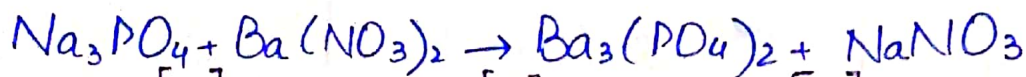
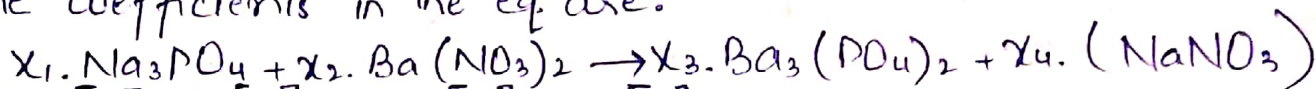


QUESTION-06



$$\text{Na}_3\text{PO}_4: \begin{bmatrix} 3 \\ 1 \\ 4 \\ 0 \\ 0 \end{bmatrix}, \text{Ba}(\text{NO}_3)_2: \begin{bmatrix} 0 \\ 0 \\ 6 \\ 1 \\ 2 \end{bmatrix}, \text{Ba}_3(\text{PO}_4)_2: \begin{bmatrix} 0 \\ 2 \\ 8 \\ 3 \\ 0 \end{bmatrix}, \text{NaNO}_3: \begin{bmatrix} 1 \\ 0 \\ 3 \\ 0 \\ 1 \end{bmatrix} \rightarrow \begin{matrix} \text{Na} \\ \text{P} \\ \text{O} \\ \text{Ba} \\ \text{N} \end{matrix}$$

The coefficients in the eq. are:



$$x_1 \begin{bmatrix} 3 \\ 1 \\ 4 \\ 0 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 0 \\ 6 \\ 1 \\ 2 \end{bmatrix} = x_3 \begin{bmatrix} 0 \\ 2 \\ 8 \\ 3 \\ 0 \end{bmatrix} + x_4 \begin{bmatrix} 1 \\ 0 \\ 3 \\ 0 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 & 0 \\ 1 & 0 & -2 & 0 & 0 \\ 4 & 6 & -8 & -3 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix} \text{ Replace } R_1 \text{ and } R_2 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 3 & 0 & 0 & -1 & 0 \\ 4 & 6 & -8 & -3 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix}$$

$$R_2 + (-3)R_1 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 0 & 6 & -1 & 0 \\ 4 & 6 & -8 & -3 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix} \quad R_3 + (-4)R_1 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 0 & 6 & -1 & 0 \\ 0 & 6 & 0 & -3 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix}$$

$$\text{Replace } R_2 \& R_4 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 6 & 0 & -3 & 0 \\ 0 & 0 & 8 & -1 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix} \quad R_3 + (-6)R_2 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 6 & 18 & -3 & 0 \\ 0 & 0 & 6 & -1 & 0 \\ 0 & 2 & 0 & -1 & 0 \end{bmatrix}$$

$$R_5 + (-2)R_2 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 0 & 18 & -3 & 0 \\ 0 & 0 & 6 & -1 & 0 \\ 0 & 0 & 6 & -1 & 0 \end{bmatrix} \quad R_3/18 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 0 & 1 & -1/6 & 0 \\ 0 & 0 & 6 & -1 & 0 \\ 0 & 0 & 6 & -1 & 0 \end{bmatrix}$$

$$R_4 + (-6)R_3 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 0 & 1 & -1/6 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 6 & -1 & 0 \end{bmatrix} \quad R_5 + (-6)R_3 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & -3 & 0 & 0 \\ 0 & 0 & 1 & -1/6 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$R_2 + (3)R_3 \sim \begin{bmatrix} 1 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1/2 & 0 \\ 0 & 0 & 1 & -1/6 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad R_1 + (2)R_3 \sim \begin{bmatrix} 1 & 0 & 0 & -1/3 & 0 \\ 0 & 1 & 0 & -1/2 & 0 \\ 0 & 0 & 1 & -1/6 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The general solution is:

$$x_1 = (1/3)x_4, \quad x_2 = (1/2)x_4, \quad x_3 = (1/6)x_4 \text{ with } x_4 \text{ free}$$

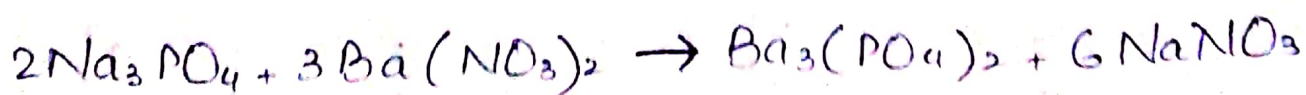
Taking $x_4 = 6$

$$x_1 = 2$$

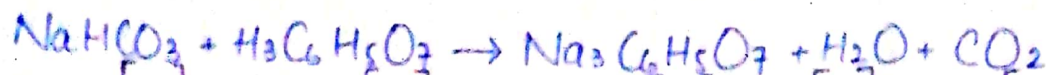
$$x_2 = 3$$

$$x_3 = 1$$

The balanced equation is:

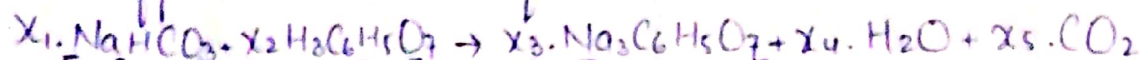


QUESTION-07



$$\text{NaHCO}_3: \begin{bmatrix} 1 \\ 1 \\ 1 \\ 3 \end{bmatrix}, \text{H}_3\text{C}_6\text{H}_5\text{O}_7: \begin{bmatrix} 0 \\ 8 \\ 6 \\ 7 \end{bmatrix}, \text{Na}_3\text{C}_6\text{H}_5\text{O}_7: \begin{bmatrix} 3 \\ 5 \\ 6 \\ 7 \end{bmatrix}, \text{H}_2\text{O}: \begin{bmatrix} 0 \\ 2 \\ 0 \\ 1 \end{bmatrix}, \text{CO}_2: \begin{bmatrix} 0 \\ 0 \\ 1 \\ 2 \end{bmatrix} \rightarrow \begin{matrix} \text{Na} \\ \text{H} \\ \text{C} \\ \text{O} \end{matrix}$$

The coefficients in the eq are:



$$x_1 \begin{bmatrix} 1 \\ 1 \\ 1 \\ 3 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 8 \\ 6 \\ 7 \end{bmatrix} = x_3 \begin{bmatrix} 3 \\ 5 \\ 6 \\ 7 \end{bmatrix} + x_4 \begin{bmatrix} 0 \\ 2 \\ 0 \\ 1 \end{bmatrix} + x_5 \begin{bmatrix} 0 \\ 0 \\ 1 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 1 & 8 & -5 & -2 & 0 & 0 \\ 1 & 6 & -6 & 0 & -1 & 0 \\ 3 & 7 & -7 & -1 & -2 & 0 \end{bmatrix} \xrightarrow{R_2 + (-1)R_1} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 8 & -2 & -2 & 0 & 0 \\ 1 & 6 & -6 & 0 & -1 & 0 \\ 3 & 7 & -7 & -1 & -2 & 0 \end{bmatrix}$$

$$\xrightarrow{R_3 + (-1)R_1} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 8 & -2 & -2 & 0 & 0 \\ 0 & 6 & -3 & 0 & -1 & 0 \\ 3 & 7 & -7 & -1 & -2 & 0 \end{bmatrix} \xrightarrow{R_4 + (-3)R_1} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 8 & -2 & -2 & 0 & 0 \\ 0 & 6 & -3 & 0 & -1 & 0 \\ 0 & 7 & 2 & -1 & -2 & 0 \end{bmatrix}$$

$$\xrightarrow{R_2 \times \frac{1}{8}} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 6 & -3 & 0 & -1 & 0 \\ 0 & 7 & 2 & -1 & -2 & 0 \end{bmatrix} \xrightarrow{R_3 + (-6)R_2} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 3/2 & 3/2 & -1 & 0 \\ 0 & 7 & 2 & -1 & -2 & 0 \end{bmatrix}$$

$$\xrightarrow{R_4 + (-7)R_2} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 3/2 & 3/2 & -1 & 0 \\ 0 & 0 & 15/4 & 3/4 & -2 & 0 \end{bmatrix} \xrightarrow{R_3 \times (-2/3)} \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 1 & 1 & 2/3 & 0 \\ 0 & 0 & 15/4 & 3/4 & -2 & 0 \end{bmatrix}$$

$$R_4 + (-1/4)R_3 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 1 & -1 & 2/3 & 0 \\ 0 & 0 & 0 & 9/2 & -9/2 & 0 \end{bmatrix} \quad R_4 \times (2/9) \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 1 & -1 & 2/3 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix}$$

$$R_3 + R_4 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & -1/4 & 0 & 0 \\ 0 & 0 & 1 & 0 & -1/3 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix} \quad R_2 + (1/4)R_4 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -1/4 & 0 & -1/4 & 0 \\ 0 & 0 & 1 & 0 & -1/3 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix}$$

$$R_2 + (1/4)R_3 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1/3 & 0 \\ 0 & 0 & 1 & 0 & -1/3 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix} \quad R_1 + (3)R_3 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 & -1/3 & 0 \\ 0 & 0 & 1 & 0 & -1/3 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix}$$

The general solution is

$$x_1 = x_5, \quad x_2 = \left(\frac{1}{3}\right)x_5, \quad x_3 = \left(\frac{1}{3}\right)x_5, \quad x_4 = x_5$$

where x_5 is free

Taking $x_5 = 3$

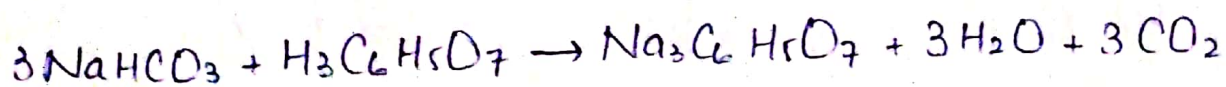
$$x_1 = 3$$

$$x_2 = 1$$

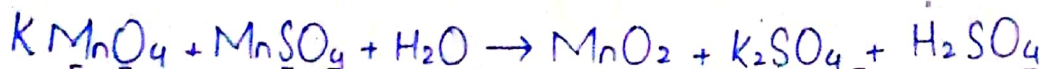
$$x_3 = 1$$

$$x_4 = 3$$

The balanced equation is

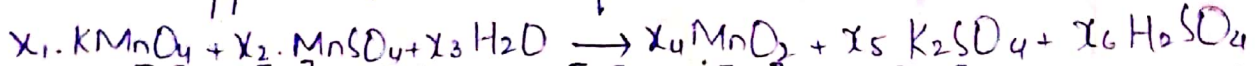


QUESTION-08



$$\text{KMnO}_4: \begin{bmatrix} 1 \\ 1 \\ 4 \\ 0 \\ 0 \end{bmatrix}, \text{MnSO}_4: \begin{bmatrix} 0 \\ 1 \\ 4 \\ 1 \\ 0 \end{bmatrix}, \text{H}_2\text{O}: \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 2 \end{bmatrix}, \text{MnO}_2: \begin{bmatrix} 0 \\ 1 \\ 2 \\ 0 \\ 0 \end{bmatrix}, \text{K}_2\text{SO}_4: \begin{bmatrix} 2 \\ 0 \\ 4 \\ 1 \\ 0 \end{bmatrix}, \text{H}_2\text{SO}_4: \begin{bmatrix} 0 \\ 0 \\ 4 \\ 1 \\ 2 \end{bmatrix} \rightarrow \begin{matrix} \text{K} \\ \text{Mn} \\ \text{O} \\ \text{S} \\ \text{H} \end{matrix}$$

The coefficients in the eq. are:



$$x_1 \cdot \begin{bmatrix} 1 \\ 1 \\ 4 \\ 0 \\ 0 \end{bmatrix} + x_2 \cdot \begin{bmatrix} 0 \\ 1 \\ 4 \\ 1 \\ 0 \end{bmatrix} + x_3 \cdot \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 2 \end{bmatrix} = x_4 \cdot \begin{bmatrix} 0 \\ 1 \\ 2 \\ 0 \\ 0 \end{bmatrix} + x_5 \cdot \begin{bmatrix} 2 \\ 0 \\ 4 \\ 1 \\ 0 \end{bmatrix} + x_6 \cdot \begin{bmatrix} 0 \\ 0 \\ 4 \\ 1 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 1 & 1 & 0 & -1 & 0 & 0 & 0 \\ 4 & 4 & 1 & -2 & -4 & -4 & 0 \\ 0 & 1 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 2 & 0 & 0 & -2 & 0 \end{bmatrix}$$

$R_2 + (-1)R_1$
~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 4 & 4 & 1 & -2 & -4 & -4 & 0 \\ 0 & 1 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 2 & 0 & 0 & -2 & 0 \end{bmatrix}$$

$$R_3 + (-4)R_1$$

~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 4 & 1 & -2 & 4 & -4 & 0 \\ 0 & 1 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 2 & 0 & 0 & -2 & 0 \end{bmatrix}$$

$$R_3 + (-4)R_2$$

~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 1 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 2 & 0 & 0 & -2 & 0 \end{bmatrix}$$

$$R_4 + (-1)R_2$$

~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 0 & 0 & 1 & -3 & -1 & 0 \\ 0 & 0 & 2 & 0 & 0 & -2 & 0 \end{bmatrix}$$

$$R_5 + (-2)R_3$$

~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 0 & 0 & 1 & -3 & -1 & 0 \\ 0 & 0 & 0 & -4 & 8 & 6 & 0 \end{bmatrix}$$

$$R_5 + (4)R_4$$

~

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 0 & 0 & 1 & -3 & -1 & 0 \\ 0 & 0 & 0 & 0 & -4 & 2 & 0 \end{bmatrix}$$

$$R_5 \times \left(-\frac{1}{4}\right)$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 0 & 0 & 1 & -3 & -1 & 0 \\ 0 & 0 & 0 & 0 & 1 & -\frac{1}{2} & 0 \end{bmatrix}$$

$$R_4 + (3)R_5 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & -4 & -4 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

$$R_3 + (4)R_5 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 2 & 0 & 0 \\ 0 & 0 & 1 & 2 & 0 & -6 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

$$R_2 + (-2)R_5 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & -2 & 0 & 0 \\ 0 & 1 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 2 & 0 & -6 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

$$R_1 + (2)R_5 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 2 & 0 & -6 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

$$R_3 + (-2)R_4 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

$$R_2 + R_4 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 & 0 & -3/2 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 & 0 & -5/2 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1/2 & 0 \end{bmatrix}$$

The general solution is :-

$$x_1 = x_6, \quad x_2 = \left(\frac{3}{2}\right)x_6, \quad x_3 = x_6, \quad x_4 = \left(\frac{5}{2}\right)x_6, \quad x_5 = \left(\frac{1}{2}\right)x_6$$

where x_6 is free

Taking $x_6 = 2$

$$x_1 = 2$$

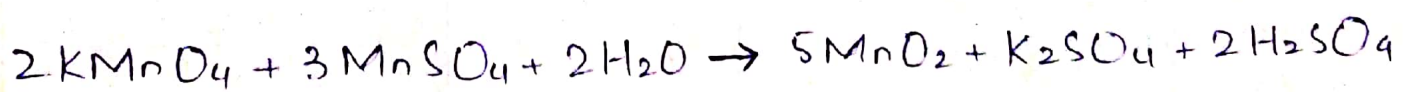
$$x_2 = 3$$

$$x_3 = 2$$

$$x_4 = 5$$

$$x_5 = 1$$

The balanced equation is :

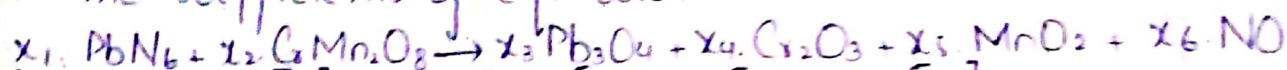


QUESTION-09



$$\text{PbN}_6: \begin{bmatrix} 1 \\ 6 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \text{CrMn}_2\text{O}_8: \begin{bmatrix} 0 \\ 0 \\ 1 \\ 2 \\ 8 \end{bmatrix}, \text{Pb}_3\text{O}_4: \begin{bmatrix} 3 \\ 0 \\ 0 \\ 0 \\ 4 \end{bmatrix}, \text{Cr}_2\text{O}_3: \begin{bmatrix} 0 \\ 0 \\ 2 \\ 0 \\ 3 \end{bmatrix}, \text{MnO}_2: \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 2 \end{bmatrix}, \text{NO}: \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} \begin{matrix} \rightarrow \text{Pb} \\ \rightarrow \text{N} \\ \rightarrow \text{Cr} \\ \rightarrow \text{Mn} \\ \rightarrow \text{O} \end{matrix}$$

The coefficients of eq. are:



$$x_1 \begin{bmatrix} 1 \\ 6 \\ 0 \\ 0 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 0 \\ 1 \\ 2 \\ 8 \end{bmatrix} = x_3 \begin{bmatrix} 3 \\ 0 \\ 0 \\ 0 \\ 4 \end{bmatrix} + x_4 \begin{bmatrix} 0 \\ 0 \\ 2 \\ 0 \\ 3 \end{bmatrix} + x_5 \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 2 \end{bmatrix} + x_6 \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 3 & 0 & 0 & 0 & 0 \\ 6 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 1 & 0 & 0 \\ 0 & 8 & 4 & 3 & 2 & 1 & 0 \end{bmatrix}$$

Replace
R₂ and R₃
~

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 6 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 2 & 0 & 0 & -1 & 0 & 0 \\ 0 & 8 & -4 & -3 & -2 & -1 & 0 \end{bmatrix}$$

$$R_3 + (-6)R_1 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 18 & 0 & 0 & -1 & 0 \\ 0 & 2 & 0 & 0 & -1 & 0 & 0 \\ 0 & 8 & -4 & -3 & -2 & -1 & 0 \end{bmatrix}$$

$$x_3 \times (1/18) \sim$$

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 2 & 0 & 0 & -1 & 0 & 0 \\ 0 & 8 & -4 & -3 & -2 & -1 & 0 \end{bmatrix}$$

$$R_4 + (-2)R_2 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 4 & -1 & 0 & 0 \\ 0 & 8 & -4 & -3 & -2 & -1 & 0 \end{bmatrix}$$

$$R_5 + (-8)R_2 \sim$$

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 4 & -1 & 0 & 0 \\ 0 & 0 & -4 & 13 & -2 & -1 & 0 \end{bmatrix}$$

$$R_5 + (4)R_3 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 4 & -1 & 0 & 0 \\ 0 & 0 & 0 & 13 & -2 & -1/9 & 0 \end{bmatrix}$$

$$R_4 \times (1/4) \sim$$

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & -1/4 & 0 & 0 \\ 0 & 0 & 0 & 13 & -2 & -1/9 & 0 \end{bmatrix}$$

$$R_5 + (-13)R_4 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & -1/4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 5/4 & -11/9 & 0 \end{bmatrix} \quad R_5 \times (4/5) \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & -1/4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -44/45 & 0 \end{bmatrix}$$

$$R_4 + (1/4)R_5 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & 0 & -1/45 & 0 \\ 0 & 0 & 0 & 0 & 1 & -44/45 & 0 \end{bmatrix} \quad R_2 + (2)R_4 \sim \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & -22/45 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & 0 & -1/45 & 0 \\ 0 & 0 & 0 & 0 & 1 & -44/45 & 0 \end{bmatrix}$$

$$R_1 + (3)R_3 \sim \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -1/6 & 0 \\ 0 & 1 & 0 & 0 & 0 & -22/45 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1/18 & 0 \\ 0 & 0 & 0 & 1 & 0 & -1/45 & 0 \\ 0 & 0 & 0 & 0 & 1 & -44/45 & 0 \end{bmatrix}$$

The general solution is :

$$x_1 = \left(\frac{1}{6}\right)x_6, \quad x_2 = \left(\frac{22}{45}\right)x_6, \quad x_3 = \left(\frac{1}{18}\right)x_6, \quad x_4 = \left(\frac{11}{45}\right)x_6, \quad x_5 = \left(\frac{44}{45}\right)x_6$$

with x_6 free

Taking $x_6 = 90$

$$x_1 = 15$$

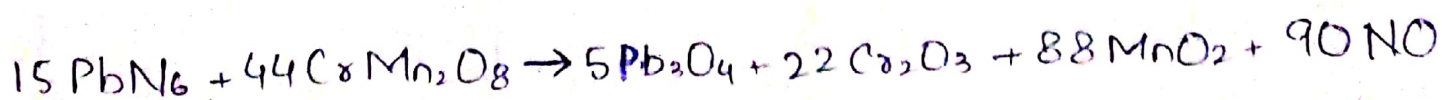
$$x_2 = 44$$

$$x_3 = 5$$

$$x_4 = 22$$

$$x_5 = 88$$

The balanced eq. is

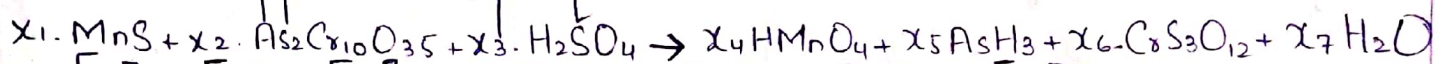


QUESTION - 10



$$\begin{matrix} \text{MnS:} & \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} & , & \text{As}_2\text{Cr}_{10}\text{O}_{35}: & \begin{bmatrix} 0 \\ 0 \\ 2 \\ 10 \\ 35 \\ 0 \end{bmatrix} & , & \text{H}_2\text{SO}_4: & \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 4 \\ 2 \end{bmatrix} & , & \text{HMnO}_4: & \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 4 \\ 1 \end{bmatrix} & , & \text{AsH}_3: & \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 3 \end{bmatrix} & , & \text{Cr}_2\text{S}_3\text{O}_{12}: & \begin{bmatrix} 0 \\ 3 \\ 0 \\ 1 \\ 12 \\ 0 \end{bmatrix} & , & \text{H}_2\text{O}: & \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 2 \end{bmatrix} \end{matrix}$$

The coefficients of eq. are:



$$x_1 \cdot \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} + x_2 \cdot \begin{bmatrix} 0 \\ 0 \\ 2 \\ 10 \\ 35 \\ 0 \end{bmatrix} + x_3 \cdot \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 4 \\ 2 \end{bmatrix} = x_4 \cdot \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 4 \\ 1 \end{bmatrix} + x_5 \cdot \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 3 \end{bmatrix} + x_6 \cdot \begin{bmatrix} 0 \\ 3 \\ 0 \\ 1 \\ 12 \\ 0 \end{bmatrix} + x_7 \cdot \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & -3 & 0 & 0 \\ 0 & 2 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 35 & 4 & -4 & 0 & -12 & -1 & 0 \\ 0 & 0 & 2 & -1 & -3 & 0 & -2 & 0 \end{bmatrix}$$

$R_2 + (-1)R_1$

\sim

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & -3 & 0 & 0 \\ 0 & 2 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 35 & 4 & -4 & 0 & -12 & -1 & 0 \\ 0 & 0 & 2 & -1 & -3 & 0 & -2 & 0 \end{bmatrix}$$

Replace R_2 and R_3 and $R_2 \times (\frac{1}{2})$

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & -3 & 0 & 0 \\ 0 & 10 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 35 & 4 & -4 & 0 & -12 & -1 & 0 \\ 0 & 0 & 2 & -1 & -3 & 0 & -2 & 0 \end{bmatrix}$$

$R_4 + (-10)R_2$

\sim

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & -3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 5 & -1 & 0 & 0 \\ 0 & 35 & 4 & -4 & 0 & -12 & -1 & 0 \\ 0 & 0 & 2 & -1 & -3 & 0 & -2 & 0 \end{bmatrix}$$

$R_5 + (-35)R_2$

\sim

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & -3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 5 & -1 & 0 & 0 \\ 0 & 0 & 4 & -4 & \frac{35}{2} & -12 & -1 & 0 \\ 0 & 0 & 2 & -1 & -3 & 0 & -2 & 0 \end{bmatrix}$$

Replace R_4 and R_6 and $R_4 \times -1$

\sim

$$\begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -\frac{1}{2} & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & -3 & 0 & 0 \\ 0 & 0 & -2 & 1 & 3 & 0 & 2 & 0 \\ 0 & 0 & 4 & -4 & \frac{35}{2} & -12 & -1 & 0 \\ 0 & 0 & 0 & 0 & 5 & -1 & 0 & 0 \end{bmatrix}$$

The general solution is:

$$x_1 = \left(\frac{16}{327}\right)x_7$$

$$x_2 = \left(\frac{13}{327}\right)x_7$$

$$x_3 = \left(\frac{374}{327}\right)x_7$$

$$x_4 = \left(\frac{16}{327}\right)x_7$$

$$x_5 = \left(\frac{26}{327}\right)x_7$$

$$x_6 = \left(\frac{130}{327}\right)x_7$$

where x_7 is free

Taking $x_7 = 327$

$$x_1 = 16, x_2 = 13, x_3 = 374, x_4 = 16, x_5 = 26, x_6 = 130$$

The balanced equation is:

