Work sheet week 7

fredag 16. februar 2018 12:09

C.1

We can set up one linear equation for each of the elements in the reaction with coefficients as variables:

$x\ NaHCO_3 + y\ C_6H_8O_7 \rightarrow z\ Na_3C_6H_5O_7 + v\ H_2O + w\ CO_2$

Na:

$x = 3z$

H:

$x + 8y = 5z + 2v$

C:

$x + 6y = 6z + w$

O:

$3x + 7y = 7z + v + 2w$

$x - 3z = 0$
$x + 8y - 5z - 2v = 0$
$x + 6y - 6z - w = 0$
$3x + 7y - 7z - v - 2w = 0$

Matrix notation:

$$\begin{bmatrix} 1 & 0 & -3 & 0 & 0 \\ 1 & 8 & -5 & -2 & 0 \\ 1 & 6 & -6 & 0 & -1 \\ 3 & 7 & -7 & -1 & -2 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 & -\frac{1}{3} \\ 0 & 0 & 1 & 0 & -\frac{1}{3} \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix} \rightarrow \begin{pmatrix} x \\ y \\ z \\ v \\ w \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} + w \begin{pmatrix} 1 \\ \frac{1}{3} \\ \frac{1}{3} \\ 1 \end{pmatrix}$$

w=3 gives whole numbers:

$$\begin{pmatrix} x \\ y \\ z \\ v \\ w \end{pmatrix} = \begin{pmatrix} 3 \\ 1 \\ 1 \\ 3 \\ 3 \end{pmatrix}$$

Which gives:

$3\ NaHCO_3 + 1\ C_6H_8O_7 \rightarrow 1\ Na_3C_6H_5O_7 + 3\ H_2O + 3\ CO_2$

C.2

We can make an equation for each node in the network:

A:

$x_1 + x_3 = 20$

B:

$x_2 = x_3 + x_4$

C:
$x_1 + x_2 = 80$

Matrix notation:

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 20 \\ 0 & 1 & -1 & -1 & 0 \\ 1 & 1 & 0 & 0 & 80 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 1 & 0 & 20 \\ 0 & 1 & -1 & 0 & 60 \\ 0 & 0 & 0 & 1 & 60 \end{bmatrix}$$

So $x_4 = 60$
And
$x_1 = 20 - x_3$
$x_2 = 60 + x_3$

None of the flows can be negative, so the larges x_3 can be for x_1 to not be negative is $x_3 \leq 20$