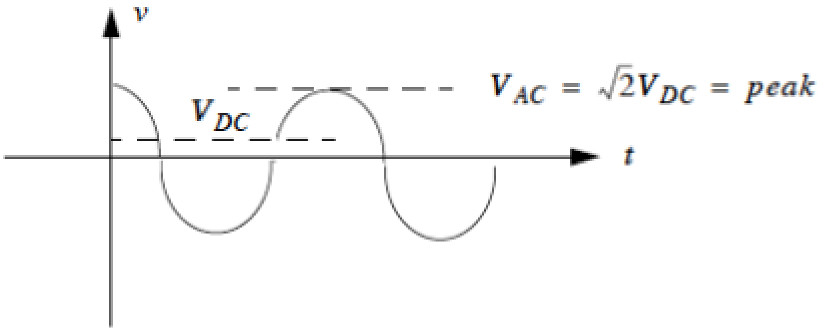
EE2210 Electric Circuits, Spring 2017

Practice Problems Solutions (Lecture1-Lecture3)

1.

Solution:



a) If peak voltage is V_{AC}, then

b)

$$V_{AC} = \sqrt{2}V_{DC}$$

Where V_{DC} is the average amplitude of the voltage signal.

$$Average\ Power = \frac{(V_{average})^2}{R} = \frac{V_{DC}^2}{R} = \frac{(V_{AC}/\sqrt{2})^2}{R} = \frac{V_{AC}^2}{2R}$$

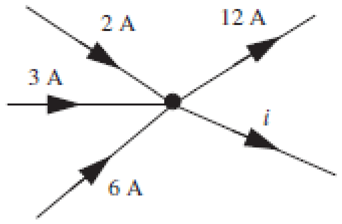
c) If peak voltage is V_{AC}, then

$$V_{AC} = \sqrt{2}V_{DC}$$

Where V_{DC} is the average amplitude of the voltage signal.

ANS: (a) $V^2_{AC}/2R$ (b) $V_{AC} = \sqrt{2}V_{DC}$

2.



Solution:
KCL:

$$2A + 3A + 6A = 12A + i$$
$$i = -1A$$

ANS:
$i = -1A$

3.

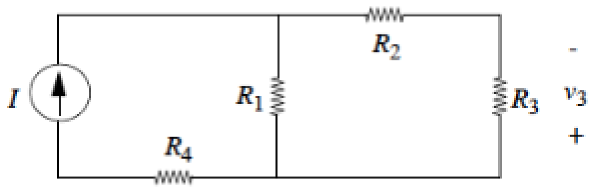


Figure 2.30:

Solution:

$R_T \quad = \quad R_4 + \frac{R_1R_2+R_1R_3}{R_1+R_2+R_3}$

Voltage across current source is not zero. $V_T = I \times (R4 + \frac{R_1R_2+R_1R_3}{R_1+R_2+R_3})$

Using voltage divider, $-v_3 = IR_T \times \frac{\frac{R_1R_2+R_1R_3}{R_1+R_2+R_3}}{R_T} \times \frac{R_3}{R_2+R_3}$

$v_3 = -I \times \frac{R_1R_2+R_1R_3}{R_1+R_2+R_3} \times \frac{R_3}{R_2+R_3}$

ANS: $v_3 = -I \times \frac{R_1R_2+R_1R_3}{R_1+R_2+R_3} \times \frac{R_3}{R_2+R_3}$

4.

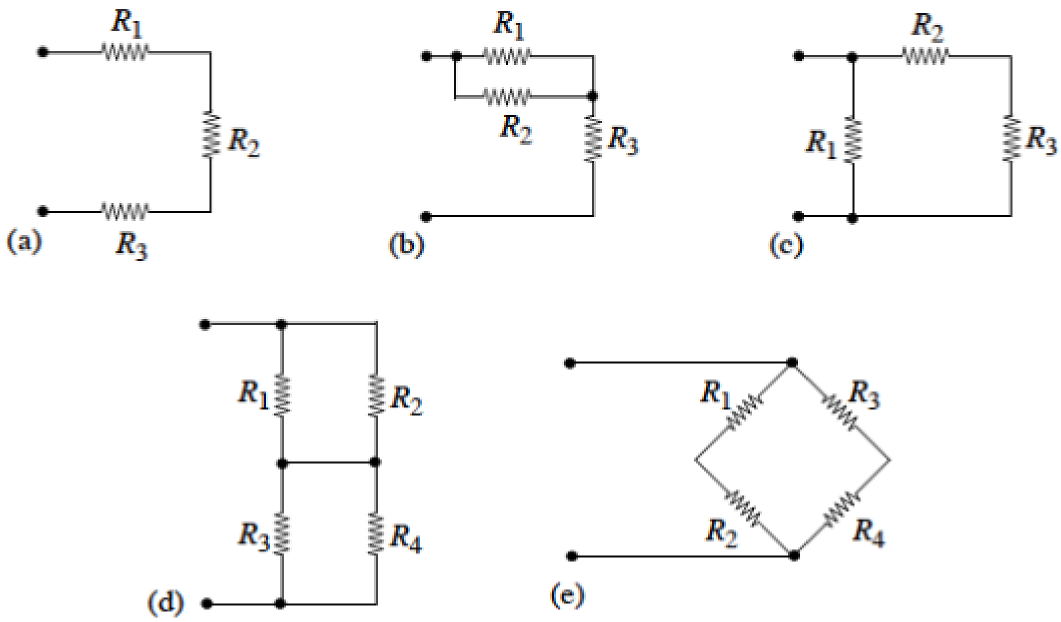


Figure 2.8:

Solution:

a)

$$R_{EQ} = R_1 + R_2 + R_3$$

b)

$$R_{EQ} = R_1 \parallel R_2 + R_3 = \frac{R_1R_2 + R_3(R_1 + R_2)}{R_1 + R_2}$$

c)

$$R_{EQ} = R_1 \parallel R_2 + R_3 = \frac{R_1(R_2 + R_3)}{R_1 + R_2 + R_3}$$

d)

$$R_{EQ} = R_1 \parallel R_2 + R_3 \parallel R_4 = \frac{R_1R_2}{R_1 + R_2} + \frac{R_3R_4}{R_3 + R_4}$$

e)

$$R_{EQ} = (R_1 + R_2) \parallel (R_3 \parallel R_4) = \frac{(R_1 + R_2)(R_3 + R_4)}{R_1 + R_2 + R_3 + R_4}$$

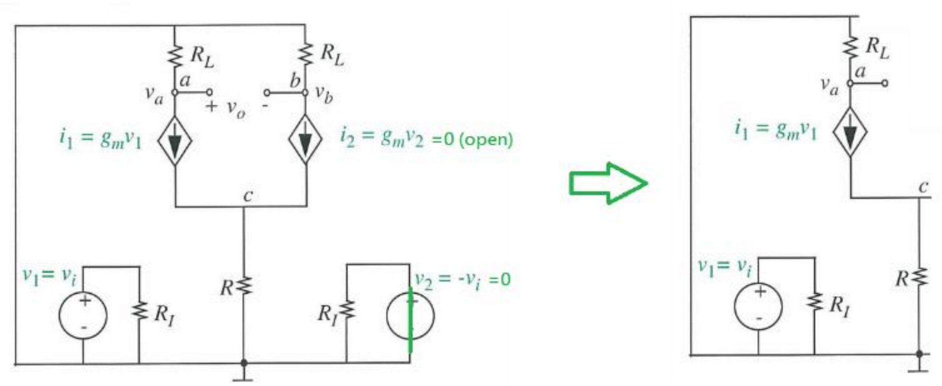
5.
Solution:

The equivalent circuit resistance is 2Ω, so $\frac{3}{2}$A of current is split between the 2Ω and 4Ω resistors. Therefore, 1A current goes through R.

Power = $2W$

ANS: Power = $2W$

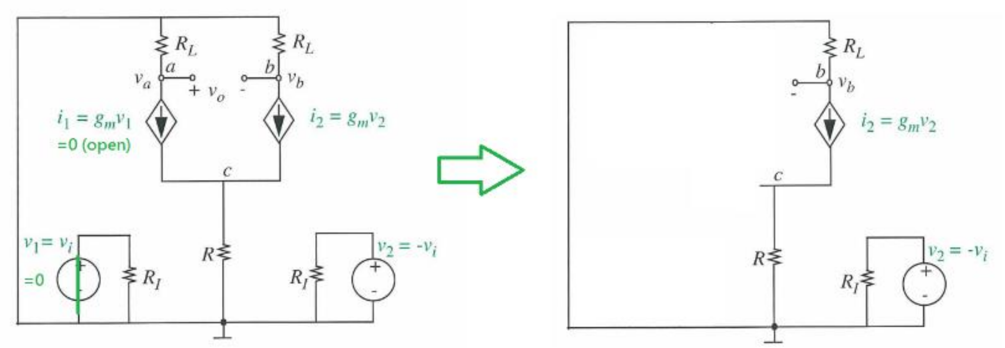
6.
Solution:
By using superposition method, we can turn off V2 first, which is given by



KCL at Va node, we have

$$g_m V_i + \frac{V_a}{R_L} = 0 \rightarrow V_a = -g_m V_i R_L$$

Then we can turn off V1, which is given by



KCL at Vb node, we have

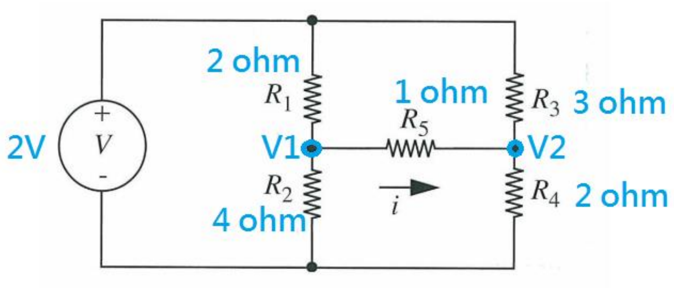
$$-g_m V_i + \frac{V_b}{R_L} = 0 \rightarrow V_b = g_m V_i R_L$$

Thus,

$$V_o = V_a - V_b = -2 g_m V_i R_L$$

7.

Solution:



KCL at V1 node, we have

$$\frac{V_1-2}{2}+\frac{V_1-V_2}{1}+\frac{V_1-0}{4}=0$$

KCL at V2 node, we have

$$\frac{V_1-2}{3}+\frac{V_2-V_1}{1}+\frac{V_2-0}{2}=0$$

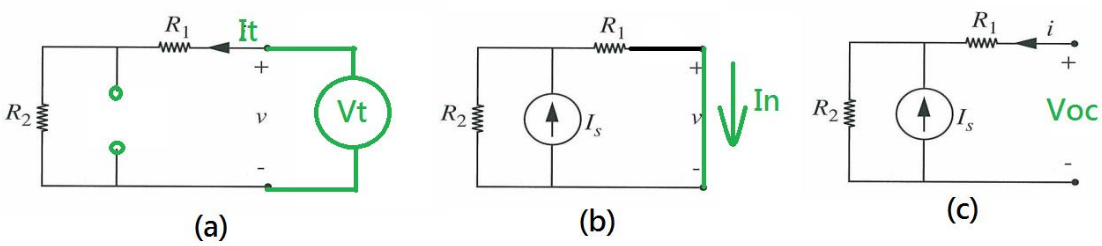
$$\rightarrow \begin{cases} V_1 = 1.13207\ V \\ V_2 = 0.9813\ V \end{cases}$$

Thus,

$$\mathrm{i}=\frac{V_1-V_2}{1}=1.13207-0.9813=0.15094\ A$$

8.

Solution:



To find $R_n \& R_{Th} (R_n = R_{Th})$, we need to turn off all the independent source and add a test voltage on the output node. $R_n = R_{Th} = \frac{V_t}{I_t}$. Please refer to figure (a).

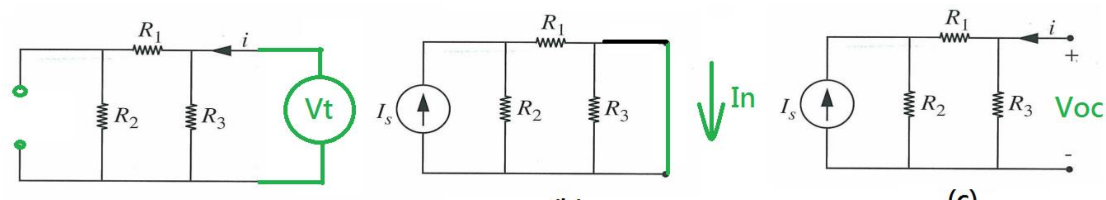
$$R_n = R_{Th} = R_1 + R_2$$

We need to find out the short circuit current (In) for Norton equivalent. Please refer to figure (b).

$$I_N = I_S \frac{R_2}{R_1 + R_2}$$

And open circuit voltage for Thevenin equivalent. Please refer to figure (c).

$$V_{OC} = I_S R_2$$



(a) (b) (c)

To find $R_n \& R_{Th} (R_n = R_{Th})$, we need to turn off all the independent source and add a test voltage on the output node. $R_n = R_{Th} = \frac{V_t}{I_t}$. Please refer to figure (a).

$$R_n = R_{Th} = (R_1 + R_2)||R_3$$

We need to find out the short circuit current (In) for Norton equivalent. Please refer to figure (b).

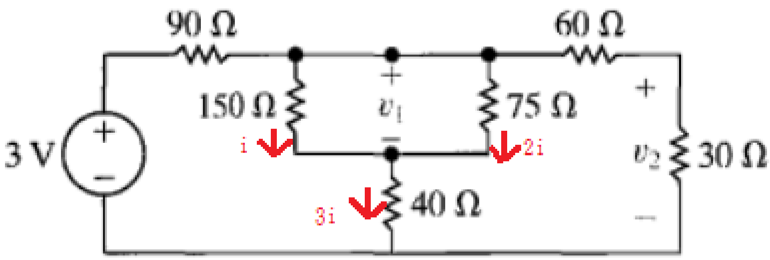
$$I_N = I_S \frac{R_2}{R_1 + R_2}$$

And open circuit voltage for Thevenin equivalent. Please refer to figure (c).

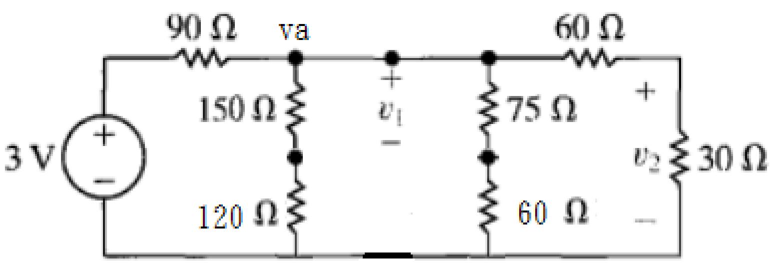
$$V_{OC} = I_S (\frac{R_2}{R_1 + R_2 + R_3}) R_3$$

10.

Solution:



圖一



圖二

由圖一

$$3i * 40\Omega = i * 120\Omega$$
$$= 2i * 60\Omega$$

等效圖二

$$va = 3V * \frac{(150+120)\|(75+60)\|(60+30)}{90+(150+120)\|(75+60)\|(60+30)}$$

$$= 3V * \frac{45\Omega}{90\Omega + 45\Omega}$$

$$= 1V$$

先求 v1

$$v1 = 1V * \frac{150\Omega}{150\Omega + 120\Omega}$$

$$= 1V * \frac{15\Omega}{27\Omega}$$

$$= \frac{5}{9}V$$

再求 v2

$$v2 = 1V * \frac{30\Omega}{90\Omega}$$

$$= \frac{1}{3}V$$