

Matrix Theory : Assignment 2

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Abstract—This is a problem to balance a chemical equation using system of linear equations.

Download all codes from

https://github.com/Debolena/EE5609/blob/master/Assignment_2/assignment_2.py

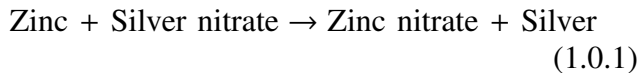
$$\mathbf{X} = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} \quad (2.0.12)$$

(2.0.11) can be reduced as follows:

$$\begin{pmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & 3 & -6 \end{pmatrix} \xleftrightarrow{R_4 \leftarrow R_4 - 3R_3} \begin{pmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & 0 & 0 \end{pmatrix} \quad (2.0.13)$$

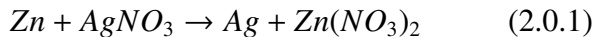
1 PROBLEM

Balance the following chemical equation.



2 SOLUTION

Equation 1.0.1 can be written as :



Suppose balance form of the equation is :



which results in the following equations:

$$(x_1 - 2x_4)\text{Zn} = 0 \quad (2.0.3)$$

$$(x_2 - x_3)\text{Ag} = 0 \quad (2.0.4)$$

$$(x_3 - 2x_4)\text{N} = 0 \quad (2.0.5)$$

$$(3x_3 - 6x_4)\text{O} = 0 \quad (2.0.6)$$

which can be expressed as

$$x_1 + 0.x_2 + 0.x_3 - x_4 = 0 \quad (2.0.7)$$

$$0.x_1 + x_2 - x_3 + 0.x_4 = 0 \quad (2.0.8)$$

$$0.x_1 + 0.x_2 + x_3 - 2x_4 = 0 \quad (2.0.9)$$

$$0.x_1 + 0.x_2 + 3x_3 - 6x_4 = 0 \quad (2.0.10)$$

resulting in the matrix equation

$$\begin{pmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & 3 & -6 \end{pmatrix} \mathbf{X} = \mathbf{0} \quad (2.0.11)$$

Thus,

$$x_1 = x_4, x_2 = 2x_4, x_3 = 2x_4 \quad (2.0.14)$$

$$\Rightarrow \mathbf{X} = \begin{pmatrix} x_4 \\ 2x_4 \\ 2x_4 \\ x_4 \end{pmatrix} = x_4 \begin{pmatrix} 1 \\ 2 \\ 2 \\ 1 \end{pmatrix} \quad (2.0.15)$$

by substituting $x_4 = 1$, we get :

$$\Rightarrow \mathbf{X} = \begin{pmatrix} 1 \\ 2 \\ 2 \\ 1 \end{pmatrix} \quad (2.0.16)$$

Hence, (2.0.2) finally becomes

