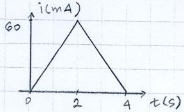
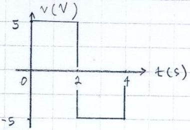
H. W. # 1
ECE 300
Spring, '07

B.S.

1.16 Given :





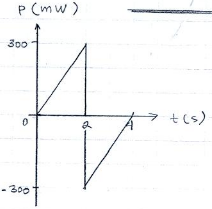
(a) sketch the power delivered to the device for $t > 0$

Solution :

$$i(t) = \begin{cases} 30t \text{ mA}, & 0<t<2 \\ (120-30t) \text{ mA}, & 2<t<4 \end{cases}$$

$$v(t) = \begin{cases} 5\text{ V}, & 0<t<2 \\ -5, & 2<t<4 \end{cases}$$

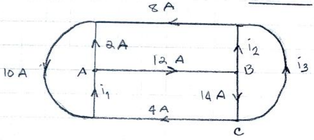
$$\Rightarrow p(t) = \begin{cases} 150t \text{ mW}, & 0<t<2 \\ (-600+150t) \text{ mW}, & 2<t<4 \end{cases}$$



(b). Total energy absorbed by the device:

$$W = \int_0^4 p\, dt = \underline{\underline{0\text{ J}}}$$

2.9 Given :



Find i_1, i_2, i_3.

Solution : At node A :

$12 + 2 = i_1 \longrightarrow \underline{\underline{i_1 = 14\text{A}}}$

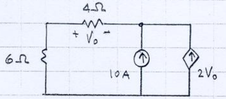
At node B :

$12 = i_2 + 14 \longrightarrow \underline{\underline{i_2 = -2\text{ A}}}$

At node C :

$14 = i_3 + 4 \longrightarrow \underline{\underline{i_3 = 10\text{ A}}}$

2.22 Given :



Find V_o and the power dissipated by the controlled source.

Solution :

At the node, KCL Requires that:

$$\frac{V_o}{4} + 10 + 2V_o = 0 \longrightarrow \underline{\underline{V_o = -4.444\ V}}$$

The current through the controlled source :

$$i = 2V_o = -8.888\ A$$

and the voltage across it :

$$V = (6+4)\ i_o \quad , \quad i_o = \frac{V_o}{4} = -1.111\ A$$

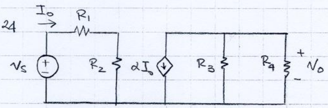
$$= 10 \times (-1.111)$$

$$= -11.111\ V$$

$\therefore$ Power $= (-8.888\ A)(-11.111\ V)$

$$= \underline{\underline{98.75\ W}}$$

2.24



Find $\frac{V_o}{V_s}$ in terms of α, R_1, R_2, R_3 and R_4

If $R_1 = R_2 = R_3 = R_4$, what value of α will produce $\left|\frac{V_o}{V_s}\right| = 10$?

Solution

(a) $I_o = \dfrac{V_s}{R_1 + R_2}$

$$V_o = -\alpha I_o\ (R_3 \,//\, R_4)$$

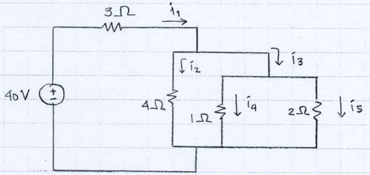
$$= -\alpha \frac{V_s}{R_1+R_2} \cdot \frac{R_3 R_4}{R_3+R_4}$$

$$\therefore \underline{\underline{\frac{V_o}{V_s} = \frac{-\alpha R_3 R_4}{(R_1+R_2)(R_3+R_4)}}}$$

(b) If $R_1 = R_2 = R_3 = R_4$.

$$\left|\frac{V_o}{V_s}\right| = \frac{\alpha}{2R} \cdot \frac{R}{2} = \frac{\alpha}{4} = 10 \longrightarrow \underline{\underline{\alpha = 40}}$$

2.31. Given:



Determine i_1 to i_5

Solution

$$R_{eq} = 3 + 4 /\!/ 1 /\!/ 2 = 3 + \frac{1}{\frac{1}{4}+1+\frac{1}{2}} = 3.5714\ \Omega$$

$$i_1 = \frac{40}{3.5714} = \underline{\underline{11.2\ A}}$$

$$v_1 = 0.5714\ i_1 = 6.4\ V$$

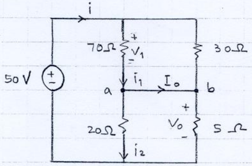
$$i_2 = \frac{V_1}{4} = \underline{\underline{1.6\ A}}$$

$$i_4 = \frac{V_1}{1} = \underline{\underline{6.4\ A}}$$

$$i_5 = \frac{V_1}{2} = \underline{\underline{3.2\ A}}$$

$$i_3 = i_4 + i_5 = \underline{\underline{9.6\ A}}$$

2.35 Given:



Calculate V_o and I_o

Solution:

Combining the resistors in parallel:

$$70 /\!/ 30 = \frac{70 \times 30}{70+30} = 21\ \Omega$$

$$20 /\!/ 5 = \frac{20 \times 5}{20+5} = 4\ \Omega$$

$$i = \frac{50}{21+4} = 2\,A$$

$$v_1 = 21\,i = 42V$$
$$v_o = 4\,i = \underline{\underline{8V}}$$

$$i_1 = \frac{v_1}{70} = 0.6\,A$$

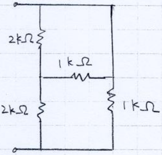
$$i_2 = \frac{v_o}{20} = 0.4\,A$$

At node a, KCL must be satisfied.

$$i_1 = i_2 + I_o \rightarrow 0.6 = 0.4 + I_o \rightarrow \underline{\underline{I_o = 0.2\,A}}$$

2.39 Evaluate R_{eq}

(a)



The top 2kΩ is parallel with the first 1kΩ :

$$2 // 1 = \frac{2}{3} = 0.667\,k\Omega$$

The 0.667 kΩ is in series with the second 2kΩ giv

$$0.667 + 2 = 2.667\,k\Omega.$$

The 2.667 kΩ is in parallel with the second 1kΩ

$$\therefore R_{eq} = \frac{2.667 \times 1}{3.667} = 0.7273\,k\Omega = \underline{\underline{727.3\,\Omega}}$$

(b)

The two 12kΩ are in parallel

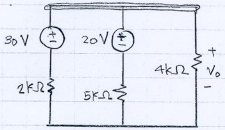
$$12 // 12 = 6\,k\Omega$$

The 6kΩ is in series with the top 6kΩ gives $6 + 6 = 12\,k\Omega$.

This 12 kΩ is in parallel with the 4kΩ

$$\therefore R_{eq} = \frac{12 \times 4}{16} = \underline{\underline{3\,k\Omega}}$$

3.5



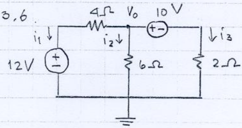
Calculate V_o

<u>Solution</u>

Applying KCL to the top node

$$\frac{30 - V_o}{2k} + \frac{20 - V_o}{5k} = \frac{V_o}{4k} \longrightarrow \underline{\underline{V_o = 20\,V}}$$

3.6



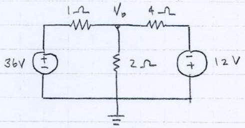
Find V_o using nodal analysis.

<u>Solution</u>

$$i_1 + i_2 + i_3 = 0$$

$$\frac{V_o - 12}{4} + \frac{V_o}{6} + \frac{V_o - 10}{2} = 0 \longrightarrow \underline{\underline{V_o = 8.727\,V}}$$

3.11



Find V_o & power dissipated in all Resistors.

<u>Solution:</u>

At the top node, KVL gives

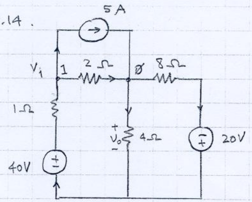
$$\frac{V_o - 36}{1} + \frac{V_o}{2} + \frac{V_o + 12}{4} = 0 \longrightarrow \underline{\underline{V_o = 18.857\,V}}$$

$$P_{1\Omega} = \frac{(36 - 18.857)^2}{1} = \underline{\underline{293.9\,W}}$$

$$P_{2\Omega} = \frac{18.857^2}{2} = \underline{\underline{177.79\,W}}$$

$$P_{4\Omega} = \frac{(18.857 + 12)^2}{4} = \underline{\underline{238\,W}}$$

3.14 .



Use nodal analysis to find V_o

Solution

At node 1 : $\frac{V_1 - V_o}{2} + 5 = \frac{40 - V_1}{1} \longrightarrow 3V_1 - V_o = 70$ — ①

At node ø : $\frac{V_1 - V_o}{2} + 5 = \frac{V_o}{4} + \frac{V_o + 20}{8} \longrightarrow 4V_1 - 7V_o = -20$ — ②

Solving ① and ② : $V_o = 20\ V$