1.

(a) $I = \frac{10\cdot\cos(\omega t)}{100} = 0.1\ \cos(\omega t)\ \text{A}$ #

(b) $P = 10\cdot\cos(\omega t) \times 0.1\ \cos(\omega t)$

$= 1\ \cos^2(\omega t)\ \text{W}$ #

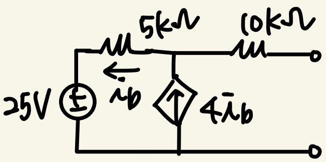
(c) $P_{AVG} = \frac{1}{T}\int_0^T \cos^2(\omega t)\,dt = \frac{1}{T}\int_0^T \frac{1+\cos 2\omega t}{2}\,dt$

$= \left(\frac{1}{2}t + \frac{1}{4\omega}\sin 2\omega t + C\Big|_0^T\right)\cdot\frac{1}{T} = \frac{1}{2}\ \text{W}$ #

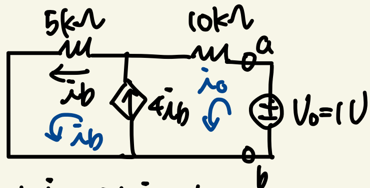
$\omega = \frac{2\pi}{T}$

(d) $P_{AVG} = \frac{10^2}{100} = 1\ \text{W}$ #

2. (a) Thevenin:



R_{TH}:



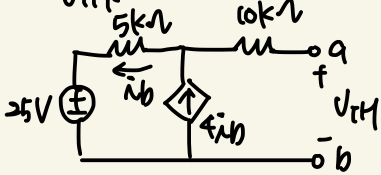
$10k\,i_o + 5k\,i_b - 1 = 0 \Rightarrow 10k\,i_o - \frac{5}{3}k\,i_o = 1$

$\Rightarrow i_o = 0.12\text{mA}$

$i_b - i_o = 4i_b$, $3i_b = -i_o$

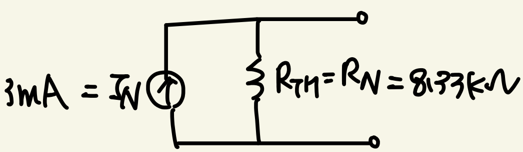
$\therefore R_{TH} = \frac{V_o}{i_o} = \frac{1}{0.12\text{m}} = 8.33\text{k}\Omega$ #

V_{TH}:

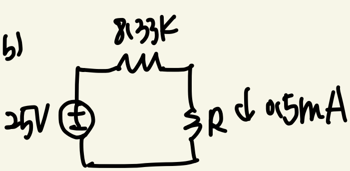


$i_b = 4i_b \Rightarrow i_b = 0 \Rightarrow V_{TH} = 25\text{V}$ #

Norton

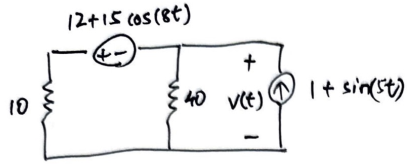


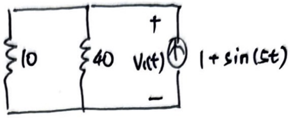
(b)

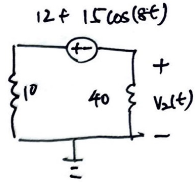


$8.33\text{k} + R = \frac{25}{0.5\text{m}} = 50\text{K}$ $\therefore R = 41.67\text{k}\Omega$ #

3.







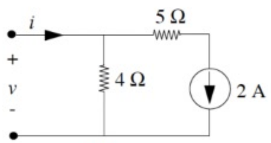
$$V_1(t) = [1+\sin(5t)] \times \frac{400}{50} = 8 + 8\sin(5t)$$

$$\frac{V_2(t)}{40} + \frac{V_2(t)+12+15\cos(8t)}{10} = 0, \quad V_2(t)+4V_2(t)+48+60\cos(8t)=0$$

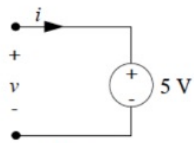
$$V_2(t) = -9.6 - 12\cos(8t)$$

$$V(t) = V_1(t) + V_2(t) = -1.6 + 8\sin(5t) - 12\cos(8t) \text{ V}$$

4. Sketch the $i - v$ characteristics (a figure with "i" on y axis and "v" on the x axis) for the networks in the following figures. (10%)

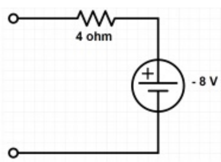


(a)



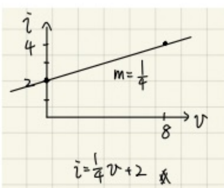
(b)

a. Use equivalent circuit
$R_{th} = 4\,\Omega, V_{th} = -8\,V$

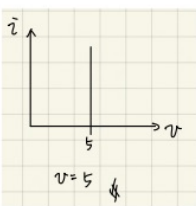


Therefore,

V	i
0	2
8	4



b.

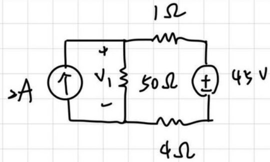


5.

(a) node : 4

branch : 5

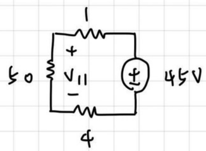
mesh : 2



(b)

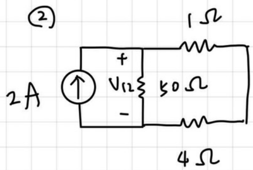
Superposition :

① V alone



$$V_{11} = 45 \cdot \frac{50}{1+50+4} = 40.9 \text{ V}$$

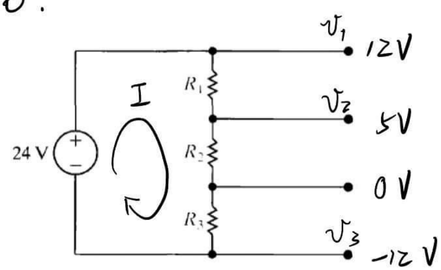
②



$$V_{12} = 2 \cdot \frac{5}{50+5} \cdot 50 = 9.09 \text{ V}$$

$$\Rightarrow V_1 = V_{11} + V_{12} = 49.99 \text{ V}$$

6.



$$P = IV \Rightarrow 80 = I \cdot 24$$

$$\therefore I = \frac{10}{3} \text{ A}$$

$$R_1 = \frac{12-5}{10/3} = 2.1 \ \Omega \#$$

$$R_2 = \frac{5-0}{10/3} = 1.5 \ \Omega \#$$

$$R_3 = \frac{0-(-12)}{10/3} = 3.6 \ \Omega \#$$