Problem-9

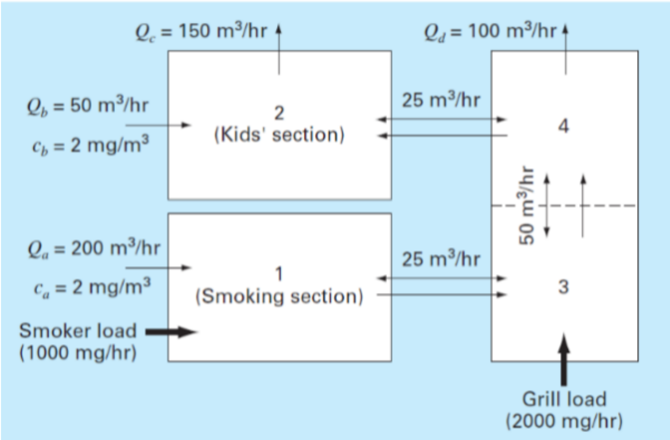

Fig-1

Calculations

$$
\begin{aligned}
W_{smoker} + Q_a(c_a - c_1) + E_{13}(c_3 - c_1) = 0 \\
W_{grill} + E_{13}(c_1 - c_3) + E_{34}(c_4 - c_3) = 0 \\
Q_d c_4 + E_{24}(c_4 - c_2) + E_{34}(c_4 - c_3) = 0 \\
Q_b(c_b - c_2) - Q_c c_2 + E_{24}(c_4 - c_2) = 0
\end{aligned} \tag{1}
$$

$$
\begin{aligned}
96 - 8c_1 + (c_3 - c_1) = 0 \Rightarrow 9c_1 - c_3 = 96 \\
80 + (c_1 - c_3) + 2(c_4 - c_3) = 0 \Rightarrow c_1 - 3c_3 + 2c_4 = -80 \\
4c_4 + (c_4 - c_2) + 2(c_4 - c_3) = 0 \Rightarrow c_2 + 2c_3 - 7c_4 = 0 \\
2(2 - c_2) - 6c_2 + (c_4 - c_2) = 0 \Rightarrow 9c_2 - c_4 = 4
\end{aligned} \tag{2}
$$

$$
\begin{bmatrix} 9 & 0 & -1 & 0 \\ 1 & 0 & -3 & 2 \\ 0 & 1 & 2 & -7 \\ 0 & 9 & 0 & -1 \end{bmatrix} \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{bmatrix} = \begin{bmatrix} 96 \\ -80 \\ 0 \\ 4 \end{bmatrix} \tag{3}
$$

⚠️ While doing the pivoting for Gauss elimination, I applied the same to Gauss Seidel as well to ensure convergence (My pivoting algorithm makes diagonal elements dominant)

The Output

Figure 2 reperesent the output. About the figure:

X1 → Output Through Gauss Elimination
X2 → Output Through Gauss Seidel
Check(:,1) → A*X1
Check(:,2) → A*X2
Check(:,3) → B

Second Part

The best way to proceed for this part is to form three independent sets of B with only one of the three smokers being non-zero. And compute the concentration for each of them.

```
>> [X1, X2] = T9_20110065

check =

   96.0000   95.9887   96.0000
  -69.3333   79.9391  -80.0000
   55.8291    0.0242         0
    4.0000    4.0258    4.0000


X1 =

   13.7436
    0.4444
   27.6923
         0


X2 =

    7.3367
   -0.5123
  -29.9582
   -8.6361
```

Fig-2