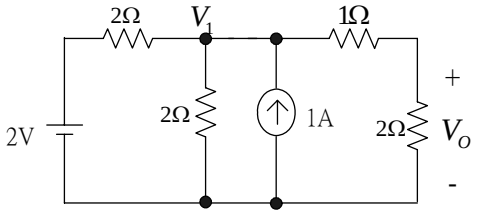
# 第二篇　節點分析 練習題解答

1. (C)




列出節點方程式

$$\begin{bmatrix} \frac{1}{2}+\frac{1}{2}+1 & -1 \\ -1 & 1+\frac{1}{2} \end{bmatrix}\begin{bmatrix} E_1 \\ V_o \end{bmatrix}=\begin{bmatrix} 1+1 \\ 0 \end{bmatrix}$$

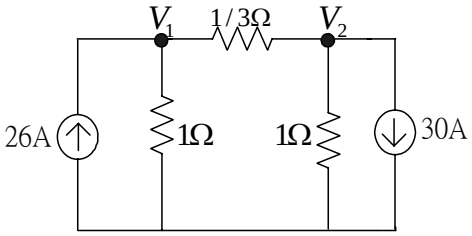
$$\begin{bmatrix} 2 & -1 \\ -1 & \frac{3}{2} \end{bmatrix}\begin{bmatrix} E_1 \\ V_o \end{bmatrix}=\begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

由克拉瑪法

則 $$V_o=\frac{\begin{vmatrix} 2 & 2 \\ -1 & 0 \end{vmatrix}}{\begin{vmatrix} 2 & -1 \\ -1 & \frac{3}{2} \end{vmatrix}}=1$$

2. (D)

由節點分析可得

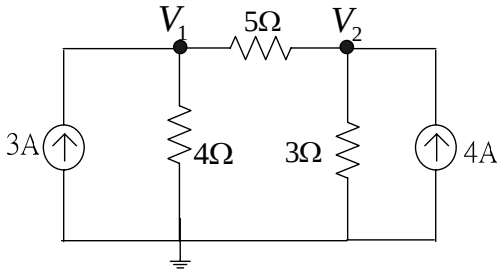



$$\begin{bmatrix} 1+3 & -3 \\ -3 & 1+3 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} 26 \\ -30 \end{bmatrix}$$

$$\begin{bmatrix} 4 & -3 \\ -3 & 4 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} 26 \\ -30 \end{bmatrix}$$

由克拉瑪法則 $$V_1=\frac{\begin{vmatrix} 26 & -3 \\ -30 & 4 \end{vmatrix}}{\begin{vmatrix} 4 & -3 \\ -3 & 4 \end{vmatrix}}=2 \qquad V_2=\frac{\begin{vmatrix} 4 & 26 \\ -3 & -30 \end{vmatrix}}{\begin{vmatrix} 4 & -3 \\ -3 & 4 \end{vmatrix}}=-6$$

3. (D)

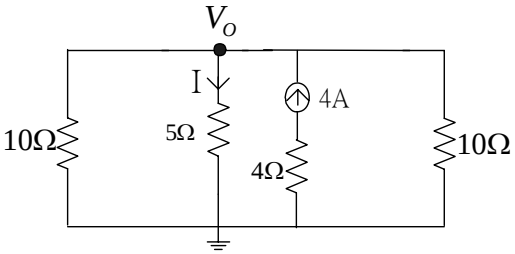



$$\begin{bmatrix} \frac{1}{4}+\frac{1}{5} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{1}{3}+\frac{1}{5} \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} -3 \\ 4 \end{bmatrix}$$

$$\begin{bmatrix} \frac{9}{20} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{8}{15} \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

$$V_1=\frac{\begin{vmatrix} 3 & -\frac{1}{5} \\ 4 & \frac{8}{15} \end{vmatrix}}{\begin{vmatrix} \frac{9}{20} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{8}{15} \end{vmatrix}}=\frac{\frac{12}{5}}{\frac{1}{5}}=12(\text{V})$$

4. (B)



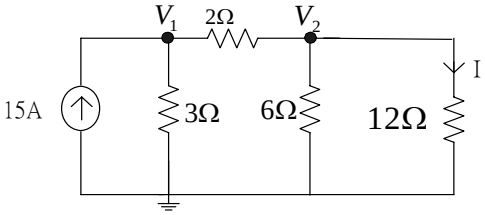

$$(\frac{1}{10}+\frac{1}{5}+\frac{1}{10})V_o=4$$

$$\frac{2}{5}V_o=4$$

$$V_o=10$$

$$I=\frac{V_o}{5}=2(\text{A})$$

5. (B)

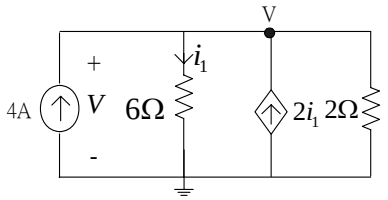



$$\begin{bmatrix} \frac{1}{3}+\frac{1}{2} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2}+\frac{1}{6}+\frac{1}{12} \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} 15 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} \frac{5}{6} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{3}{4} \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} 15 \\ 0 \end{bmatrix}$$

$$V_2=\frac{\begin{vmatrix} \frac{5}{6} & 15 \\ -\frac{1}{2} & 0 \end{vmatrix}}{\begin{vmatrix} \frac{5}{6} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{3}{4} \end{vmatrix}}=20\text{V} \quad , \quad I=\frac{V_2}{12}=1.67(\text{A})$$

6. (A)

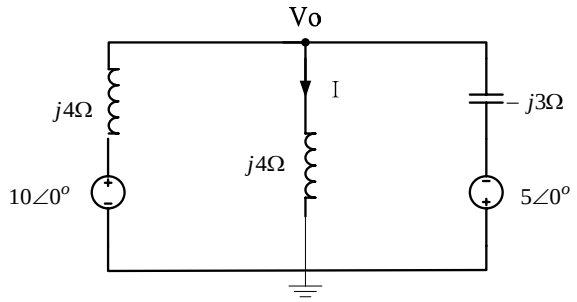



$$(\frac{1}{6}+\frac{1}{2})V=4+2i_1 \quad , \quad i_1=\frac{V}{6}$$

$$(\frac{1}{6}+\frac{1}{2})\text{V}=4+\frac{1}{3}\text{V}$$

$$\frac{1}{3}\text{V}=4 \quad , \quad \text{V}=12(\text{V})$$

7. (D)



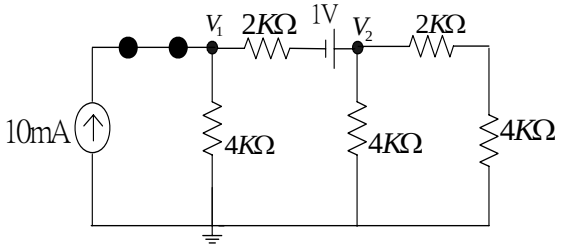

$$(\frac{1}{j4}+\frac{1}{j4}+\frac{1}{-j3})\text{V}_0=\frac{10\angle 0^0}{j4}-\frac{5\angle 0^0}{-j3}$$

$$\text{j}\frac{1}{6}\text{V}_0=-\text{j}\frac{25}{6}$$

$$\text{V}_0=25\angle 0^0$$

$$\text{I}=\frac{V_0}{j4}=\frac{25\angle 0^0}{4\angle 90^0}=6.25\angle -90^0$$

8. (D)




$$\begin{bmatrix}\frac{1}{2}+\frac{1}{4} & -\frac{1}{2}\\ -\frac{1}{2} & \frac{1}{2}+\frac{1}{4}+\frac{1}{6}\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}10-\frac{1}{2}\\ \frac{1}{2}\end{bmatrix}$$

$$\begin{bmatrix}\frac{3}{4} & -\frac{1}{2}\\ -\frac{1}{2} & \frac{11}{12}\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}\frac{19}{2}\\ \frac{1}{2}\end{bmatrix}$$

$$\text{V}_2=\frac{82}{7}(\text{V}) \qquad \text{V}_{AB}=\frac{4}{2+4}\times V_2=7.8(\text{V})$$

9. (C)

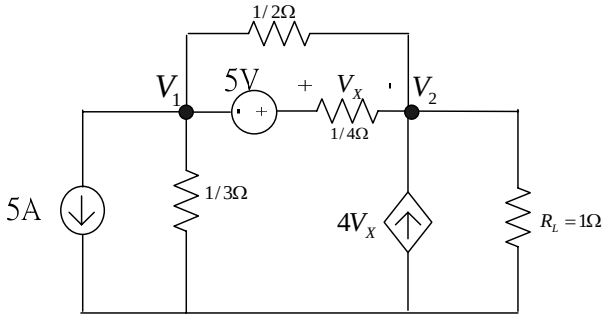
$$(\frac{1}{2}+\frac{1}{5}+\frac{1}{10})\text{V}_0=5+\frac{V_1}{5}$$

$$\frac{4}{5}\text{V}_0=5+\frac{V_1}{5}$$

欲 I=0　則 $\text{V}_0=10(\text{V})$

$$\frac{4}{5}\times 10=5+\frac{V_1}{5} \Rightarrow \text{V}_1=15(\text{V})$$

10. (A)




所須方程式：3-1=2

$$\begin{bmatrix} 3+2+4 & -2-4 \\ -2-4 & 2+4+1 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} -5-20 \\ 20+4V_X \end{bmatrix}$$

其中 $V_X = V_1 - V_2 + 5$

$$\begin{bmatrix} 9 & -6 \\ -6 & 7 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=\begin{bmatrix} -25 \\ 20+20+4V_1-4V_2 \end{bmatrix}$$

將變數移至左邊

$$\begin{bmatrix} 9 & -6 \\ -10 & 11 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}=2$$

由克拉瑪法則可得

$$V_2 = \frac{\begin{vmatrix} 9 & -25 \\ 10 & 40 \end{vmatrix}}{\begin{vmatrix} 9 & -6 \\ -10 & 11 \end{vmatrix}} = \frac{110}{39}$$

$$P_L = \frac{V_2^{\,2}}{R_1} = 7.96(\text{W})$$