

DEPARTMENT OF MATHEMATICS

Ma 162 Second Exam March 5, 2012

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	11	
2	11	
3	12	
4	11	
5	11	
6	11	
7	11	
8	11	
9	11	
Total	100	

NAME: _____ Section: _____

Last four digits of Student ID: _____

Show your work. Answers with no work receive no credit.

1. Use the matrices given to answer the following arithmetic problems. If a problem cannot be solved, explain why it cannot be solved.

$$A = \begin{bmatrix} 10 & 13 \\ 11 & 14 \\ 12 & 15 \end{bmatrix} \quad B = \begin{bmatrix} 9 \\ 8 \\ 7 \end{bmatrix}$$
$$C = [1 \ 3 \ 5] \quad D = [2 \ 4 \ 6]$$

(a) $A + B$

(b) $B + C$

(c) $C + D$

(d) $100C + 10D$

(e) AB

(f) BC

(g) DA

Show your work. Answers with no work receive no credit.

2. Use the matrices given to answer the following arithmetic problems. If a problem cannot be solved, explain why it cannot be solved.

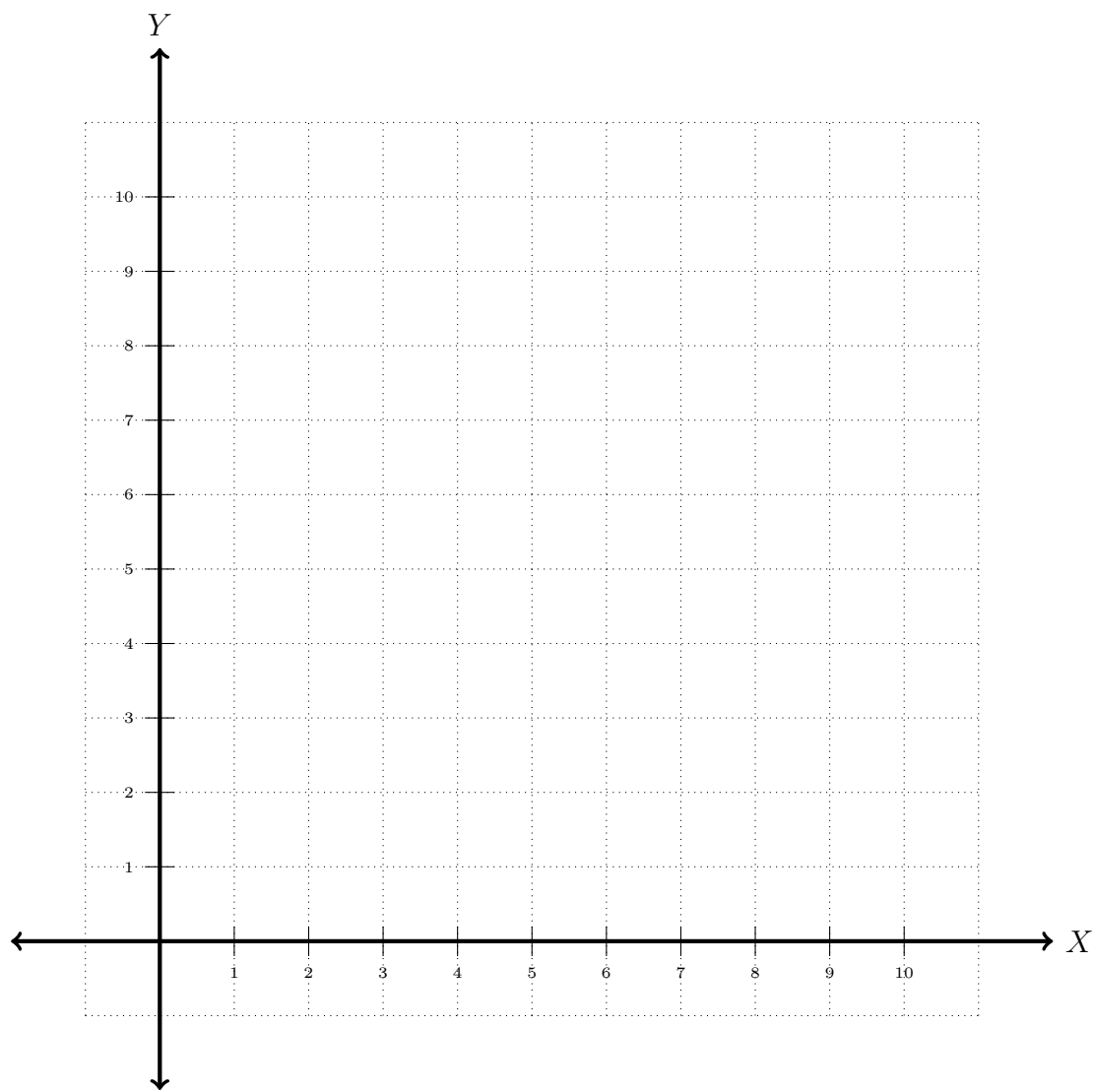
$$A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 3 \\ 4 & 5 & 24 \end{bmatrix} \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \quad B = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix} \quad C^{-1} = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

(a) A^{-1}

(b) If $CX = B$, then find X explicitly.

3. 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 #5 to be a good model of clear edges, corners, and labels).

$$\text{Maximize } P = 4x + 5y \text{ subject to } \begin{cases} E: 5x + y \leq 35 \\ F: x + 3y \leq 30 \\ G: x + y \leq 12 \\ H: 4x + 4y \geq 12 \end{cases} \text{ and } x \geq 0, y \geq 0.$$



Is this region bounded or unbounded?

4. Vincent is trying maximize profit using his limited resources. He has four limited resources: 27 tubes of Amarillo paint, 30 tubes of Berry red paint, 12 Canvases, and 30 tubes of Dark blue paint. He only knows how to paint two things: Sunshine and Lollipops, but he can sell as many as he can paint, earning a profit of \$10 per Sunshine painting and \$12 per Lollipops painting. Each painting requires a few tubes of paint:

	Amarillo	Berry Red	Canvases	Dark Blue	Profit
Sunshine	3	3	1	1	10
Lollipops	1	2	1	3	12
Inventory	27	30	12	30	

Theo advises him to paint 8 Sunshine paintings and 3 Lollipops paintings.

Describe the effects of such a business decision by filling in the form:

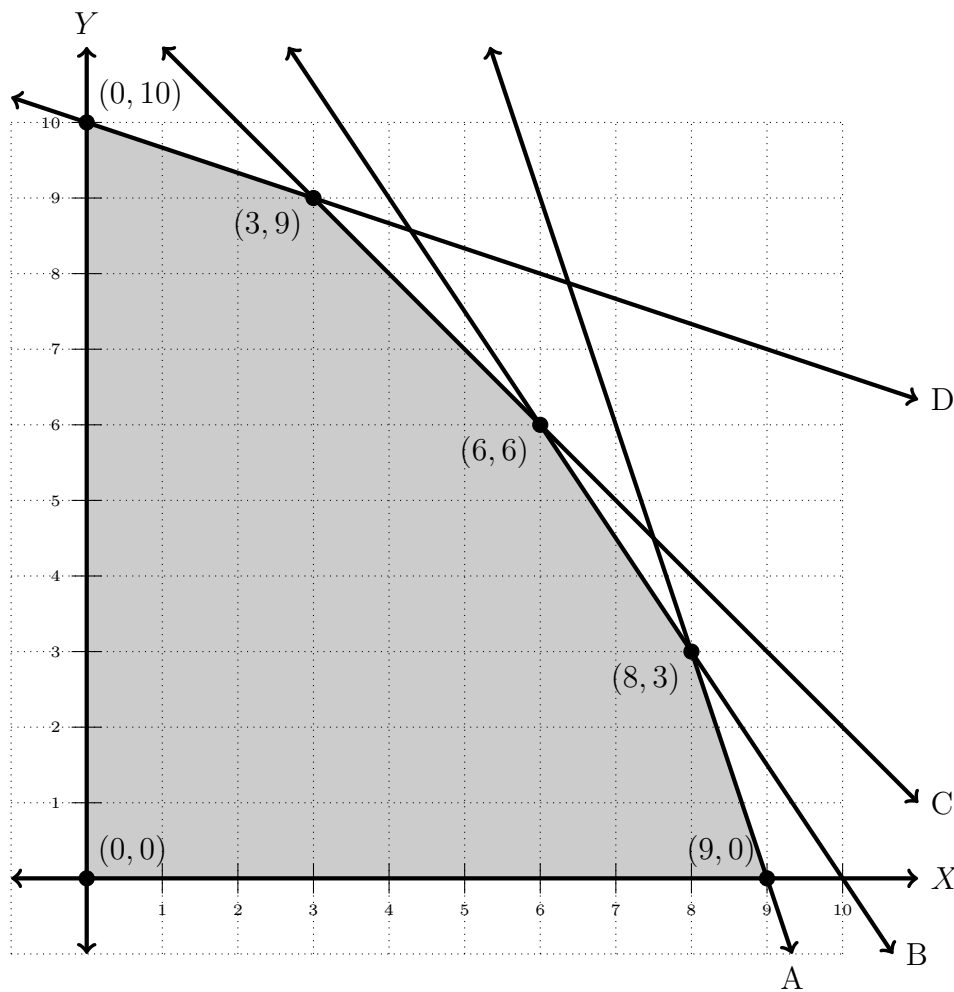
Number of Sunshine paintings: 8	Bottom Line Profit:
Number of Lollipops paintings: 3	
Leftover tubes of Amarillo paint:	
Leftover tubes of Berry red paint:	
Leftover Canvases:	
Leftover tubes of Dark blue paint:	

Give a recommendation to increase his profit using only his limited resources:

Number of Sunshine paintings:	Bottom line Profit:
Number of Lollipops paintings:	
Leftover tubes of Amarillo paint:	
Leftover tubes of Berry red paint:	
Leftover Canvases:	
Leftover tubes of Dark blue paint:	

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

$$\text{Maximize } P = 10x + 12y \text{ subject to } \begin{cases} A: & 3x + y \leq 27 \\ B: & 3x + 2y \leq 30 \\ C: & x + y \leq 12 \\ D: & x + 3y \leq 30 \end{cases} \text{ and } x \geq 0, y \geq 0.$$



X	Y	P

Is this region bounded or unbounded?

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

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

$$\text{Maximize } P = 10x + 12y \text{ subject to } \begin{cases} A: & 3x + y \leq 27 \\ B: & 3x + 2y \leq 30 \\ C: & x + y \leq 12 \\ D: & x + 3y \leq 30 \end{cases} \text{ and } x \geq 0, y \geq 0.$$

7. 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 Meaty soup, Leafy soup, and Soupy soup (see table for ingredients). The three soups earn the Soup Parlour profits of \$1.20, \$1.10, and \$1.00 per bowl, but there is limited demand for the soups: only 1000 bowls total can be sold.

	ounces of Chicken stock	ounces of Beef stock	ounces of Vegetable stock	bowls of Demand	Profit
each bowl of Meaty	1 oz per bowl	6 oz per bowl	1 oz per bowl		\$1.20 per bowl
each bowl of Leafy	0 oz per bowl	0 oz per bowl	8 oz per bowl		\$1.10 per bowl
each bowl of Soupy	2 oz per bowl	2 oz per bowl	4 oz per bowl		\$1.00 per bowl
Total Available	1000 oz	3600 oz	4000 oz	1000 bowls	

Set up this problem below. You will do one step of its solution on #8, and read and interpret the final answer on #9.

Variables:

Constraints:

Objective:

8. 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 #7 resulting from the two decisions: (1) Meaty is good, but limited by the supply of beef stock, (2) Soupy is good, but limited by the remaining supply of chicken stock)

	Meaty	Leafy	Soupy	Chicken	Beef	Veg.	Hungry	Profit	RHS
S	0	0	1	0.6	-0.1	0	0	0	240
M	1	0	0	-0.2	0.2	0	0	0	520
V	0	8	0	-2.2	0.2	1	0	0	2520
H	0	1	0	-0.4	-0.1	0	1	0	240
P	0	-1.1	0	0.36	0.14	0	0	1	864.00

Is this a final tableau? Why or why not?

9. Read the answer from the following finished tableau (based on #7). Give the location of the maximum, the maximum itself, and the resulting surpluses.

Use the word problem in #7 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.

	Meaty	Leafy	Soupy	Chicken	Beef	Veg.	Hungry	Profit	RHS
	0	0	5/3	1	-1/6	0	0	0	400
	1	0	1/3	0	1/6	0	0	0	600
	0	0	-5/3	0	7/6	1	-8	0	200
	0	1	2/3	0	-1/6	0	1	0	400
	0	0	2/15	0	1/60	0	1.1	1	1160.00

M = _____	C = _____	HM = _____
L = _____	B = _____	HL = _____
S = _____	V = _____	HS = _____
Profit = _____		

Plain English recommendation:

Higher level evaluation: If there was demand for one more bowl (but other supplies remained at current levels), which kind (M, L, or S) of bowl should they make? Why?