

# DEPARTMENT OF MATHEMATICS

Ma 162 First Exam September 26, 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.

<b>Problem</b>	<b>Maximum Score</b>	<b>Actual Score</b>
1	10	
2	10	
3	10	
4	15	
5	10	
6	15	
7	10	
8	10	
9	10	
Total	100	

NAME: \_\_\_\_\_ Section: \_\_\_\_\_

Last four digits of Student ID: \_\_\_\_\_

(Practice version)

1. A courier travels from city Ashton with coordinates  $(0, 0)$  to city Cranston with coordinates  $(125, 135)$ . He must pass through **exactly one of the cities** Brady with coordinates  $(72, 45)$  or Dalton  $(45, 72)$  along the way. Assume he travels a straight line between cities.
- (a) Which city should he pass through (Brady or Dalton) in order to minimize his trip distance from Ashton to Cranston?

He should pass through city

on his way to Cranston.

- (b) What is the total minimum length of his trip from Ashton to Cranston, taking into account the stop in the city from part (a)?

Minimum trip length is:

2. Point A has coordinates  $(7, 3)$ , and point B has coordinates  $(0, 5)$ .

(a) What is the distance from A to B and what is the slope of the line joining A to B?

distance:

, slope:

(b) Suppose that the point C with coordinates  $(x, 9)$  is such that the triangle ABC is a right triangle with right angle at B. Determine the value of  $x$ . (Note: The coordinates of A and B were given at the top of the problem.)

$x =$



4. In a free market, the supply equation for a supplier of corn is  $x = 35p + 200$  where the price  $p$  is in dollars and  $x$  is in bushels. When the price is \$4 per bushel the demand is 1170 bushels. When the price goes up to \$18 per bushel the demand drops to 0 bushels. Assuming that the demand equation is also linear, find the equilibrium price and the number of bushels supplied at that equilibrium price.

Demand equation:

$p =$

$x =$

5. For the following word problem: (a) Write down variables describing the (numerical) business decision to be made, (b) write down equations that constrain your decision, (c) convert the equations to an augmented matrix. **You need not solve the system.**

Mr. Marjoram runs a stuffed animal factory, and is very worried about paying taxes on his rather large inventory of plush fabric, cloud-like stuffing, and whimsical trim. He decides he is going to use every last bit of his inventory to make the 2011 Marjoram Menagerie! His menagerie only includes Pandas, Saint Bernards, and Onery Ostriches. Each Panda requires 1.5 square yards of plush, 30 cubic feet of stuffing, and 12 pieces of trim. Each Saint Bernard requires 2 square yards of plush, 35 cubic feet of stuffing, and 8 pieces of trim. Each Onery Ostrich requires 2.5 square yards of plush, 25 cubic feet of stuffing, and 5 pieces of trim. Marjoram's storage room has 110 square yards of velvety plush, 1400 cubic feet of fluffy stuffing, and 350 pieces of tremendous trim. How many stuffed animals of each type should he make in order to use up all of his inventory?

The variables describing the decision are:

The equations to be solved are:

The augmented matrix describing the equations is:

6. Here is the augmented matrix of a linear system of equations. Take this matrix to RREF. Be sure to label your reduction operations in standard notation. You need not solve for the variables.

$$\left( \begin{array}{cccc|c} x & y & z & w & \text{RHS} \\ 7 & 6 & 5 & 4 & 3 \\ 0 & 3 & 4 & 5 & 6 \\ 0 & 0 & 1 & 2 & 3 \end{array} \right)$$

7. Here is the augmented matrix of a linear system of equations. As usual, the variables are mentioned for your convenience.

$$\left( \begin{array}{cccc|c} x & y & z & w & \text{RHS} \\ 1 & 2 & 0 & 0 & 3 \\ 0 & 0 & 1 & 0 & 4 \\ 0 & 0 & 0 & 1 & 5 \end{array} \right)$$

(a) Is this matrix in REF or RREF or neither of these?

(b) Finish the solution process as needed and determine the complete solution of the system by filling in the answers below. If a variable is free, then enter the word “free” as its value. Be sure to show all calculations.

$x =$

$y =$

$z =$

$w =$



8. Consider the following matrices and answer the questions. In each case, either calculate the expression or explain why it is not defined.

$$P = \begin{bmatrix} 5 & 3 & -6 \\ -2 & -6 & -6 \\ -3 & -2 & -1 \end{bmatrix} \quad Q = \begin{bmatrix} 4 & -5 & -4 \\ 5 & 5 & 2 \end{bmatrix} \quad L = \begin{bmatrix} -1 & -2 \\ -3 & -6 \\ -3 & 5 \end{bmatrix} \quad M = \begin{bmatrix} 1 & -4 \\ -4 & -2 \end{bmatrix}$$

(a)  $M^2 + M$

Answer:

(b)  $QP$

Answer:

(c)  $LP$

Answer:

(d)  $11Q - 5L$

Answer:

(e)  $MQ$

Answer:

9. (a) Find the inverse of the matrix  $P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 0 & 3 & 1 \end{bmatrix}$ .

Answer:

- (b) Suppose that  $A^{-1} = \begin{bmatrix} -3 & -3 & -1 \\ 3 & 1 & 0 \\ 4 & 3 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 \\ -3 \\ -5 \end{bmatrix}$ .

Determine the solution  $X$  of the equation  $AX = B$ .

Answer: