DEPARTMENT OF MATHEMATICS

Ma 162 Second Exam October 17, 2011

Instructions: No cell phones or network-capable devices are allowed during the exam. You may use calculators, but you must show your work to receive credit. If your answer is not in the box or if you have no work to support your answer, you will receive no credit. The test has been carefully checked and its notation is consistent with the homework problems. No additional details will be provided during the exam.

Problem	**Maximum Score**	**Actual Score**
1	12	
2	12	
3	10	
4	16	
5	12	
6	16	
7	10	
8	12	
Total	100	

NAME: _____ **Section:** _____

Last four digits of Student ID: _____

1. Zach Crusoe (age 8) is trying to feed the birds. He has been allocated 396 sunflower seeds, 482 millet grains, 246 kernels of corn, and 593 crumbs of bread (at last according to his latest count). Being a scientific lad, he has devised two optimal dinners for the birds using his seeds, grains, kernels, and crumbs: the Cheep dinner and the Squawky dinner (see table below for ingredients). After eating a Cheep dinner, the birds sing 2 lovely songs; after eating a Squawky dinner, the birds sing 3 loud songs. Zach wants to use his available resources to make dinners for the birds in order to maximize the number of songs they sing.

	Seeds	Grains	Kernels	Crumbs	Songs
each Cheep dinner	4	6	2	8	2
each Squawky dinner	8	4	6	1	3
Available	396	482	246	593	

Zach's best friend Christopher Guessed suggests that Zach feed the birds 51 Cheep dinners and 24 Squawky dinners.

Number of Cheep dinners: 51
Number of Squawky dinners: 24
Number of songs: _____
Leftover seeds: _____
Leftover grains: _____
Leftover kernels: _____
Leftover crumbs: _____

Can you do better? (#3 and #7 may be useful)

Number of Cheep dinners: _____
Number of Squawky dinners: _____
Number of songs: _____
Leftover seeds: _____
Leftover grains: _____
Leftover kernels: _____
Leftover crumbs: _____

2. Soup Parlour has asked you to maximize profit by setting production goals for their soup mixing factory without using more than their limited supplies of chicken stock, beef stock, and vegetable stock. Their stores sell Beef-A-Rooni soup, Buddha's Delight soup, and Pot O' Luck soup (see table for ingredients). The three soups earn the Soup Parlour profits of \$1.20, \$1.30, and \$1.50 per bowl, but there is limited demand for the soups: 1200, 600, and 900 bowls.

	Chicken stock	Beef stock	Vegetable stock	Demand	Profit
each bowl of Beef-A-Rooni	1	6	1	1200	\$1.20
each bowl of Buddha's Delight	0	0	8	600	\$1.30
each bowl of Pot O' Luck	3	2	2	900	\$1.50
Available	3400	6800	5014		

Set up this problem below. You will do one step of its solution on #4, and read and interpret the final answer on #5.

Variables:

Constraints:

Objective:

3. Write down the (standard, primal) tableau corresponding to the problem:

$$\text{Maximize } S = 2x + 3y \text{ subject to } \begin{cases} 4x + 8y \leq 396 \\ 6x + 4y \leq 482 \\ 2x + 6y \leq 246 \\ 8x + \ \ y \leq 593 \end{cases} \text{ and } x \geq 0,\ y \geq 0.$$

4. Apply one full step of the simplex algorithm. Circle your pivot, write out your row operations, and write down the next tableau. Explain why that next tableau is or is not final. (This is the table for #2 resulting from the three decisions: Buddha's Delight is good, Pot O' Luck is good, unsatisfied Delight customers are worse than unsatisfied Pot O' Luck customers)

	Rooni	Delight	Potluck	Chicken	Beef	Veg.	Hungry R	Hungry D	Hungry P	Profit	RHS
C	1	0	0	1	0	0	0	0	-3	0	700
B	6	0	0	0	1	0	0	0	-2	0	5000
P	0	0	1	0	0	0	0	0	1	0	900
HR	1	0	0	0	0	0	1	0	0	0	1200
D	1/8	1	0	0	0	1/8	0	0	-1/4	0	1607/4
HD	-1/8	0	0	0	0	-1/8	0	1	1/4	0	793/4
Profit	-415/4	0	0	0	0	65/4	0	0	235/2	1	374455/2

Is this a final tableau? Why or why not?

5. Read the answer from the following finished tableau (based on #2). Give the location of the maximum, the maximum itself, and the resulting surpluses.

Use the word problem in #2 to give a plain English version of the answer for your supervisor at the Soup Parlour. Be sure to include the recommended decision, its important effect (the "bottom line"), and some information on the slack variables.

	R	D	P	C	B	V	HR	HD	HP	Profit	RHS
	1	0	0	-1/8	3/16	0	0	0	0	0	850
	0	0	0	-3/8	1/16	0	0	0	1	0	50
	0	0	1	3/8	-1/16	0	0	0	0	0	850
	0	0	0	1/8	-3/16	0	1	0	0	0	350
	0	1	0	-5/64	-1/128	1/8	0	0	0	0	308
	0	0	0	5/64	1/128	-1/8	0	1	0	0	292
	0	0	0	995/32	775/64	65/4	0	0	0	1	269540

R = _____ C = _____ HR = _____

D = _____ B = _____ HD = _____

P = _____ V = _____ HP = _____

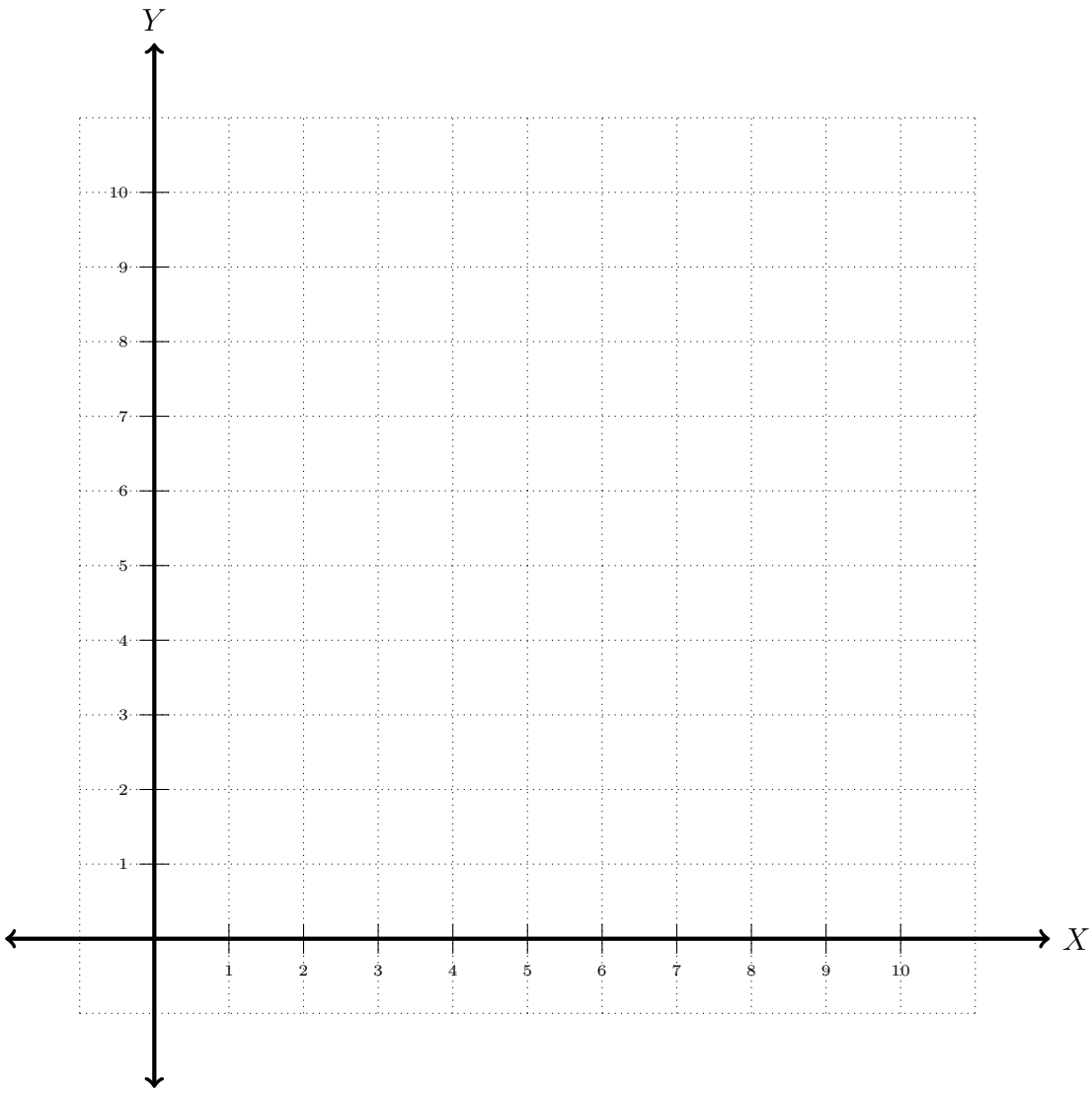
Profit = _____ (Be careful about units for the Profit)

Plain English recommendation:

Does the Soup Parlour need more supplies or more marketing right now?

6. Graph the feasible region for the following LPP. You will be graded on three aspects: correctly drawn edges, correctly shaded region, and correctly labelled corners. (The numbers in this problem are not related to either word problem, but you may find the picture on #7 to be a good model of clear edges, corners, and labels).

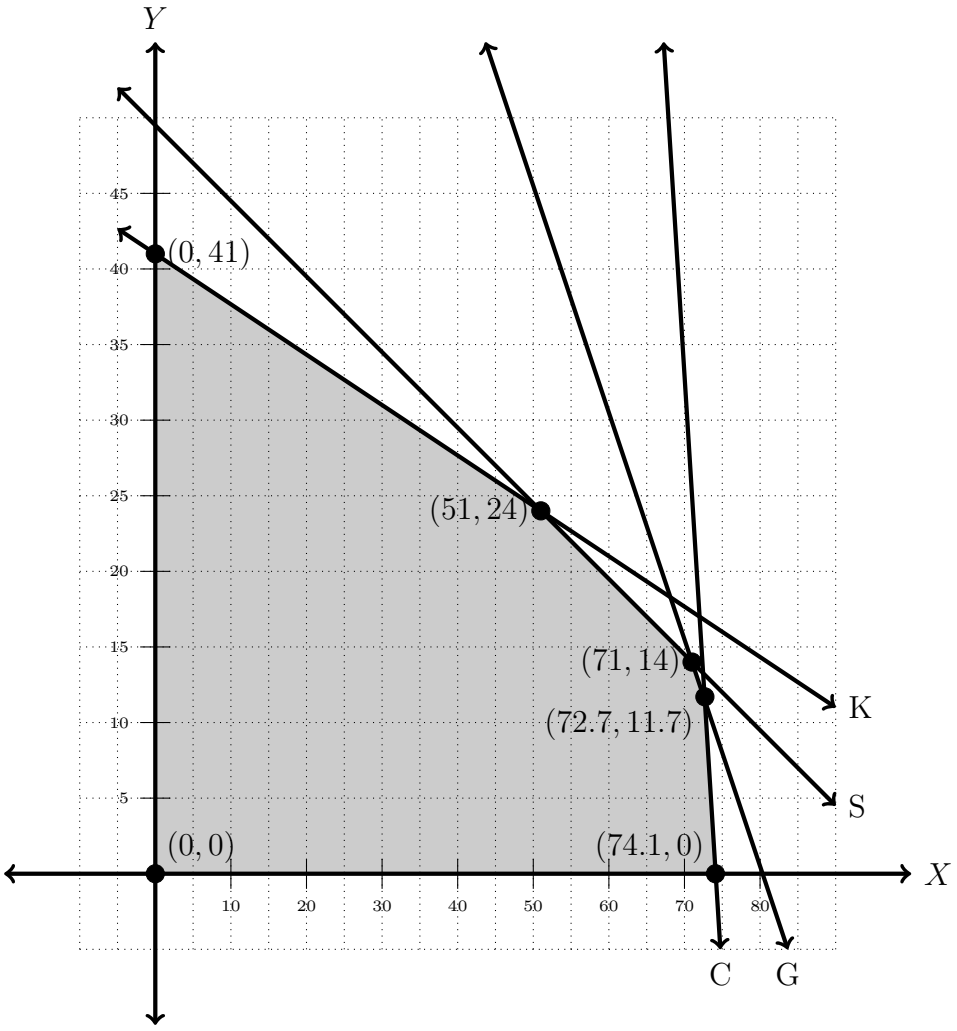
Maximize $S = 2x + 3y$ subject to $\left\{ \begin{array}{l} 2x \leq 8 + 4y \\ 4x + 4y \leq 40 \\ 5x + 10y \leq 80 \\ 6y \leq 9x + 30 \end{array} \right\}$ and $x \geq 0$, $y \geq 0$.



Is this region bounded or unbounded?

7. List the corners, determine if the region is bounded or unbounded, and find the maximum value of P.

Maximize $P = 2x + 3y$ subject to $\begin{cases} S: & 4x + 8y \leq 396 \\ G: & 6x + 4y \leq 482 \\ K: & 2x + 6y \leq 246 \\ C: & 8x + y \leq 593 \end{cases}$ and $x \geq 0$, $y \geq 0$.

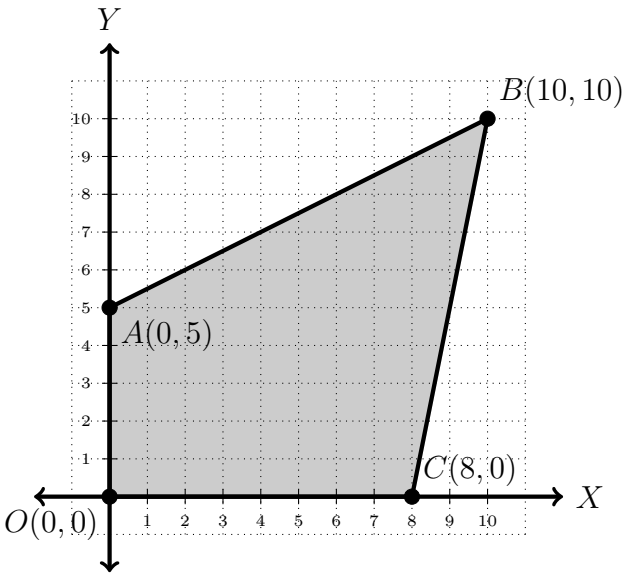


X	Y	P

Is this region bounded or unbounded?

The maximum value of P is _____ and it occurs at ($x =$ _____, $y =$ _____).

8. Determine a system of inequalities that defines the feasible region graphed below. (This region is not related to either word problem.)



Maximize $P = x + y$ subject to

$$\begin{cases} OA: \_\_\_\_\_ \\ AB: \_\_\_\_\_ \\ BC: \_\_\_\_\_ \\ CO: \_\_\_\_\_ \end{cases}$$