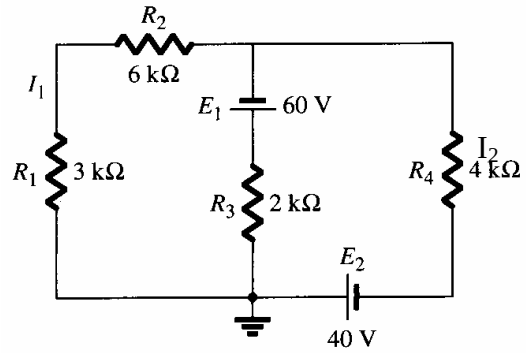
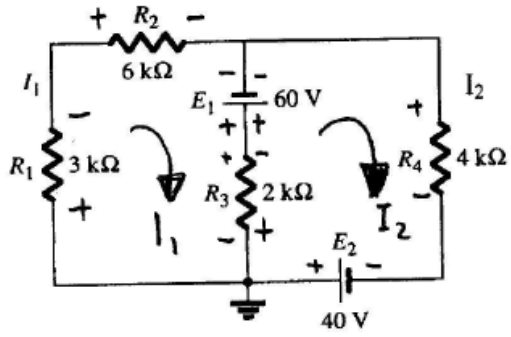
生機系電工學第四次隨堂練習 2011/03/16

學號：_____ 姓名：_____

Problem 1 （Mesh analysis）

Using mesh analysis to determine the current I_1 and I_2 for the network as shown.（建議把推算過程有秩序的交待清楚）





Mesh 1

$-I_1R_1-I_1R_2+E_1-(I_1-I_2)R_3=0$

Mesh 2

$-(I_2-I_1)R_3-E_1-I_2R_4+E_2=0$

$$\Rightarrow \begin{aligned} I_1(R_1+R_2+R_3)-I_2R_3&=E_1\\ -I_1R_3+I_2(R_3+R_4)&=E_2-E_1\end{aligned}$$

代入

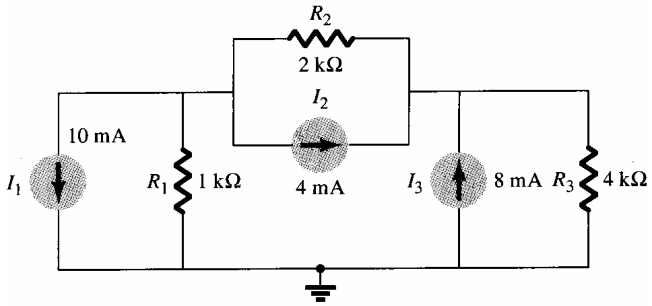
$$\begin{aligned} 11K\,I_1-2K\,I_2&=60\\ -2K\,I_1+6K\,I_2&=-20\end{aligned}$$

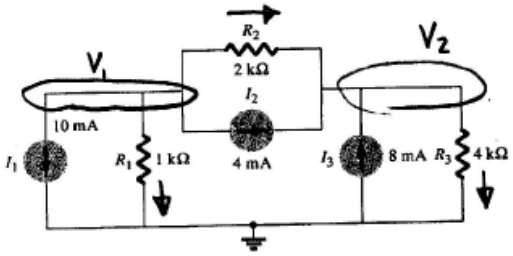
$$I_1=\frac{\begin{vmatrix}60 & -2K\\ -20 & 6K\end{vmatrix}}{\begin{vmatrix}11K & -2K\\ -2K & 6K\end{vmatrix}}=5.161\ mA$$

$$I_2=\frac{\begin{vmatrix}11K & 60\\ -2K & -20\end{vmatrix}}{\begin{vmatrix}11K & -2K\\ -2K & 6K\end{vmatrix}}=-1.613\ mA$$

Problem 2 （Nodal analysis）

1. Using nodal analysis to determine the nodal voltages for the network as shown.
2. Using the nodal voltages, determine the current (magnitude and direction) through each resistive element.（建議把推算過程有秩序的交待清楚）





Node 1: $-I_1 - \frac{V_1}{R_1} - I_2 - \frac{V_1 - V_2}{R_2} = 0$

Node 2: $\frac{V_1 - V_1}{R_2} + I_2 + I_3 - \frac{V_2}{R_3} = 0$

$$\Rightarrow -V_1\left(\frac{1}{R_1} + \frac{1}{R_2}\right) + V_2\left(\frac{1}{R_2}\right) = I_1 + I_2$$

$$V_1\left(\frac{1}{R_1}\right) + V_2\left(\frac{1}{R_2} + \frac{1}{R_3}\right) = I_2 + I_3$$

代入 $-1.5\,\text{mS}\,V_1 + 0.5\,\text{mS}\,V_2 = 14\,\text{mA}$

$-0.5\,\text{mS}\,V_1 + 0.75\,\text{mS}\,V_2 = 12\,\text{mA}$

解

$$V_1 = \frac{\begin{vmatrix} 14\,\text{mA} & 0.5\,\text{mS} \\ 12\,\text{mA} & 0.75\,\text{mS} \end{vmatrix}}{\begin{vmatrix} -1.5\,\text{mS} & 0.5\,\text{mS} \\ -0.5\,\text{mS} & 0.75\,\text{mS} \end{vmatrix}} = -5.143\,\text{V}$$

$$V_2 = \frac{\begin{vmatrix} -1.5\,\text{mS} & 14\,\text{mA} \\ -0.5\,\text{mS} & 12\,\text{mA} \end{vmatrix}}{\begin{vmatrix} -1.5\,\text{mS} & 0.5\,\text{mS} \\ -0.5\,\text{mS} & 0.75\,\text{mS} \end{vmatrix}} = 12.571\,\text{V}$$

流經 R_1 的電流 $= -5.143\,\text{mA}$ ↓ (或 $5.143\,\text{mA}$ ↑)

流經 R_2 的電流 $= -8.857\,\text{mA}$ → (或 $8.857\,\text{mA}$ ←)

流經 R_3 的電流 $= 3.143\,\text{mA}$ ↓

注意：數字與方向