1. (1) T

(2) T

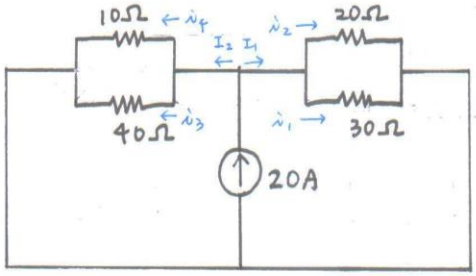
(3) T

(4) F ; Nodal analysis applies KCL to find unknown voltages.
Mesh analysis applies KVL to find unknown currents.

(5) F ; $P = IV$, $I = \frac{dq(t)}{dt} = 40\pi\cos(4\pi t)$

$p(t) = 40\pi\cos(4\pi t) \times 4\sin(4\pi t) = 80\pi\sin(8\pi t) \neq 40\sin^2(4\pi t)$.

2.



$V = IR$ ，電流和電阻成反比.

由分流定理，$\frac{I_1}{I_2} = \frac{R_2}{R_1} = \frac{10 // 40}{20 // 30} = \frac{2}{3}$

得 $I_1 = 20 \times \frac{2}{5} = 8(A)$, $I_2 = 20 \times \frac{3}{5} = 12(A)$

由分流定理，$\frac{i_1}{i_2} = \frac{20}{30}$ $\frac{i_3}{i_4} = \frac{10}{40}$

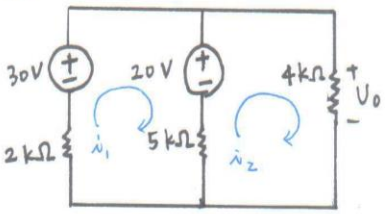
得 $i_1 = I_1 \times \frac{2}{5} = 3.2(A)$

$i_2 = I_1 \times \frac{3}{5} = 4.8(A)$

$i_3 = I_2 \times \frac{1}{5} = 2.4(A)$

$i_4 = I_2 \times \frac{4}{5} = 9.6(A)$ ※

3.



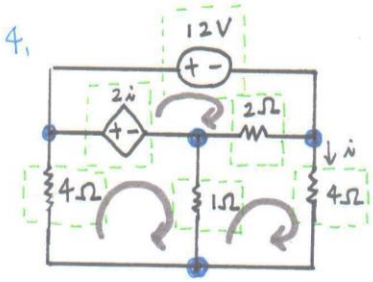
$$\begin{cases} 2i_1 - 30 + 20 + 5(i_1 - i_2) = 0 \\ 5(i_2 - i_1) - 20 + 4i_2 = 0 \end{cases}$$

整理得 $\begin{cases} 7i_1 - 5i_2 = 10 \\ -5i_1 + 9i_2 = 20 \end{cases}$

$\begin{cases} i_1 = 5\,(mA) \\ i_2 = 5\,(mA) \end{cases}$

$V_0 = i_2 \times 4 = 20(V)$ ※

4.



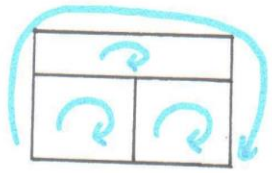
node : 4

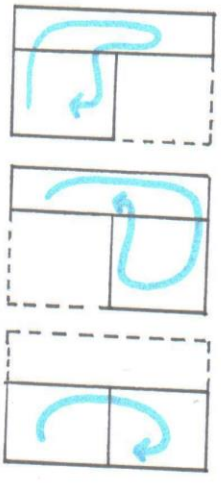
branch : 6

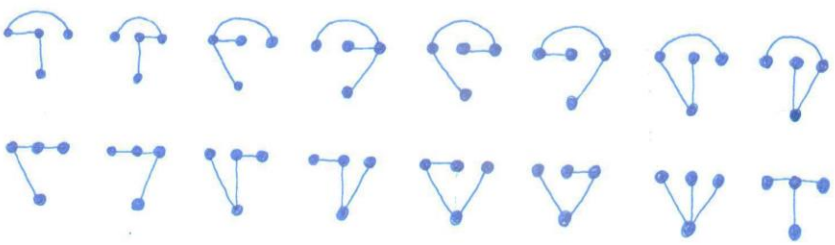
mesh : 3

loop : 7

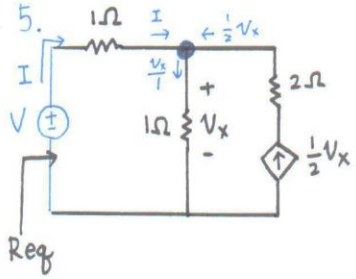
tree : 16 ($C_3^6 - 4 = 16$)







5.



在左側假設一電壓源 V.

$V = I \cdot R_{eq} \Rightarrow R_{eq} = \frac{V}{I}$

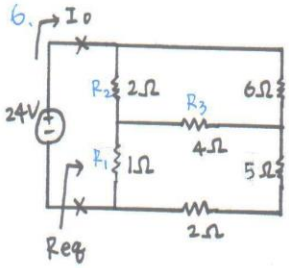
By KCL: $I + \frac{1}{2}V_x = \frac{V_x}{1}$

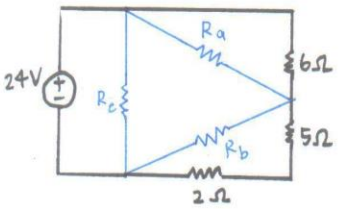
得 $I = \frac{1}{2}V_x$

$V = I \cdot 1 + V_x = \frac{3}{2}V_x$

得 $R_{eq} = \frac{\frac{3}{2}V_x}{\frac{1}{2}V_x} = 3\,(\Omega)$ ※

6.





$R_a = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_1} = \frac{2+4+8}{1} = 14$

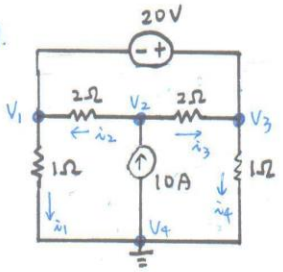
$R_b = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_2} = \frac{2+4+8}{2} = 7$

$R_c = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_3} = \frac{2+4+8}{4} = \frac{7}{2}$

$R_{eq} = R_c \,//\, [(R_a \,//\, 6) + (R_b \,//\, (5+2))] = \frac{7}{2} \,//\, [(\frac{21}{5}) + (\frac{7}{2})] = \frac{77}{32}\,(\Omega)$ ※

$I_0 = \frac{24}{R_{eq}} = \frac{768}{77}\,(A)$ ※

7.



By KVL:

V_2: $\frac{V_2 - V_1}{2} + \frac{V_2 - V_3}{2} = V_2 - \frac{1}{2}(V_1 + V_3) = 10$

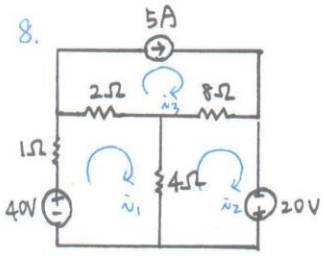
V_4: $\frac{V_1 - 0}{1} + \frac{V_3 - 0}{1} = V_1 + V_3 = 10$

且 $V_3 - V_1 = 20$

$\begin{cases} V_1 + V_3 = 10 \\ V_1 - V_3 = -20 \\ V_2 = 15 \end{cases}$

$\Rightarrow \begin{cases} V_1 = -5\,(V) \\ V_2 = 15\,(V) \\ V_3 = 15\,(V) \end{cases}$ ※

8.



mesh 1: $40 = i_1 + 2(i_1 - i_3) + 4(i_1 - i_2)$

mesh 2: $20 = 4(i_2 - i_1) + 8(i_2 - i_3)$

mesh 3: $i_3 = 5$

$\begin{cases} 7i_1 - 4i_2 = 50 \\ -4i_1 + 12i_2 = 60 \end{cases}$

$\Rightarrow \begin{cases} i_1 = \frac{210}{17}\,(A) \\ i_2 = \frac{135}{17}\,(A) \\ i_3 = 5\,(A) \end{cases}$

9.

$$\begin{bmatrix} 5 & -4 & 0 \\ -4 & 9 & -3 \\ 0 & -3 & 3 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 3(V_2 - V_3) - 5 \\ 0 \\ 11 \end{bmatrix} = \begin{bmatrix} -16 \\ 0 \\ 11 \end{bmatrix}$$

$$\begin{bmatrix} 5 & -7 & 3 \\ -4 & 9 & -3 \\ 0 & -3 & 3 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} -5 \\ 0 \\ 11 \end{bmatrix}$$

兩種寫法皆可.

10.

$$\begin{bmatrix} 7 & -2 & 0 & 0 \\ -2 & 6 & -4 & 0 \\ 0 & -4 & 5 & -1 \\ 0 & 0 & -1 & 5 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \end{bmatrix} = \begin{bmatrix} 8 \\ 4 \\ -10 \\ -4 \end{bmatrix}$$