ENGR222 Assignment 4

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4.

$$aug = \left[\begin{array}{cccc|c} 1 & -1 & 2 & 4 & 2 \\ 3 & -3 & 1 & 2 & 1 \\ 2 & -1 & 1 & 0 & -1 \\ 2 & -6 & 1 & 10 & 9 \end{array}\right]$$

Solved using the python sympy library:

```
from sympy import linsolve, Matrix, symbols
x,y,z,w = symbols("x,y,z,w")
aug  = Matrix(([1,-1,2,4,2],
               [3,-3,1,2,1],
               [2,-1,1,0,-1],
               [2,-6,1,10,9]))

linsolve(aug,x,y,z,w)
```

$$(x, y, z, w) = (2w - 2, 2w - 2, 1 - 2w, w)$$

5.

$$aug = \left[\begin{array}{cccc|c} 1 & 2 & 2 & 3 & 0 \\ -4 & -8 & -8 & -9 & 0 \\ 2 & 4 & 1 & 0 & 3 \\ 1 & 2 & -2 & -4 & 4 \end{array}\right]$$

Solved using the python sympy library:

```
from sympy import linsolve, Matrix, symbols
x,y,z,w = symbols("x,y,z,w")
M  = Matrix(([1,2,2,3,0],
             [-4,-8,-8,-9,0],
             [2,4,1,0,3],
             [1,2,-2,-7,4]))

linsolve(M,x,y,z,w)
```

$$(x, y, z, w) = (2 - 2y, y, -1, 0)$$

7. $aCH_4 + bO_2 \rightarrow cCO_2 + dH_2O$

$$C : a = c \rightarrow 1a + 0b - 1c + 0d = 0$$
$$H : 4a = 2d \rightarrow 4a + 0b + 0c - 2d = 0$$
$$O : 2b = 2c \rightarrow 0a + 2b - 2c = 0d = 0$$

$$aug = \left[\begin{array}{cccc|c} 1 & 0 & -1 & 0 & 0 \\ 4 & 0 & 0 & -2 & 0 \\ 0 & 2 & -2 & 1 & 0 \end{array}\right]$$

$$(a, b, c, d) = (1, 2, 1, 2)$$

8.

$$x : (1, 0) \rightarrow (-1, 0.3)$$
$$y : (0, 1) \rightarrow (0.2, 0.5)$$

$$A = \begin{bmatrix} -1 & 0.2 \\ 0.3 & 0.5 \end{bmatrix}$$

10.
- Rotate the x-axis 20^o
- Reflect about the x-axis
- Rotate the x-axis -20^o

$$= \begin{bmatrix} \cos(20) & -\sin(20) \\ \sin(20) & \cos(20) \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} \cos(20) & \sin(20) \\ -\sin(20) & \cos(20) \end{bmatrix}$$
$$= \begin{bmatrix} \cos(20) & \sin(20) \\ \sin(20) & -\cos(20) \end{bmatrix} \begin{bmatrix} \cos(20) & \sin(20) \\ -\sin(20) & \cos(20) \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2(20) - \sin^2(20) & 2\cos(20)\sin(20) \\ 2\sin(20)\cos(20) & \sin^2(20) - \cos^2(20) \end{bmatrix}$$

$$= \begin{bmatrix} 0.7660 & 0.6428 \\ 0.6428 & -0.7660 \end{bmatrix}$$