(Ex) let $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 1K$

$V_{B1} = 10 \qquad V_{B2} = 5$

$$\begin{bmatrix} 2 & -1 & 0 & -1 \\ -1 & 3 & -1 & -1 \\ 0 & -1 & 2 & -1 \\ -1 & -1 & -1 & 4 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ -5 \\ 0 \end{bmatrix}$$

$$A\bar{x} = \bar{b}$$

$$\bar{x} = A^{-1}\bar{b}$$

$$\bar{x} = \begin{bmatrix} 10.625 \\ 6.25 \\ 3.125 \\ 5 \end{bmatrix} mA$$

Note: Relationship between Nodal current i_1 and mesh (loop) current i_1.

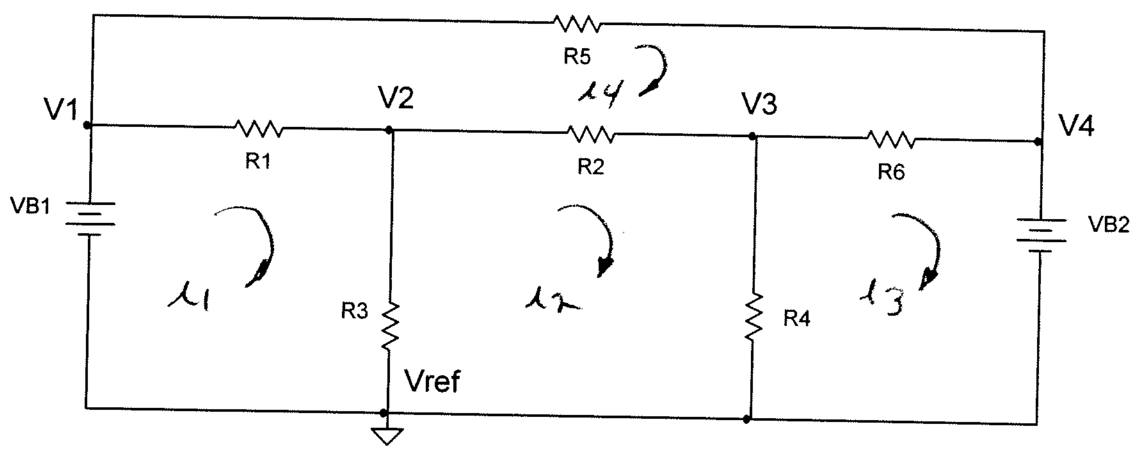
$$i_1(\text{Nodal}) = i_1(\text{mesh}) - i_4(\text{mesh})$$

$$i_1(\text{Nodal}) = \frac{V_{B1} - V_2}{R_1} = \frac{10 - 4.375}{1K} = 5.625\,mA$$ ✓

$$i_1(\text{mesh}) - i_4(\text{mesh}) = 10.625 - 5 = 5.625\,mA$$

Obviously, it's easier to solve the circuit using nodal analysis (using KCL) vs. the mesh method, since we only had two unknowns vs four unknowns.

See if you can verify the other mesh currents using the results from the Nodal exam



MESH ANALYSIS METHOD – USING KVL

① ΣV @ Mesh 1 $\quad -V_{B1} + R_1(i_1 - i_4) + R_3(i_1 - i_2) = 0$

② ΣV @ Mesh 2 $\quad R_2(i_2 - i_4) + R_4(i_2 - i_3) + R_3(i_2 - i_1) = 0$

③ ΣV @ Mesh 3 $\quad R_6(i_3 - i_4) + V_{B2} + R_4(i_3 - i_2) = 0$

④ ΣV @ Mesh 4 $\quad R_5(i_4) + R_6(i_4 - i_3) + R_2(i_4 - i_2) + R_1(i_4 - i_1) = 0$

① $(R_1 + R_3)i_1 - R_3 i_2 + 0\, i_3 - R_1 i_4 = V_{B1}$

② $-R_3 i_1 + (R_2 + R_4 + R_3) i_2 - R_4 i_3 - R_2 i_4 = 0$

③ $0\, i_1 - R_4 i_2 + (R_6 + R_4) i_3 - R_6 i_4 = -V_{B2}$

④ $-R_1 i_1 - R_2 i_2 - R_6 i_3 + (R_5 + R_6 + R_2 + R_1) i_4 = 0$

$$\begin{bmatrix} R_1 + R_3 & -R_3 & 0 & -R_1 \\ -R_3 & (R_2 + R_4 + R_3) & -R_4 & -R_2 \\ 0 & -R_4 & (R_6 + R_4) & -R_6 \\ -R_1 & -R_2 & -R_6 & (R_5 + R_6 + R_2 + R_1) \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \end{bmatrix} = \begin{bmatrix} V_{B1} \\ 0 \\ -V_{B2} \\ 0 \end{bmatrix}$$