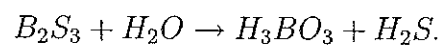


Math 301: Exam 1  
Thursday, Feb. 17th

Name:

Question 1. (20 points) Use linear algebra to balance the chemical equation



2. Which of the following are linear transformations? In each case, either find the matrix  $A$  such that  $Av = Tv$  for all  $v \in \mathbb{R}^2$  or else give some reason why  $T$  cannot be a linear transformation.

(a) (10 points) Flip across line  $y = 1$

(b) (10 points) Rotate 60 degrees counterclockwise about origin

Question 3: Consider the matrix

$$M = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 2 & 4 \\ 0 & 3 & 6 \end{pmatrix}$$

(a) (10 points) Put  $M$  in reduced row echelon form.

(b) (10 points) Is the system

$$M \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} 2 \\ 2 \\ 3 \end{pmatrix}$$

consistent? Either find a solution or explain why there isn't one.

(c) (10 points) Is

$$\begin{pmatrix} 2 \\ 2 \\ 3 \end{pmatrix}$$

in the span of the columns of  $M$ ? Either show how or explain why not.

(d) (10 points) Find a basis for the image of the matrix  $M$ .

(e) (10 points) For which choices of  $b_1, b_2, b_3$  is the linear system

$$x_1 + x_2 + x_3 = b_1$$

$$2x_2 + 4x_3 = b_2$$

$$3x_2 + 6x_3 = b_3$$

consistent? (Hint: the coefficient matrix for this system is  $M$ .)

Question 4. (10 points) Set up a system of linear equations that would enable you to determine the current in each loop of the following electrical network:

