Math 11 Winter 2019 Quiz 2 20 points Name Last _____ **First** KEY

There are 3 questions on this quiz. Solve Question 1 graphically.
On the other side of the page, set up the linear programs for each word problems but do not solve.

1. *(10 points)* **Solve the linear program graphically. Show your work.**

Maximize $z = 60x + 75y$

subject to:

$3x + 4y \leq 72$ (C1) (24,0), (0,18) Red

$x + 2y \leq 32$ (C2) (32,0), (0,16) Green

$3x + 2y \leq 60$ (C3) (20,0) (0,30) Purple

$x \geq 4$ (C4) Vertical line through (4,0) blue

$x \geq 0, y \geq 0$

Do ALL of the following:

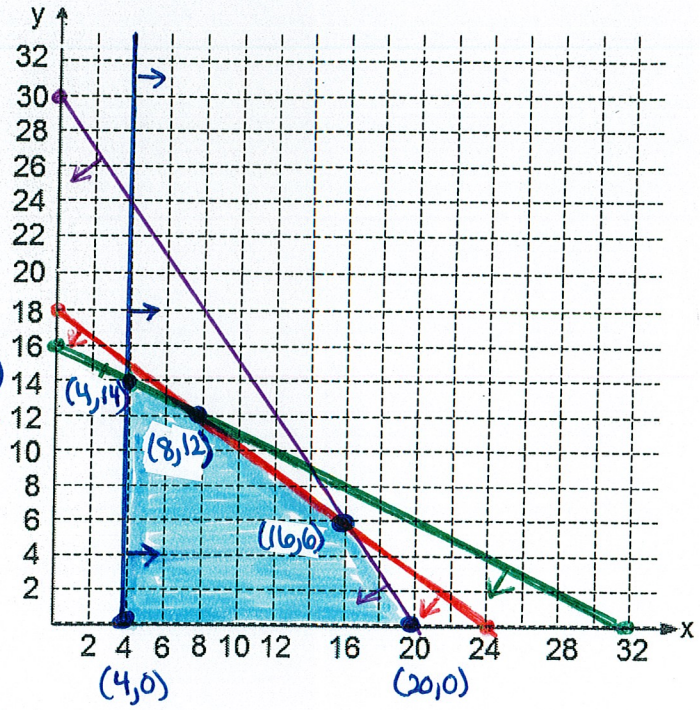
Graph all constraints.

Shade the feasible region.

Identify ALLcritical points (corners of the feasible region).

5 critical points (corners)

(4,0), (20,0), (16,6), (8,12), (4,14)



see next page if you need to see work to find intersection points for critical points

Show work to find the optimal solution:

Critical Point	Objective Function
(4,0)	$Z = 60(4) + 75(0) = 240$
(20,0)	$Z = 60(20) + 75(0) = 1200$
(16,6)	$Z = 60(16) + 75(6) = 1410$ ← MAXIMUM
(8,12)	$Z = 60(8) + 75(12) = 1380$
(4,14)	$Z = 60(4) + 75(14) = 1290$

Write the optimal solution here: x = 16 y = 6 z = 1410

To find intersections for critical points

C1 and C2

$3x+4y=72$

$-2(x+2y=32)$

$x = 8$

$3(8)+4y=72$

$4y=48$

$y=12$

OR

$$\left[\begin{array}{cc|c} 3 & 4 & 72 \\ 1 & 2 & 32 \end{array}\right]$$

RREF

$$\left[\begin{array}{cc|c} 1 & 0 & 8 \\ 0 & 1 & 12 \end{array}\right]$$

C1 and C3

$3x+4y=72$

$-(3x+2y=60)$

$2y=12$

$y=6$

$3x+4(6)=72$

$3x=48$

$x=16$

OR

$$\left[\begin{array}{cc|c} 3 & 4 & 72 \\ 3 & 2 & 60 \end{array}\right]$$

RREF

$$\left[\begin{array}{cc|c} 1 & 0 & 16 \\ 0 & 1 & 6 \end{array}\right]$$

C2 and C4

$x+2y=32$

$x=4$

$4+2y=32$

$2y=28$

$y=14$

Math 11 Winter 2019 Quiz 2 20 points Name Last _____ **First** KEY

Write the mathematical statements for each linear program on this page. Do NOT solve them!!
State whether to minimize or maximize the objective function, write the objective function and all constraints.
You should present a well-organized mathematical statement of the problem.
You should not have random scattered equations and expressions.

---

2. *(5 points)* **Write the LINEAR PROGRAM for this problem.** *DO NOT SOLVE IT!!!!*
State whether to minimize or maximize the objective function, write the objective function and all constraints.

A company makes adult tee shirts, adult sweatshirts, and children's tee shirts.
Each shirt requires 3 resources: fabric, cutting (labor), and sewing (labor)

- Each adult tee shirt requires 1 yard of fabric, 6 minutes in cutting, and 10 minutes in sewing.
- Each adult sweatshirt requires 1.5 yards of fabric, 7 minutes in cutting, and 15 minutes in sewing.
- Each child tee shirt requires 0.5 yards of fabric, 5 minutes in cutting, and 8 minutes in sewing.

There are at most: 78 yards of fabric available; 500 minutes of cutting labor; 840 minutes of sewing labor.

	adult tee shirt	adult sweatshirt	child tee shirt
Profit per item	$6	$8	$4

Let x_1 = number of adult tee shirts; x_2 = number of sweatshirts; x_3 = number of children's tee shirts

Write the linear program that would be used to determine the maximum profit
and to find how many of each type of shirt should be made and sold in order to maximimze profit.

Maximize: $Z = 6x_1 + 8x_2 + 4x_3$ (profit)

Subject to: $1x_1 + 1.5x_2 + 0.5x_3 \leq 78$ (fabric)

$6x_1 + 7x_2 + 5x_3 \leq 500$ (cutting)

$10x_1 + 15x_2 + 8x_3 \leq 840$ (sewing)

$x_1 \geq 0 \quad x_2 \geq 0 \quad x_3 \geq 0$

---

3. *(5 points)* **Write the LINEAR PROGRAM for this problem.** *DO NOT SOLVE IT!!!!*
State whether to minimize or maximize the objective function, write the objective function and all constraints.

A diet is to contain: **at least 1500** calories and **at least 2000** units of vitamins and **at most 60** grams of fat.
Two foods, X and Y are used to create this diet. Food X costs $0.60 per unit. Food Y costs $0.40 per unit.

- Each unit of Food X provides 80 calories and 40 units of vitamins and 2 g of fat.
- Each unit of Food Y provides 60 calories and 50 units of vitamins and 1 g of fat.

x = amount of Food X y = amount of Food Y

Write the linear program that would be used to determine many units of each food (X and Y) should be purchased to keep costs at a minimum.

Minimize: $Z = .60x + .40y$ (cost)

Subject to: $80x + 60y \geq 1500$ (calories)

$40x + 50y \geq 2000$ (vitamins)

$2x + y \leq 60$ (fat)

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