor space, and holds twelve cubic feet of files. You have been given $140 for this purchase, though you don't have to spend that much. The office has room for no more than 72 square feet of cabinets. How many of which model should you buy, in order to maximize storage volume?
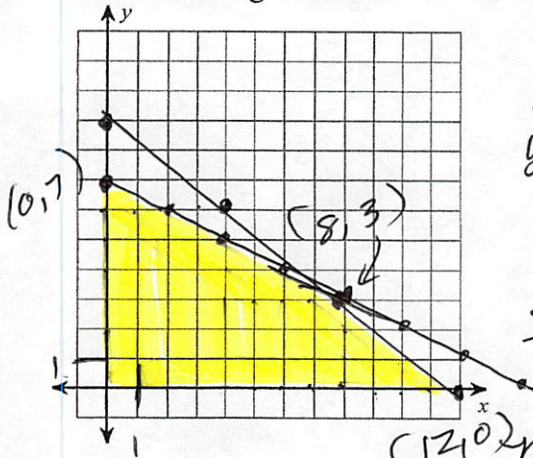
$x$: number of model $x$    $y$: number of model $y$

$x \geq 0$
$y \geq 0$

max vol = 100 ft$^2$
8 type x
3 type y

Cost:
$10x + 20y \leq 140 \Rightarrow y \leq -\frac{1}{2}x + 7$

Space:
$6x + 8y \leq 72 \Rightarrow y \leq -\frac{3}{4}x + 9$

$(12,0)$ max Volume $= 8x + 12y$

$(0,7) \Rightarrow 84$
$(8,3) \Rightarrow 100$ max
$(12,0) \Rightarrow 96$

8) TV Electronics Inc. makes console and wide-screen televisions. The equipment in the factory allows for manufacturing at most 450 console televisions and 200 wide-screen televisions in one month.

The cost of making each type of television, as well as the profit for each.

| Television | Cost Per Unit | Profit Per Unit |
|---|---|---|
| Console | $600 | $125 |
| Wide-Screen | $900 | $200 |

During the month of November, the company can spend $360,000 to make these televisions.
(a) What are your variables and what do they represent?   $x$: console   $y$: wide screen

(b) Write the objective quantity equation. Profit $= 125x + 200y$

(c) Write the system of inequalities that describes the constraints.
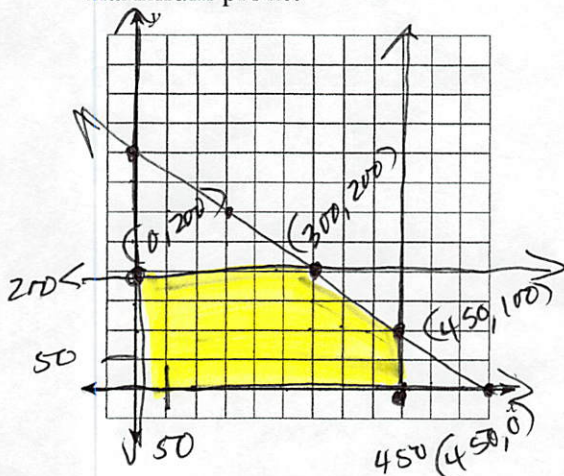
$0 \leq x \leq 450$       $600x + 900y \leq 360,000$
$0 \leq y \leq 200$       $\Rightarrow y \leq -\frac{2}{3}x + 400$

(d) Graph the system of inequalities and find the vertices.

(e) How many of each type should be produced in order to maximize profit? What is the maximum profit?

$P = 125x + 200y$
$(0,200) = \$40,000$
$(300,200) = \$77,500$ max
$(450,100) = \$76,250$
$(450,0) = \$56,250$

max profit   $\$77,500$
300 console
200 wide screens

-4-