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Sol:-

Pakistan = 1:2:1

Egyption ratio = 2:1:1

American = 2:0:2

and cost of one kg be the x, y, z, the according to the condition

$$\frac{1}{4}x + \frac{2}{4}y + \frac{1}{4}z = 40$$

$$\frac{2}{4}x + \frac{1}{4}y + \frac{1}{4}z = 50$$

$$\frac{2}{4}x + \frac{0}{4}y + \frac{2}{4}z = 60$$

} ①

$$1x + 2y + 1z = 160$$

$$2x + 1y + 1z = 200$$

$$2x + 0 + 1z = 120$$

} → ②

So in the form of matrix it can be written as

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}$$

$$A \quad X = B.$$

$$A = \begin{vmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{vmatrix}, X = \begin{vmatrix} x \\ y \\ z \end{vmatrix}, B = \begin{bmatrix} 160 \\ 200 \\ 120 \end{bmatrix}.$$

Now

$$A_1 = \begin{bmatrix} 160 & 2 & 1 \\ 200 & 1 & 1 \\ 120 & 0 & 1 \end{bmatrix}, A_2 \begin{bmatrix} 1 & 160 & 1 \\ 2 & 200 & 1 \\ 1 & 120 & 1 \end{bmatrix}, A_3 = \begin{bmatrix} 1 & 2 & 160 \\ 2 & 1 & 200 \\ 1 & 0 & 120 \end{bmatrix}$$

Finding $|A| = \begin{vmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{vmatrix}$ Expand by R_1

$$= 1\begin{vmatrix} 1 & 1 \\ 0 & 1 \end{vmatrix} - 2\begin{vmatrix} 2 & 1 \\ 1 & 1 \end{vmatrix} + 1\begin{vmatrix} 2 & 1 \\ 1 & 0 \end{vmatrix}$$

$$= 1(1\times1 - 1\times0) - 2(2\times1 - 1\times1) + 1(2\times0 - 1\times1)$$

$$= -2$$

Now

$$|A_1| = \begin{vmatrix} 160 & 2 & 1 \\ 200 & 1 & 1 \\ 120 & 0 & 1 \end{vmatrix} \text{ by } R_1$$

$$= 160\begin{vmatrix} 1 & 1 \\ 0 & 1 \end{vmatrix} - 2\begin{vmatrix} 200 & 1 \\ 120 & 1 \end{vmatrix} + 1\begin{vmatrix} 200 & 1 \\ 120 & 0 \end{vmatrix}$$

$$|A_1| = -120$$

$$|A_2| = \begin{vmatrix} 1 & 160 & 1 \\ 2 & 200 & 1 \\ 1 & 120 & 1 \end{vmatrix} \text{ Expand by } R_1$$

$$= 1\begin{vmatrix} 200 & 1 \\ 120 & 1 \end{vmatrix} - 160\begin{vmatrix} 2 & 1 \\ 1 & 1 \end{vmatrix} + 1\begin{vmatrix} 2 & 200 \\ 1 & 120 \end{vmatrix}$$

$$|A_2| = -40$$

$$|A_3| = \begin{vmatrix} 1 & 2 & 160 \\ 2 & 1 & 200 \\ 1 & 0 & 120 \end{vmatrix} \text{ Expand by } R_1$$

$$= 1\begin{vmatrix} 1 & 200 \\ 0 & 120 \end{vmatrix} - 2\begin{vmatrix} 2 & 200 \\ 1 & 120 \end{vmatrix} + 160\begin{vmatrix} 2 & 1 \\ 1 & 0 \end{vmatrix}$$

$$= 1(120-0) - 2(240-200) + 160(0-1)$$

$$|A_3| = -120$$

Now according to cramer's rule

$$x = \frac{|A_1|}{|A|} = \frac{-120}{-2} = 60$$

$$y = \frac{|A_2|}{|A|} = \frac{-40}{2} = 20$$

$$z = \frac{A_3}{|A|} = \frac{-120}{-2} = 60$$

So

x = pak = 60

y = egyption = 20

z = American = 60