Agriculture
Maximizing Profits Worksheet **Name** Key

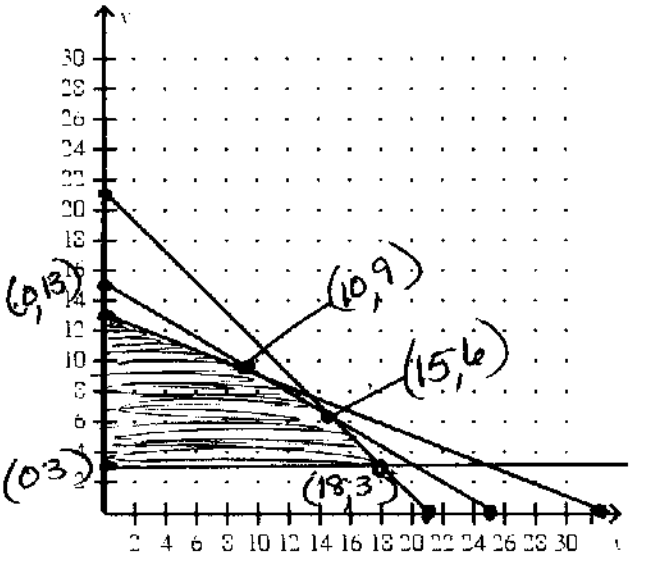
1. The Smiths have a small farm where they grow corn and tomatoes for sale. They have a total of 21 acres available for planting. Because they cannot afford to pay a lot for help, they have many restrictions based on their labor. They have a total of 150 hours available for planting and 130 hours available for harvesting. Each acre of corn takes 6 hours to plant and 4 hours to harvest. Each acre of tomatoes takes 10 hours to plant and 10 hours to harvest. A local grocery chain has agreed to purchase 3 acres worth of tomatoes.
If each acre of corn can be sold for $600 and each acre of tomatoes can be sold for $800, how many acres of each type should the Smiths plant to maximize their profit? What is the maximum profit?

Profit function P = $600x + 800y$
Constraints

x = # acres corn
y = # acres tomatoes

land $x + y \leq 21$ $x \geq 0$
Plant $6x + 10y \leq 150$ $y \geq 3$
Harvest $4x + 10y \leq 130$

$x+y=21$	$6x+10y=150$	$4x+10y=130$
(0, 21)	(0, 15)	(0, 13)
(21, 0)	(25, 0)	(32.5, 0)



(x, y)	P = 600x + 800y	
(0, 3)	2400	600(0) + 800(3)
(18, 3)	13200	600(18) + 800(3)
(0, 13)	10400	600(0) + 800(13)
(10, 9)	13200	600(10) + 800(9)
* (15, 6)	13800	600(15) + 800(6)

Max profit $13800

Acres of corn 15 Acres of tomatoes 6

2. A fish market buys tuna for $.50 per pound and spends $1.50 per pound to clean and package it. Salmon costs $2.00 per pound to buy and $2.00 per pound to clean and package. The market makes $2.50 per pound profit on tuna and $2.80 per pound profit for salmon. The market can spend only $106 per day to buy fish and $134 per day to clean it. How much of each type of fish should the market buy to maximize profit?

a. Write an objective function P and constraints for a linear program to model the problem.

b. Graph the constraint and find the coordinates of each vertex.

c. Evaluate P at each vertex to find the maximum profit.

x = Tuna
y = Salmon

a. $P = 2.50x + 2.80y$

b. Constraints

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

Buy $.5x + 2y \leq 106$

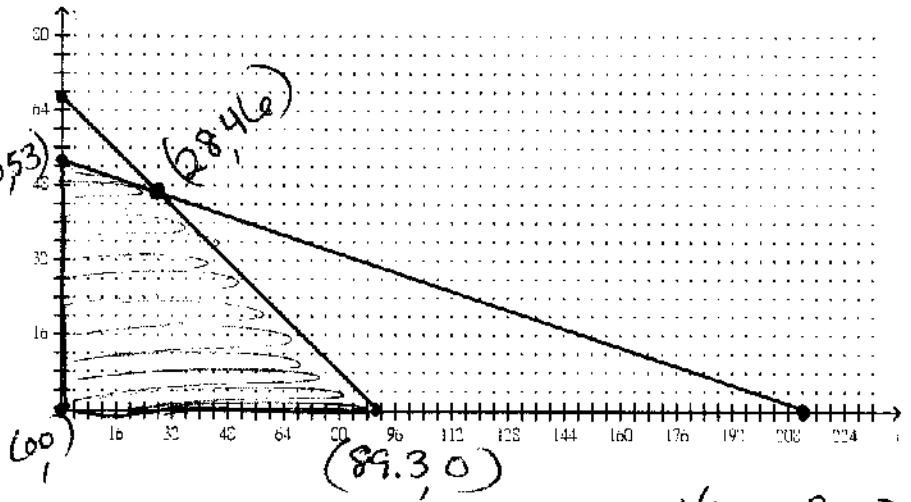
Clean $1.5x + 2y \leq 134$

$.5x + 2y = 106$

(0, 53) (212, 0)

$1.5x + 2y = 134$

(0, 67) (89.3, 0)



(x, y)	P = 2.50x + 2.80y	
(0, 0)	0	2.50(0) + 2.80(0)
(0, 53)	148.4	2.50(0) + 2.80(53)
(28, 46)	198.8	2.5(28) + 2.80(46)
(89.3, 0)	223.25	2.5(89.3) + 2.8(0)

$-1(.5x + 2y = 106)$
$1.5x + 2y = 134$

$-.5x - 2y = -106$
$1.5x + 2y = 134$

$x = 28$

$.5(28) + 2y = 106$
$14 + 2y = 106$
$2y = 92$
$y = 46$
(28, 46)

c. Max profit 223.25

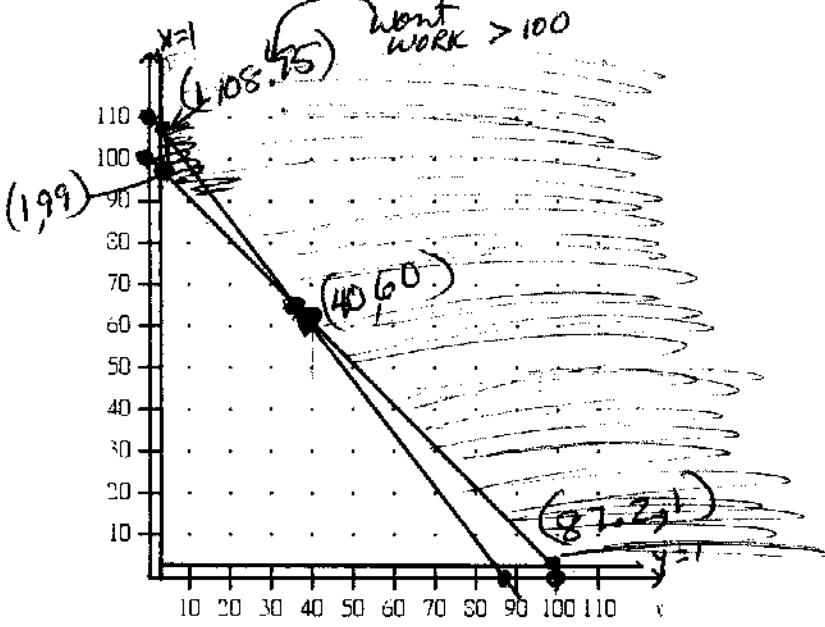
lbs Salmon 0 lbs tuna 89.3

3. Your computer supply store sells two types of inkjet printers. The first, type A, costs $137 and you make a $50 profit on each one. The second, type B, costs $100 and you make a $40 profit on each one. You can order no more than 100 printers this month, and you need to make at least $4400 profit on them. If you must order at least one of each type of printer, how many of each type of printer should you order if you want to minimize your cost?

x = Type A
y = Type B

Cost function C = $137x + 100y$
Constraints

printers $x + y \leq 100$
Profit $50x + 40y \geq 4400$
$x \geq 1$ $y \geq 1$



$x + y = 100$
(0, 100)
(100, 0)

$50x + 40y = 4400$
(0, 110)
(88, 0)

(x, y)	$C = 137x + 100y$
(1, 108.75)	11012 ← This won't work because more than 100 printers
* (40, 60)	11480
(87.2, 1)	12046.4

$-40(x + y = 100)$
$50x + 40y = 4400$

$50x + 40y = 4400$
$-40x - 40y = -4000$
$\frac{10x}{10} = \frac{400}{10}$
$x = 40$
$x + y = 100$
$-40 \quad -40$
$y = 60$
(40, 60)

Min Cost $11,480

Type A 40 Type B 60

4. Given the system of constraints, name all vertices. Then find the maximum value of the given objective function. Maximum for $C = 4x - 3y$

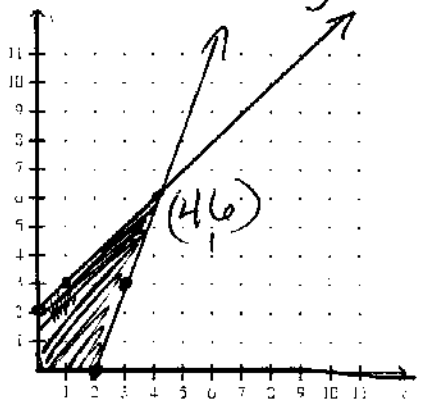
$$\begin{cases} x \geq 0 \\ y \geq 0 \\ 6x - 2y \leq 12 \\ 4y \leq 4x + 8 \end{cases}$$

$(0,-6)(2,0)$

$-2y \leq -6x + 12$

$y \geq 3x - 6$ test (0,0) $0 \leq 12$ T

$y \leq x + 2$ test (0,0) $0 \leq 8$ T



(x, y)	C = 4x − 3y	
(0, 2)	−6	4(0) − 3(2)
✱ (2, 0)	8	4(2) − 3(0)
(4, 6)	−2	4(4) − 3(6)

Max of 8 at (2, 0)

a. (0, 2), (2, 0), (4, 6); maximum value of –6
b. ~~(0, 2), (2, 0), (6, 4); maximum value of 12~~
c. ~~(0, 2), (2, 0), (4, 2); maximum value of 10~~
d. (0, 2), (2, 0), (4, 6); maximum value of 8

5. Graph the system of constraints. Then find the values of x and y that maximize.

P = 40x +20y

$x \geq 0$

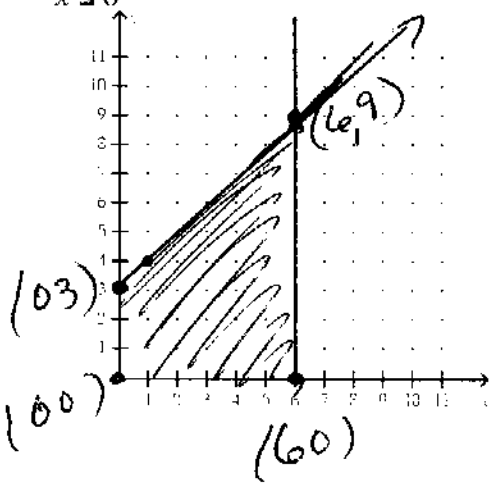
$y \geq 0$

$-2x + 2y \leq 6$ $(0,3)(-3,0)$

$2y \leq 2x + 6$

$y \leq x + 3$

$x \leq 6$



(x, y)	P = 40x + 20y	
(0, 0)	0	40(0) + 20(0)
(0, 3)	60	40(0) + 20(3)
(6, 0)	240	40(6) + 20(0)
✱ (6, 9)	420	40(6) + 20(9)

Max of 420 at (6, 9)

6. Graph the system of constraints. Then find the values of x and y that maximize.

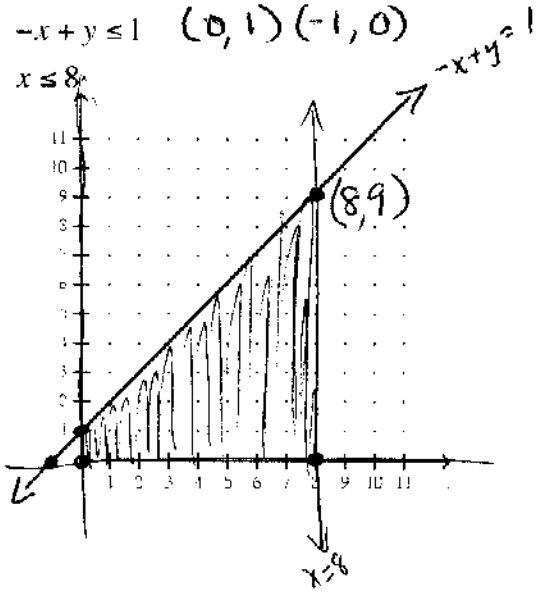
$P = 50x + 40y$

$x \geq 0$

$y \geq 0$

$-x + y \leq 1$ (0, 1) (−1, 0)

$x \leq 8$



(x, y)	$P = 50x + 40y$	
(0, 0)	0	50(0) + 40(0)
(0, 1)	40	50(0) + 40(1)
(8, 0)	400	50(8) + 40(0)
(8, 9)	760	50(8) + 40(9)

Max of 760 at (8, 9)

7. Graph the system of constraints. Then find the values of x and y that maximize.

$P = 30x + 40y$

$x \geq 0$

$y \geq 0$

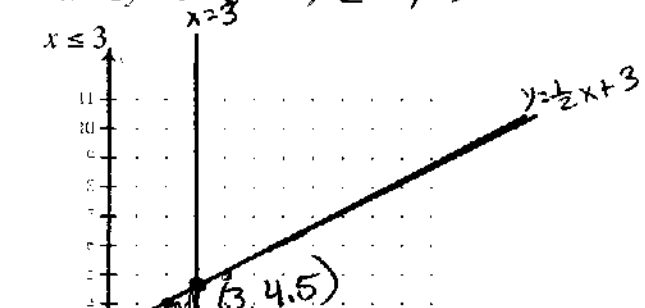
$-x + 2y \leq 6$ (0, 3) (−6, 0)

$x \leq 3$

$-x + 2y \leq 6$

$\frac{2y}{2} \leq \frac{x + 6}{2}$

$y \leq \frac{1}{2}x + 3$



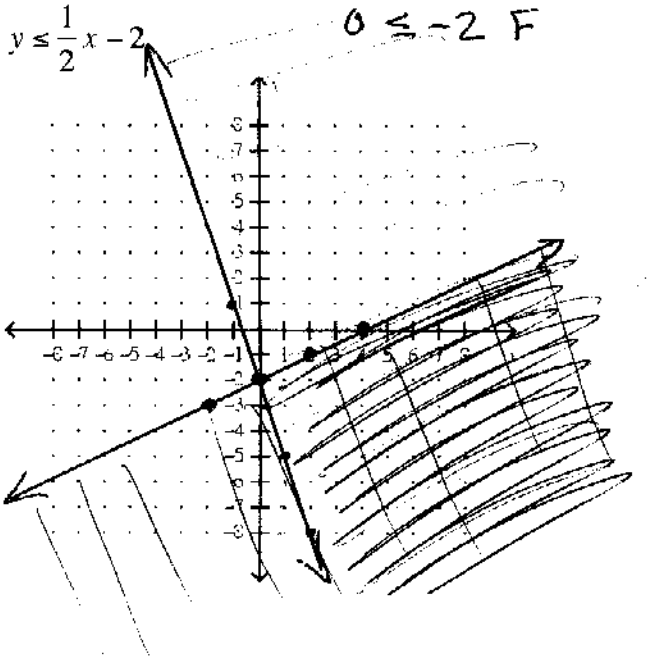
(x, y)	$P = 30x + 40y$	
(0, 0)	0	30(0) + 40(0)
(0, 3)	120	30(0) + 40(3)
(3, 0)	90	30(3) + 40(0)
(3, 4.5)	270	30(3) + 40(4.5)

Max of 270 at (3, 4.5)

8. Graph the inequalities. test (0,0)

$y \geq -3x - 2$ $0 \geq -2$ T

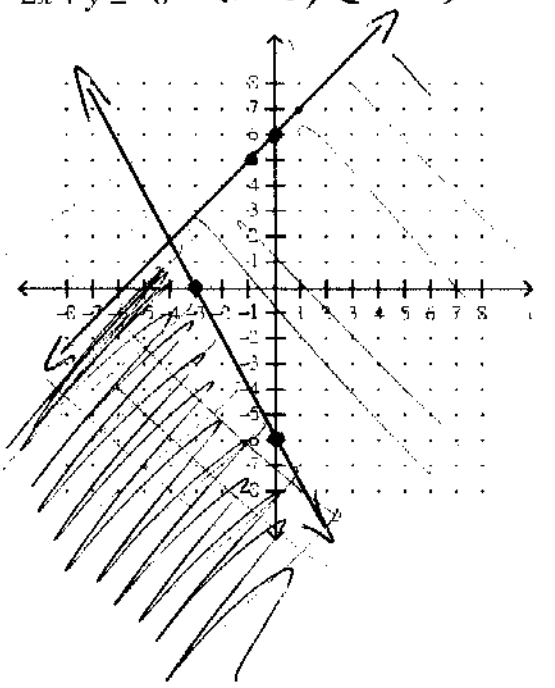
$y \leq \frac{1}{2}x - 2$ $0 \leq -2$ F



9. Graph the inequalities. test (0,0)

$y \leq x + 6$ $0 \leq 6$ T

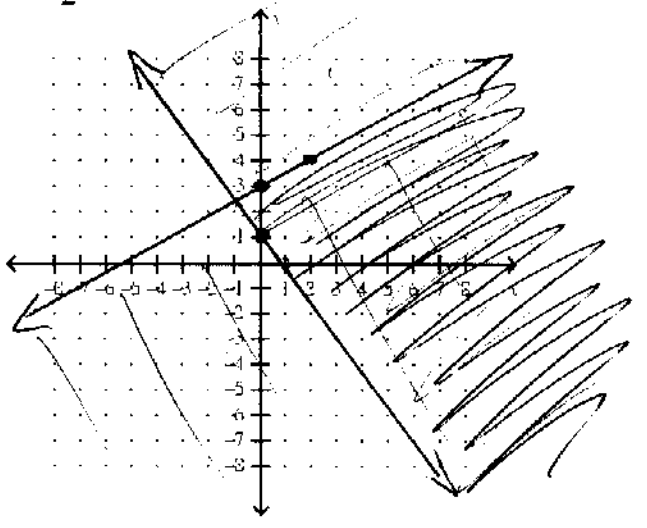
$2x + y \leq -6$ (0,-6) (-3, 0) $0 \leq -6$ F



10. Graph the inequalities test (0,0)

$y \geq -x + 1$ $0 \geq 1$ F

$y \leq \frac{1}{2}x + 3$ $0 \leq 3$ T



11. Graph the inequalities

$x \geq -3$

$y \leq 5$