

# Assignment 3

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**Abstract**—This document balances the given chemical equation where

Download all latex codes from

[https://github.com/Matish007/Matrix-Theory-EE5609-/tree/master/Assignment\\_3](https://github.com/Matish007/Matrix-Theory-EE5609-/tree/master/Assignment_3)

and all python codes from

[https://github.com/Matish007/Matrix-Theory-EE5609-/tree/master/Assignment\\_3/Codes](https://github.com/Matish007/Matrix-Theory-EE5609-/tree/master/Assignment_3/Codes)

$$\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} \quad (2.0.5)$$

equation (2.0.4) can be row reduced as follows

$$\begin{pmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 2 & 0 & -1 \\ 2 & 0 & 0 & -1 \end{pmatrix} \xleftrightarrow{R4 \leftarrow R4 - 2R1} \begin{pmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 2 & 0 & -1 \\ 0 & 0 & 2 & -1 \end{pmatrix} \quad (2.0.6)$$

## 1 PROBLEM

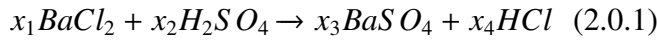
Balance the following chemical equation:-



$$\begin{pmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 2 & 0 & -1 \\ 0 & 0 & 2 & -1 \end{pmatrix} \xleftrightarrow{R3 \leftarrow R3 - 2R2} \begin{pmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 2 & -1 \\ 0 & 0 & 2 & -1 \end{pmatrix} \quad (2.0.7)$$

## 2 EXPLANATION

Let the balanced version of (1.0.1) be:-



which results in the following equations:-

$$\begin{aligned} (x_1 - x_3)Ba &= 0 \\ (x_2 - x_4)SO_4 &= 0 \\ (2x_2 - x_4)H &= 0 \\ (2x_1 - x_4)Cl &= 0 \end{aligned} \quad (2.0.2)$$

which can be expressed as:-

$$\begin{aligned} 1.x_1 + 0.x_2 - 1.x_3 + 0.x_4 &= 0 \\ 0.x_1 + 1.x_2 + 0.x_3 - 1.x_4 &= 0 \\ 0.x_1 + 2.x_2 + 0.x_3 - 1.x_4 &= 0 \\ 2.x_1 + 0.x_2 + 0.x_3 - 1.x_4 &= 0 \end{aligned} \quad (2.0.3)$$

resulting in the matrix equation:-

$$\begin{pmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 2 & 0 & -1 \\ 2 & 0 & 0 & -1 \end{pmatrix} \mathbf{x} = \mathbf{0} \quad (2.0.4)$$

Thus,

$$x_1 = x_3, x_2 = x_3, 2x_3 = x_4 \quad (2.0.9)$$

$$\mathbf{x} = x_3 \begin{pmatrix} 1 \\ 1 \\ 1 \\ 2 \end{pmatrix} \quad (2.0.10)$$

Upon substituting  $x_3 = 1$  in (2.0.10), then (2.0.1) becomes,



(2.0.11) is our required balance equation.