

day/date

## : Exercise # 1-6 :

Qno.1)-

Solution:

Output

G

s

Input

$$\begin{array}{ccc} 0.2 & 0.7 \\ 0.8 & 0.3 \end{array}$$

G

s

Eg:

$$0.2G + 0.7s = G$$

$$0.8G + 0.3s = s$$

$$0.2G - G + 0.7s = 0$$

$$0.8G + 0.3s - s = 0$$

$$-0.8G + 0.7s = 0$$

$$0.8G - 0.7s = 0$$

(Homogeneous System)

$$= \begin{bmatrix} -0.8 & 0.7 & 0 \\ 0.8 & -0.7 & 0 \end{bmatrix}$$

Finally  
Bingo!

day/date

$$\rightarrow R_2 + R_1$$

$$= \begin{bmatrix} -0.8 & 0.7 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_1 \div (-0.8)$$

$$= \begin{bmatrix} 1 & -0.875 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$x_1 - 0.875x_2 = 0$$

$$x_1 = 0.875x_2$$

Here  $x_2$  is free variable.

Q no. 3)

Soln- Part a :

Output :

Fuel & power	M	S	Input
0.1	0.1	0.2	F <sub>p</sub>
0.8	0.1	0.4	m
0.1	0.8	0.4	s.

Part b :

$$0.1F + 0.1M + 0.2S = F$$

$$0.8F + 0.1M + 0.4S = M$$

$$0.1F + 0.8m + 0.4S = S.$$

Date

$$\begin{aligned} -0.9F + 0.1M - 0.2S &= 0 \rightarrow (i) \\ 0.8F - 0.9M + 0.2S &= 0 \rightarrow (ii) \\ 0.1F + 0.8M - 0.6S &= 0 \rightarrow (iii) \end{aligned}$$

Augmented Matrix :

$$= \begin{bmatrix} -0.9 & 0.1 & 0.2 & 0 \\ 0.8 & -0.9 & 0.2 & 0 \\ 0.1 & 0.8 & -0.6 & 0 \end{bmatrix}$$

Multiplying  $R_1, R_2$  &  $R_3$  by '10':

$$= \begin{bmatrix} -9 & 1 & 2 & 0 \\ 8 & -9 & 2 & 0 \\ 1 & 8 & -6 & 0 \end{bmatrix}$$

$\rightarrow R_1 \leftrightarrow R_3$

$$= \begin{bmatrix} 1 & 8 & -6 & 0 \\ 8 & -9 & 2 & 0 \\ -9 & 1 & 2 & 0 \end{bmatrix}$$

$$\rightarrow R_2 - 8R_1$$

$$= \begin{bmatrix} 1 & 8 & -6 & 0 \\ 0 & -73 & +52 & 0 \\ -9 & 1 & 2 & 0 \end{bmatrix}$$

$$\rightarrow R_3 + 9R_1$$

$$= \begin{bmatrix} 1 & 8 & -6 & 0 \\ 0 & -73 & +52 & 0 \\ 0 & 73 & -52 & 0 \end{bmatrix}$$

Finally  
BingO!

day/date

$$= R_3 + R_2$$

$$= \begin{bmatrix} 1 & 8 & -6 & 0 \\ 0 & -73 & 52 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\text{Now } R_2 \div -73.$$

$$= \begin{bmatrix} 1 & 8 & -6 & 0 \\ 0 & 1 & -0.712 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$
$$\rightarrow R_1 - 8R_2$$

$$= \begin{bmatrix} 0 & 0 & -0.304 & 0 \\ 0 & 1 & -0.712 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$x_1 - 0.304x_3 = 0$$

$$x_2 - 0.712x_3 = 0$$

$x_3$  is free here

$$x_1 = 0.304x_3$$

$$x_2 = 0.712x_3$$

(C)

$$F_p = 0.304 S$$

$$M = 0.712 S$$

$$S = 1 S$$

For  $S = 100$

$$F_p = 30.4, M = 71.2, S = 100$$

Bingo!

day/date

(Qno.4)

Sol-

(a)

(Output)

Mining Lumber Energy Transportation Input

0.3	0.15	0.2	0.2	M
0.1	0.15	0.15	0.1	L
0.6	0.5	0.45	0.5	E
0	0.2	0.20	0.2	T

(b)

$$0.3M + 0.15L + 0.2E + 0.2T = M$$

$$0.1M + 0.15L + 0.15E + 0.1T = L$$

$$0.6M + 0.5L + 0.45E + 0.5T = E$$

$$0.2L + 0.2E + 0.2T = T$$

$$-0.7M + 0.15L + 0.2E + 0.2T = 0$$

$$0.1M - 0.85L + 0.15E + 0.1T = 0$$

$$0.6M + 0.5L - 0.55E + 0.5T = 0$$

$$0.2L + 0.2E - 0.8T = 0$$

The augmented matrix is ;

$$\begin{bmatrix} -0.7 & 0.15 & 0.2 & 0.2 & 0 \\ 0.1 & -0.85 & 0.15 & 0.1 & 0 \\ 0.6 & 0.5 & -0.55 & 0.5 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

Finally  
BingO!

day/date

$$\rightarrow R_1 \div (-0.7)$$

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0.1 & -0.85 & 0.15 & 0.1 & 0 \\ 0.6 & 0.5 & -0.55 & 0.5 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

$$\rightarrow R_2 - 0.1 R_1$$

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0 & -0.82 & 0.18 & 0.13 & 0 \\ 0.6 & 0.5 & -0.55 & 0.5 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.6 R_1$$

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0 & -0.82 & 0.18 & 0.13 & 0 \\ 0 & 0.63 & -0.38 & 0.67 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

$$\rightarrow R_2 \div (-0.82)$$

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0.63 & -0.38 & 0.67 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.63(R_2)$$

day/date

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0 & -0.24 & 0.77 & 0 \\ 0 & 0.2 & 0.2 & -0.8 & 0 \end{bmatrix}$$

$$\rightarrow R_4 - 0.2R_2$$

$$= \begin{bmatrix} 1 & -0.21 & -0.28 & -0.28 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0 & -0.24 & 0.77 & 0 \\ 0 & 0 & 0.24 & -0.77 & 0 \end{bmatrix}$$

$$\rightarrow R_1 + 0.21R_2$$

$$= \begin{bmatrix} 1 & 0 & -0.32 & -0.31 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0 & -0.24 & 0.77 & 0 \\ 0 & 0 & 0.24 & -0.77 & 0 \end{bmatrix}$$

$$\rightarrow R_4 - R_3$$

$$= \begin{bmatrix} 1 & 0 & -0.32 & -0.31 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0 & -0.24 & 0.77 & 0 \\ 0 & 0 & 0 & -0.77 & 0 \end{bmatrix}$$

$$\rightarrow R_3 \div (-0.24)$$

$$\begin{bmatrix} 1 & 0 & -0.32 & -0.31 & 0 \\ 0 & 1 & -0.21 & -0.16 & 0 \\ 0 & 0 & 1 & -3.2 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_2 + 0.21 R_3$$

$$= \begin{bmatrix} 1 & 0 & -0.32 & -0.31 & 0 \\ 0 & 1 & 0 & -0.83 & 0 \\ 0 & 0 & 1 & -3.2 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_1 + 0.32 R_3$$

$$= \begin{bmatrix} 1 & 0 & 0 & -1.33 & 0 \\ 0 & 1 & 0 & -0.83 & 0 \\ 0 & 0 & 1 & -3.2 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The fourth variable i.e, T is free here  
 $\rightarrow$  Forming Equations:

$$M = +1.33T$$

$$L = +0.83T$$

$$E = +3.2T$$

To eliminate  $T$  we will put  $T = 100$ , which will also eliminate decimal points.

$$M = 1.33(100) = 133$$

$$L = 0.84(100) = 84$$

$$E = 3.16(100) = 316$$

$$T = 100.$$

prices are : (133, 84, 316, 100).

~~Q no.5)~~

Sol :

Output

(a) Ag	M	S	T	Input
--------	---	---	---	-------

0.2	0.35	0.1	0.2	Ag
0.2	0.1	0.2	0.3	m
0.3	0.35	0.5	0.2	S
0.3	0.2	0.2	0.3	T

(b)

$$0.2 \text{ Ag} + 0.35 \text{ m} + 0.1 \text{ S} + 0.2 \text{ T} = \text{Ag}$$

$$0.2 \text{ Ag} + 0.1 \text{ m} + 0.2 \text{ S} + 0.3 \text{ T} = \text{m}$$

$$0.3 \text{ Ag} + 0.35 \text{ m} + 0.5 \text{ S} + 0.2 \text{ T} = \text{S}$$

$$0.3 \text{ Ag} + 0.2 \text{ m} + 0.2 \text{ S} + 0.3 \text{ T} = \text{T}$$

Finally  
BingO!

day/date

$$-0.8Ag + 0.35M + 0.1S + 0.2T = 0 \rightarrow (i)$$

$$0.2Ag - 0.9M + 0.2S + 0.3T = 0 \rightarrow (ii)$$

$$0.3Ag + 0.35M - 0.5S + 0.2T = 0 \rightarrow (iii)$$

$$0.3Ag + 0.2M + 0.2S - 0.7T = 0 \rightarrow (iv)$$

The augmented Matrix is :

$$= \begin{bmatrix} -0.8 & 0.35 & 0.1 & 0.2 & 0 \\ 0.2 & -0.9 & 0.2 & 0.3 & 0 \\ 0.3 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$\rightarrow R_1 \div (-0.8)$ .

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0.2 & -0.9 & 0.2 & 0.3 & 0 \\ 0.3 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_2 - 0.2R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & -0.81 & 0.225 & 0.35 & 0 \\ 0.3 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.3R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & -0.81 & 0.225 & 0.35 & 0 \\ 0 & 0.48 & -0.46 & 0.27 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

/date

$$\rightarrow R_4 - 0.3R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & 0.225 & 0.35 & 0 \\ 0 & 0.48 & -0.46 & 0.27 & 0 \\ 0 & 0.33 & 0.24 & -0.625 & 0 \end{bmatrix}$$

$$\rightarrow R_2 \div (-0.81)$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.278 & -0.43 & 0 \\ 0 & 0.48 & -0.46 & 0.27 & 0 \\ 0 & 0.33 & 0.24 & -0.625 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.48R_2$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.278 & -0.43 & 0 \\ 0 & 0 & -0.33 & 0.47 & 0 \\ 0 & 0.33 & 0.24 & -0.625 & 0 \end{bmatrix}$$

$$\rightarrow R_4 - 0.33R_2$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.278 & -0.43 & 0 \\ 0 & 0 & -0.33 & 0.48 & 0 \\ 0 & 0 & 0.33 & -0.48 & 0 \end{bmatrix}$$

$$\rightarrow R_1 + 0.437R_2$$

$$= \begin{bmatrix} 1 & 0 & -0.246 & -0.4 & 0 \\ 0 & 1 & -0.218 & -0.43 & 0 \\ 0 & 0 & -0.33 & 0.48 & 0 \\ 0 & 0 & 0.33 & -0.48 & 0 \end{bmatrix}$$

day/date

$$\rightarrow R_4 + R_3$$

$$= \begin{bmatrix} 1 & 0 & -0.246 & -0.4 & 0 \\ 0 & 1 & -0.278 & -0.43 & 0 \\ 0 & 0 & -0.33 & 0.47 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_3 \div (-0.33)$$

$$= \begin{bmatrix} 1 & 0 & -0.246 & -0.4 & 0 \\ 0 & 1 & -0.278 & -0.43 & 0 \\ 0 & 0 & 1 & -1.4 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_2 + 0.278R_3$$

$$= \begin{bmatrix} 1 & 0 & -0.246 & -0.4 & 0 \\ 0 & 1 & 0 & -0.82 & 0 \\ 0 & 0 & 1 & -1.4 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_1 + 0.246R_3$$

$$= \begin{bmatrix} 1 & 0 & 0 & -0.74 & 0 \\ 0 & 1 & 0 & -0.82 & 0 \\ 0 & 0 & 1 & -1.4 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(XPrices can never be negative X)

$$Ag = +0.74T$$

$$m = +0.82T$$

$$S = -1.4T$$

T is ~~free~~ free here.

Value of Transportation is 10\$.

$$Ag = (0.74)(10\$) = 7.4\$\phantom{0}$$

$$m = (0.82)(10\$) = 8.2\$\phantom{0}$$

$$S = (1.4)(10\$) = 14\$\phantom{0}$$

Set of equilibrium :

$$(\$7.4, \$8.2, \$14, \$10).$$

(c) (new economy).

Ag	m	S	T	Input
----	---	---	---	-------

0.2	0.35	0.1	0.2	Ag
-----	------	-----	-----	----

0.1	0.1	0.2	0.3	m
-----	-----	-----	-----	---

0.4	0.35	0.5	0.2	S
-----	------	-----	-----	---

0.3	0.2	0.2	0.3	T
-----	-----	-----	-----	---

(d)

$$[0.2Ag + 0.35m + 0.1S + 0.2T = Ag \rightarrow (i)]$$

$$[0.1Ag + 0.1m + 0.2S + 0.3T = m \rightarrow (ii)]$$

$$[0.4Ag + 0.35S + 0.5S + 0.2T = S \rightarrow (iii)]$$

$$[0.3Ag + 0.2m + 0.2S + 0.3T = T \rightarrow (iv)]$$

$$-0.8Ag + 0.35m + 0.1S + 0.2T = 0$$

$$0.1Ag - 0.9m + 0.2S + 0.3T = 0$$

$$0.4Ag + 0.35m - 0.5S + 0.2T = 0$$

$$0.3Ag + 0.2m + 0.2m - 0.7T = 0$$

Finally  
Bingo!

day/date

Augmented matrix is :

$$= \begin{bmatrix} -0.8 & 0.35 & 0.1 & 0.2 & 0 \\ 0.1 & -0.9 & 0.2 & 0.3 & 0 \\ 0.4 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_1 \div (-0.8)$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0.1 & -0.9 & 0.2 & 0.3 & 0 \\ 0.4 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_2 - 0.1R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & -0.85 & 0.21 & 0.32 & 0 \\ 0.4 & 0.35 & -0.5 & 0.2 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.4R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & -0.85 & 0.21 & 0.32 & 0 \\ 0 & 0.52 & -0.45 & 0.3 & 0 \\ 0.3 & 0.2 & 0.2 & -0.7 & 0 \end{bmatrix}$$

$$\rightarrow R_4 - 0.3R_1$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & -0.85 & 0.21 & 0.32 & 0 \\ 0 & 0.52 & -0.45 & 0.3 & 0 \\ 0 & 0.33 & 0.24 & -0.62 & 0 \end{bmatrix}$$

day/date

$$\rightarrow R_2 \div (-0.85)$$
$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0.52 & -0.45 & 0.3 & 0 \\ 0 & 0.33 & 0.24 & -0.62 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 0.52R_2$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0 & -0.325 & 0.49 & 0 \\ 0 & 0.33 & 0.24 & -0.62 & 0 \end{bmatrix}$$

$$\rightarrow R_4 - 0.33R_2$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0 & -0.325 & 0.49 & 0 \\ 0 & 0 & 0.32 & -0.49 & 0 \end{bmatrix}$$

$$\rightarrow R_4 + R_3$$

$$= \begin{bmatrix} 1 & -0.437 & -0.125 & -0.25 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0 & -0.325 & 0.49 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_1 + 0.437R_2$$

$$= \begin{bmatrix} 1 & 0 & -0.229 & -0.41 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0 & -0.325 & 0.49 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_3 \div (-0.325)$$

day/date

$$= \begin{bmatrix} 1 & 0 & -0.229 & -0.41 & 0 \\ 0 & 1 & -0.24 & -0.37 & 0 \\ 0 & 0 & 1 & -1.5 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\rightarrow R_2 + 0.24R_3 \Leftrightarrow R_1 + 0.229R_3.$$

$$= \begin{bmatrix} 1 & 0 & +0 & -0.75 & 0 \\ 0 & 1 & 0 & -0.73 & 0 \\ 0 & 0 & 1 & -1.51 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

T is free here.

$$Ag = 0.75T$$

$$m = 0.7T$$

$$S = 1.5T$$

value of T is \$ 10.

$$Ag = 7.5\$\text{}$$

$$m = 7.3\$\text{}$$

$$S = 15.01\$\text{.}$$

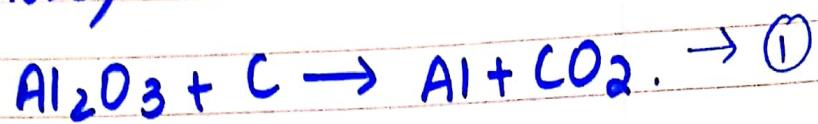
$$T = 10\$\text{.}$$

The equilibrium prices slightly decreased due to campaign.

Services sector is benefited due to this campaign as its price has increased.

day/date

Q no. 6)



$$\text{Al}_2\text{O}_3 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix} \quad \begin{bmatrix} \text{Al} \\ \text{O} \\ \text{C} \end{bmatrix}$$

$$\text{C} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$\text{Al} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$$\text{CO}_2 = \begin{bmatrix} 0 \\ 2 \\ 1 \end{bmatrix}$$

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

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

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

Finally  
Bingo!

Augmented matrix is ;

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

$$\rightarrow R_1 \div 2$$

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

$$\rightarrow R_2 - 3R_1$$

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

$$\rightarrow R_2 \leftrightarrow R_3$$

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

$$\rightarrow R_3 \times \frac{2}{3}$$

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

$$\rightarrow R_1 + \frac{1}{2}R_3$$

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

day/date

$$x_1 = \frac{2}{3} x_4$$

$$x_2 = x_4$$

$$x_3 = \frac{4}{3} x_4$$

To eliminate fractions, we will  
put  $x_4 = 3$ .

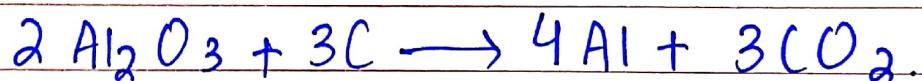
$$x_1 = \frac{2}{3} (3) = 2$$

$$x_2 = 3$$

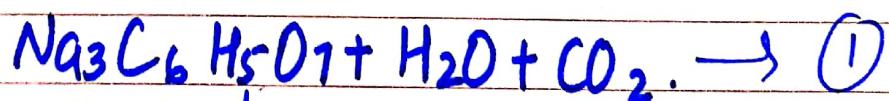
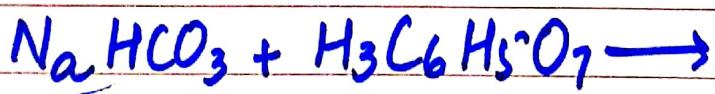
$$x_3 = \frac{4}{3} (3) = 4$$

$$x_4 = 3.$$

Now eq. ① can be written as;



Q no. 7)



Elements involved :

Na  
H  
C  
O

BingO! Finally

day/date

$$\text{NaHCO}_3 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 3 \end{bmatrix}, \text{H}_3\text{C}_6\text{H}_5\text{O}_7 = \begin{bmatrix} 3 \\ 3+5=8 \\ 6 \\ 7 \end{bmatrix}$$

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

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

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

$$x_1 - 3x_3 = 0$$

$$x_1 + 8x_2 - 5x_3 - 2x_4 = 0$$

$$x_1 + 6x_2 - 6x_3 - x_5 = 0$$

$$3x_1 + 7x_2 - 7x_3 - x_4 - 2x_5 = 0.$$

The augmented matrix is ;

$$= \left[ \begin{array}{ccccc|c} 1 & 0 & -3 & 0 & 0 & 0 \\ 1 & 8 & -5 & -2 & 0 & 0 \\ 1 & 6 & -6 & 0 & -1 & 0 \\ 3 & 7 & -7 & -1 & -2 & 0 \end{array} \right]$$

Finally  
Bingo!

day/date

$$\rightarrow R_2 - R_1$$

$$\rightarrow R_3 - R_1$$

$$\rightarrow R_4 - 3R_1$$

$$= \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 8 & -2 & -2 & 0 & 0 \\ 0 & 6 & -3 & 0 & -1 & 0 \\ 0 & 7 & 2 & -1 & -2 & 0 \end{bmatrix}$$

$$\rightarrow R_2 \div 8.$$

$$= \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -0.25 & -0.25 & 0 & 0 \\ 0 & 6 & -3 & 0 & -1 & 0 \\ 0 & 7 & 2 & -1 & -2 & 0 \end{bmatrix}$$

$$\rightarrow R_3 - 6R_2$$

$$\rightarrow R_4 - 7R_2$$

$$= \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -0.25 & -0.25 & 0 & 0 \\ 0 & 0 & -1.5 & +1.5 & -1 & 0 \\ 0 & 0 & 3.75 & -0.75 & -2 & 0 \end{bmatrix}$$

$$\rightarrow R_3 \div (-1.5)$$

$$= \begin{bmatrix} 1 & 0 & -3 & 0 & 0 & 0 \\ 0 & 1 & -0.25 & -0.25 & 0 & 0 \\ 0 & 0 & 1 & -1 & 0.67 & 0 \\ 0 & 0 & 3.75 & 0.75 & -2 & 0 \end{bmatrix}$$

Bingo!

day/date

$$\rightarrow R_4 - 3 \cdot 75 R_3$$

$$\rightarrow R_2 + 0.25 R_3$$

$$\rightarrow R_1 + 3R_3.$$

$$= \begin{bmatrix} 1 & 0 & 0 & -3 & 2.0 & 0 \\ 0 & 1 & 0 & -0.5 & 0.167 & 0 \\ 0 & 0 & 1 & -1 & 0.67 & 0 \\ 0 & 0 & 0 & 4.5 & -4.5 & 0 \end{bmatrix}$$

$$\rightarrow R_4 \div 4.5$$

$$= \begin{bmatrix} 1 & 0 & 0 & -3 & 2 & 0 \\ 0 & 1 & 0 & -0.5 & 0.167 & 0 \\ 0 & 0 & 1 & -1 & 0.67 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix}$$

$$\rightarrow R_3 + R_4$$

$$\rightarrow R_2 + 0.5R_4$$

$$\rightarrow R_1 + 3R_1$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 & -0.33 & 0 \\ 0 & 0 & 1 & 0 & -0.33 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 \end{bmatrix}$$

$$x_1 = x_5$$

$$x_2 = 0.33x_5$$

$$x_3 = 0.33x_5$$

$$x_4 = x_5.$$

✓ date

In fraction form ;

$$x_1 = \frac{x_5}{x_5}$$

$$x_2 = \frac{1}{3} x_5$$

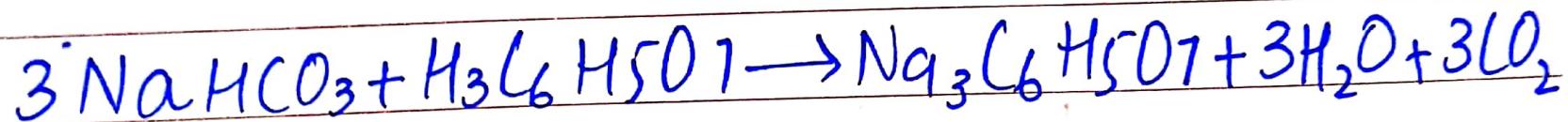
$$x_3 = \frac{1}{3} x_5$$

$$x_4 = x_5$$

put  $x_5 = 3$  to eliminate fractions.

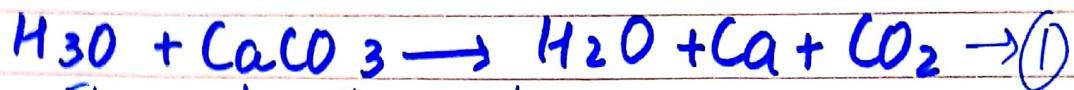
$$x_1 = 3, x_2 = 1, x_3 = 1, x_4 = 3, x_5 = 3$$

Eq ① now becomes ;



day/date

(Q no. 8)



Elements involved :

$$= \begin{bmatrix} Ca \\ C \\ O \\ H \end{bmatrix}$$

$$H_3O : \begin{bmatrix} 0 \\ 0 \\ 1 \\ 3 \end{bmatrix}, CaCO_3 = \begin{bmatrix} 1 \\ 1 \\ 3 \\ 0 \end{bmatrix}, H_2O = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 2 \end{bmatrix}$$

$$Ca : \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, CO_2 : \begin{bmatrix} 0 \\ 1 \\ 2 \\ 0 \end{bmatrix}$$

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

$$x_1 \begin{bmatrix} 0 \\ 0 \\ 1 \\ 3 \end{bmatrix} + x_2 \begin{bmatrix} 1 \\ 1 \\ 3 \\ 0 \end{bmatrix} + x_3 \begin{bmatrix} 0 \\ 0 \\ -1 \\ -2 \end{bmatrix} + x_4 \begin{bmatrix} -1 \\ 0 \\ 0 \\ 0 \end{bmatrix} + x_5 \begin{bmatrix} 0 \\ -1 \\ -2 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

day/date

## Augmented Matrix :

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

$$\rightarrow R_1 \longleftrightarrow R_3$$

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

$$\rightarrow R_4 - 3R_1$$

$$\rightarrow R_3 - R_2$$

$$= \begin{bmatrix} 1 & 3 & -1 & 0 & -2 & 0 \\ 0 & 1 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & -9 & 1 & 0 & 6 & 0 \end{bmatrix}$$

$$\rightarrow R_4 + 9R_2$$

$$\rightarrow R_1 - 3R_2$$

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

day/date

$\rightarrow R_3 \leftrightarrow R_4$

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

$\rightarrow R_1 + R_3$

$\rightarrow R_4 \div -1$

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

$$x_1 = 2x_5$$

$$x_2 = x_5$$

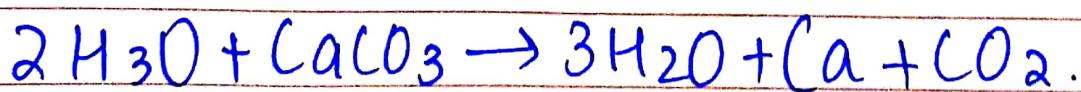
$$x_3 = 3x_5$$

$$x_4 = x_5.$$

put  $x_5 = 1$ .

$$x_1 = 2, x_2 = 1, x_3 = 3, x_4 = 1, x_5 = 1.$$

put in eq ①.



ite

Q no. 9)



Elements involved :

$$= \begin{bmatrix} B \\ S \\ H \\ O \end{bmatrix}$$

$$B_2S_3 : \begin{bmatrix} 2 \\ 3 \\ 0 \\ 0 \end{bmatrix}, H_2O : \begin{bmatrix} 0 \\ 0 \\ 2 \\ 1 \end{bmatrix}$$

$$H_3BO_3 : \begin{bmatrix} 1 \\ 0 \\ 3 \\ 3 \end{bmatrix}, H_2S : \begin{bmatrix} 0 \\ 1 \\ 2 \\ 0 \end{bmatrix}$$

$$\chi_1 \begin{bmatrix} 2 \\ 3 \\ 0 \\ 0 \end{bmatrix} + \chi_2 \begin{bmatrix} 0 \\ 0 \\ 2 \\ 1 \end{bmatrix} = \chi_3 \begin{bmatrix} 1 \\ 0 \\ 3 \\ 3 \end{bmatrix} + \chi_4 \begin{bmatrix} 0 \\ 1 \\ 2 \\ 0 \end{bmatrix}$$

$$\chi_1 \begin{bmatrix} 2 \\ 3 \\ 0 \\ 0 \end{bmatrix} + \chi_2 \begin{bmatrix} 0 \\ 0 \\ 2 \\ 1 \end{bmatrix} + \chi_3 \begin{bmatrix} -1 \\ 0 \\ -3 \\ -3 \end{bmatrix} + \chi_4 \begin{bmatrix} 0 \\ -1 \\ -2 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

day/date

## Augmented Matrix :

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

$$\rightarrow R_1 \div 2.$$

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

$$\rightarrow R_2 - 3R_1$$

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

$$\rightarrow R_2 + R_4.$$

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

$$\rightarrow R_3 - 2R_2$$

$$\rightarrow R_4 - R_2$$

lay/date

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

$\rightarrow R_3 \leftrightarrow R_4$

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

$\rightarrow R_3 \times \left(-\frac{2}{3}\right)$

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

$\rightarrow R_2 + \frac{3}{2} R_3$

$\rightarrow R_1 + \frac{1}{2} R_3$

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

Bingo! Finally

day/date

## Forming Equations:

$$x_1 = \frac{1}{3}x_4$$

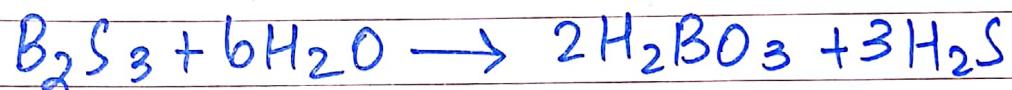
$$x_2 = 2x_4$$

$$x_3 = \frac{2}{3}x_4$$

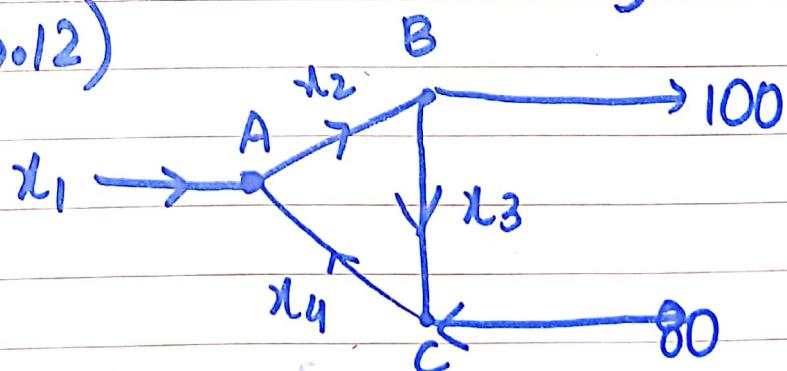
To Eliminate fractions, put  $x_4 = 3$ .

$$x_1 = 1, x_2 = 6, x_3 = 2, x_4 = 3$$

Eq. ① becomes :



$\left. \begin{array}{l} Q_{n0.10} \\ (\text{Same as } Q: 6, 7, 8, 9) \end{array} \right]$   
 $Q_{n0.11}$   
 $Q_{n0.12}$



Intersections	In-flow	Out-flow
A	$x_1 + x_4$	$x_2$
B	$x_2$	$x_3 + 100$
C	$x_3 + 80$	$x_4$

Finally Bing

day/date

## Forming Equations:

$$\rightarrow x_1 + x_4 = x_2$$

$$x_2 = 100 + x_3$$

$$\therefore x_3 + 80 = x_4.$$

$$\rightarrow x_1 - x_2 + x_4 = 0$$

$$x_2 - x_3 = 100$$

$$x_3 - x_4 = -80$$

## Augmented Matrix:

$$\left[ \begin{array}{cccc|c} 1 & -1 & 0 & 1 & 0 \\ 0 & 1 & -1 & 0 & 100 \\ 0 & 0 & 1 & -1 & -80 \end{array} \right]$$

$$\rightarrow R_1 + R_2.$$

$$= \left[ \begin{array}{cccc|c} 1 & 0 & -1 & 1 & 100 \\ 0 & 1 & -1 & 0 & 100 \\ 0 & 0 & 1 & -1 & -80 \end{array} \right]$$

$$\rightarrow R_2 + R_3$$

$$\rightarrow R_1 + R_3$$

$$= \left[ \begin{array}{cccc|c} 1 & 0 & 0 & 0 & 20 \\ 0 & 1 & 0 & -1 & 20 \\ 0 & 0 & 1 & -1 & -80 \end{array} \right]$$

day/date

$$\rightarrow x_1 = 20$$

$$\rightarrow x_2 - x_4 = 20$$

$$\rightarrow x_3 - x_4 = -80$$

$x_4$  is free variable

$$\rightarrow x_1 = 20$$

$$\rightarrow x_2 = 20 + x_4$$

$$\rightarrow x_3 = -80 + x_4.$$

(negative)

$\rightarrow x_3$  must not be negative. which is possible if and only if  $x_4$  is greater than 80 or equal to 80.  
i.e.,  $x_3 \geq 0$   
only when  $x_4 \geq 80$ .

Result:

$$x_4 \geq 80.$$

Q no. 13)  
(a)

Intersections	In-flow	Out-flow
A	$x_2 + 30$	$x_1 + 80$
B	$x_3 + x_5$	$x_2 + x_4$
C	$x_6 + 100$	$x_5 + 40$
D	$x_4 + 40$	$x_6 + 90$
E	$x_1 + 60$	$x_3 + 20.$

day/date

Equations become :

$$\rightarrow x_1 - x_2 = -50$$

$$\rightarrow x_2 - x_3 + x_4 - x_5 = 0$$

$$\rightarrow x_5 - x_6 = 60$$

$$\rightarrow x_4 - x_6 = 50$$

$$\rightarrow x_1 - x_3 = -40$$

→ The augmented matrix is :

$$\left[ \begin{array}{cccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & -50 \\ 0 & 1 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & -1 & 1 & 1 & 40 \end{array} \right]$$

$$\hookrightarrow = \left[ \begin{array}{cccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & -50 \\ 0 & 1 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 1 & 0 & -1 & 0 & 0 & 0 & -40 \end{array} \right]$$

→  $R_5 - R_1$

$$\left[ \begin{array}{cccccc|c} 1 & -1 & 0 & 0 & 0 & 0 & -50 \\ 0 & 1 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 1 & -1 & 0 & 0 & 0 & 10 \end{array} \right]$$

Bingo!

day/date

$$\rightarrow R_1 + R_2$$

$$\rightarrow R_5 - R_2$$

$$:= \begin{bmatrix} 1 & 0 & -1 & 1 & -1 & 0 & -50 \\ 0 & 1 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & -1 & 1 & 0 & 10 \end{bmatrix}$$

~~swapping~~

$$\therefore \rightarrow R_3 \leftrightarrow R_4$$

$$= \begin{bmatrix} 1 & 0 & -1 & 1 & -1 & 0 & -50 \\ 0 & 1 & -1 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & 0 & 1 & -1 & 50 \\ 0 & 0 & 0 & -1 & 1 & 0 & 10 \end{bmatrix}$$

$$\rightarrow R_5 + R_3$$

$$\rightarrow R_2 - R_3$$

$$\rightarrow R_1 - R_3$$

$$= \begin{bmatrix} 1 & 0 & -1 & 0 & -1 & 1 & -100 \\ 0 & 1 & -1 & 0 & -1 & 1 & -50 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \end{bmatrix}$$

Finally  
Bina

$\rightarrow R_4 - R_5$

$$= \begin{bmatrix} 1 & 0 & -1 & 0 & -1 & 1 & -100 \\ 0 & 1 & -1 & 0 & -1 & 1 & -50 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$\rightarrow R_2 + R_4$

$\rightarrow R_1 + R_4$ .

$$= \begin{bmatrix} 1 & 0 & -1 & 0 & 0 & 0 & -40 \\ 0 & 1 & -1 & 0 & 0 & 0 & 10 \\ 0 & 0 & 0 & 1 & 0 & -1 & 50 \\ 0 & 0 & 0 & 0 & 1 & -1 & 60 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

day/date

## Forming Equations :

$$x_1 = -40 + x_3$$

$$x_2 = 10 + x_3$$

$$x_4 = 50 + x_6$$

$$x_5 = 60 + x_6$$

Here  $x_3$  and  $x_6$  are free variables.

(b) While choosing minimum values all variables should remain non-negative.

For example;

Minimum value of  $x_3$  should be 40 to make  $x_1$  positive

Similarly, a value

minimum of  $x_6$  should be zero to remain  $x_4$  and  $x_5$

positive then by putting  $x_6 = 0$

and  $x_3 = 40$ , above equations becomes;

$$x_1 = 0, \quad x_6 = 0$$

$$x_2 = 50$$

$$x_4 = 50$$

$$x_5 = 60$$

$$x_3 = 40$$

Finally  
Bingo!