ENGG104 Tutorial 5 Class Questions

Team Name: ____

Question 1 [typical exam question]

Using superposition, find the voltage V_2 for the network in Fig. 9.123.

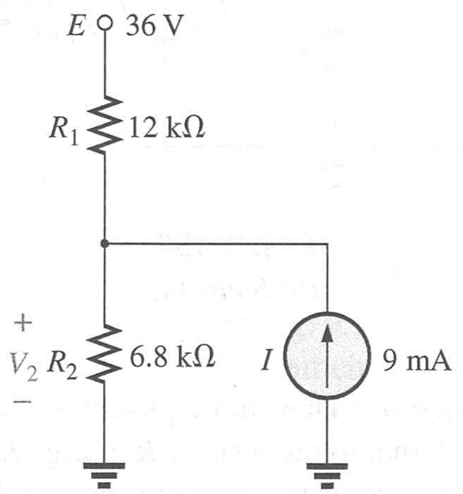
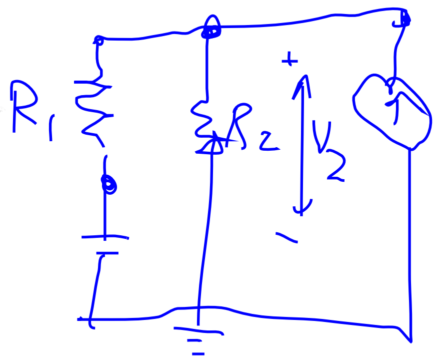
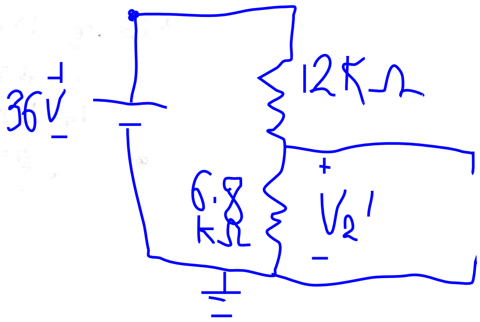
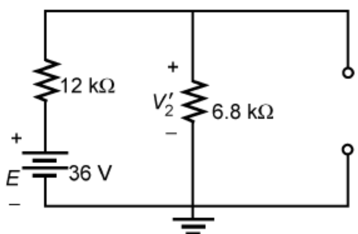


FIG. 9.123



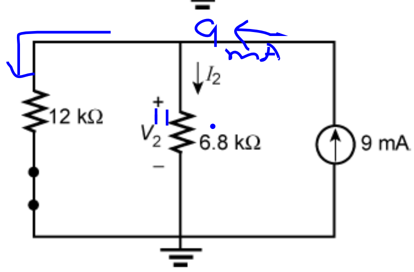


E:



$$V_2' = \frac{6.8\ \text{k}\Omega(36\ \text{V})}{6.8\ \text{k}\Omega + 12\ \text{k}\Omega} = 13.02\ \text{V}$$

I:



$$I_2 = \frac{12\ \text{k}\Omega(9\ \text{mA})}{12\ \text{k}\Omega + 6.8\ \text{k}\Omega} = 5.75\ \text{mA}$$

$V_2'' = I_2 R_2 = (5.75\ \text{mA})(6.8\ \text{k}\Omega) = 39.10\ \text{V}$

$V_2 = V_2' + V_2'' = 13.02\ \text{V} + 39.10\ \text{V} = \mathbf{52.12\ V}$

Question 2

a. Find the Thévenin equivalent circuit for the network external to the resistor R in Fig. 9.126.

b. Find the current through R when R is 2 Ω, 30 Ω, and 100 Ω.

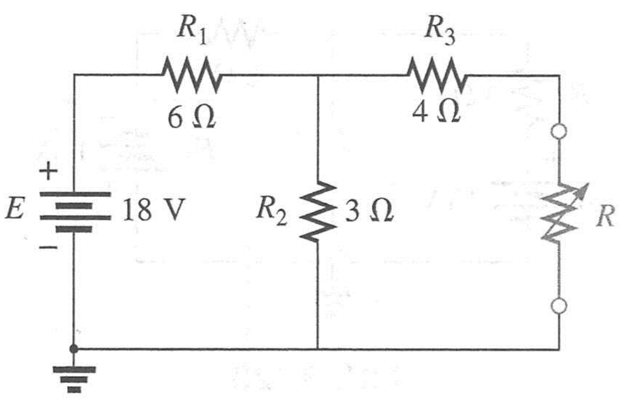
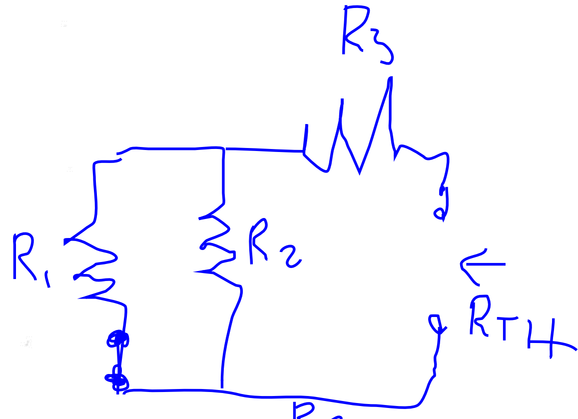
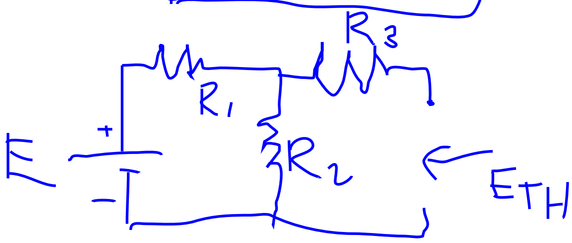


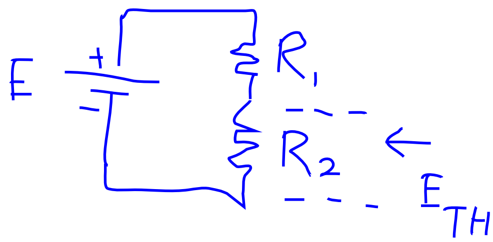
FIG. 9.126





a. $R_{Th} = R_3 + (R_1 \parallel R_2) = 4\ \Omega + (6\ \Omega \parallel 3\ \Omega) = 4\ \Omega + 2\ \Omega = \mathbf{6\ \Omega}$

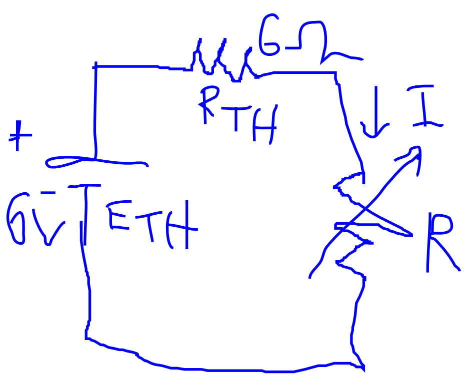
$$E_{Th} = \frac{R_2 E}{R_2 + R_1} = \frac{3\ \Omega(18\ \text{V})}{3\ \Omega + 6\ \Omega} = \mathbf{6\ V}$$



b. $$I_1 = \frac{E_{Th}}{R_{Th} + R} = \frac{6\ \text{V}}{6\ \Omega + 2\ \Omega} = \mathbf{0.75\ A}$$

$$I_2 = \frac{6\ \text{V}}{6\ \Omega + 30\ \Omega} = \mathbf{166.67\ mA}$$

$$I_3 = \frac{6\ \text{V}}{6\ \Omega + 100\ \Omega} = \mathbf{56.60\ mA}$$



Question 3 [typical exam question]

a. Find the Thévenin equivalent circuit for the network external to the resistor R for the network in Fig. 9.127.

b. Find the power delivered to R when R is 2 kΩ and 100 kΩ.

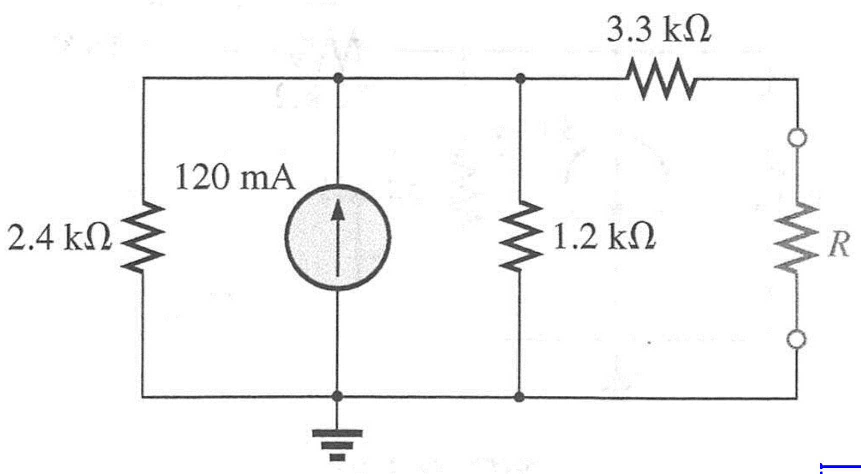
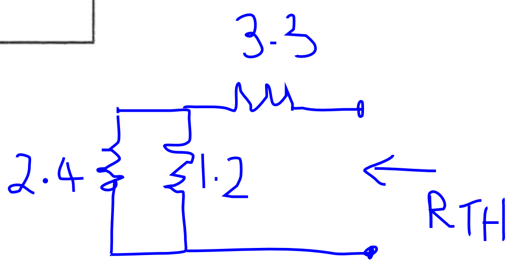
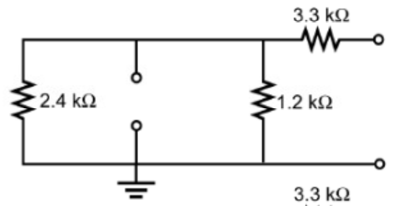


FIG. 9.127



a. R_{Th}:



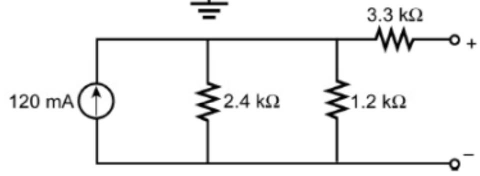
$$\leftarrow R_{Th} = 3.3\text{ k}\Omega + (1.2\text{ k}\Omega \,\|\, 2.4\text{ k}\Omega)$$ ← a

$$= 3.3\text{ k}\Omega + 0.8\text{ k}\Omega$$

$$= \mathbf{4.1\ k\Omega}$$

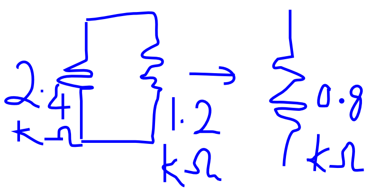
κ b

E_{Th}:



$$E_{Th} = (120\text{ mA})(2.4\text{ k}\Omega \,\|\, 1.2\text{ k}\Omega)$$

$$= \mathbf{96\ V}$$

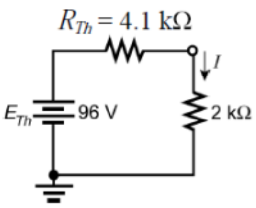


κ c

κ d

κ e

b. $R_{Th} = 4.1$ kΩ



$$I = \frac{96\text{ V}}{6.1\text{ k}\Omega} = 15.74\text{ mA}$$

$$P = I^2R = (15.74\text{ mA})^2\, 2\text{ k}\Omega = \mathbf{0.495\ W}$$

$R = 100$ kΩ:

$$I = \frac{96\text{ V}}{104.1\text{ k}\Omega} = 0.922\text{ mA}$$

$$P = I^2R = (0.922\text{ mA})^2\, 100\ \text{k}\Omega = \mathbf{85\ mW}$$

Question 4

a. Write the nodal equations using the general approach for the network of Fig. 8.125.

b. Find the nodal voltages using determinants.

c. Using the results of part (a), calculate the current through the 20 Ω resistor.

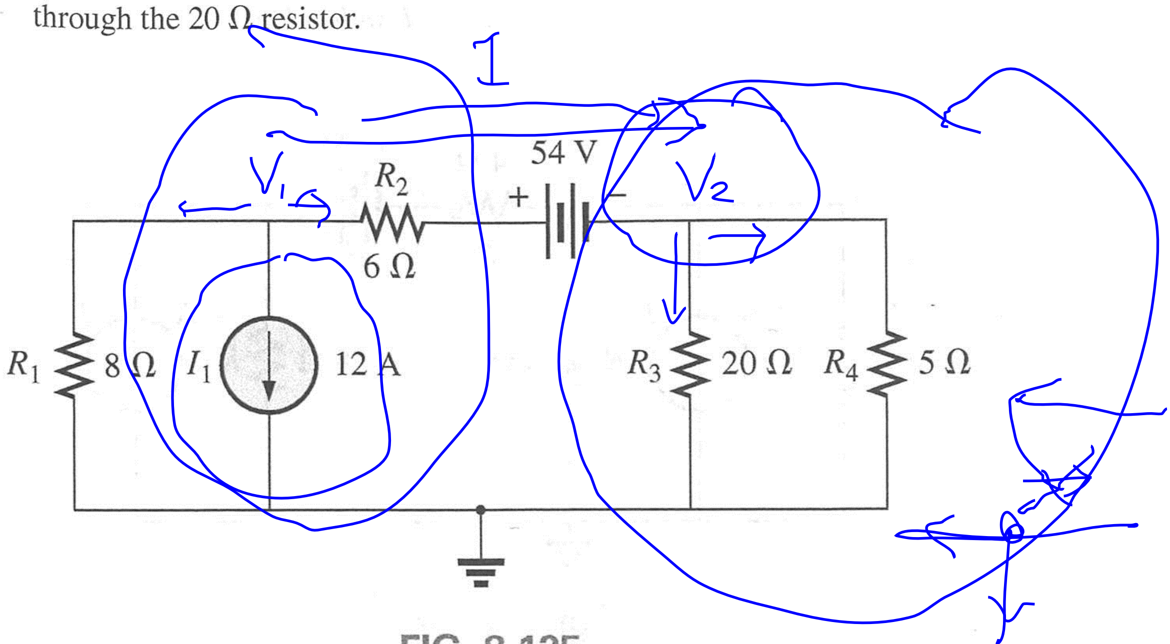


FIG. 8.125

a. V_1 V_2

At V_1: $\Sigma I_i = \Sigma I_o$

$$0 = \frac{V_1}{8\ \Omega} + 12\text{ A} + I_{6\Omega} \text{ and } V_1 - I6\Omega - 54\text{ V} - V_2 = 0$$

$$\text{or } I = \frac{V_1 - V_2 - 54\text{ V}}{6\ \Omega} = \frac{V_1}{6\ \Omega} + \frac{V_2}{6\ \Omega} - 9\text{ A}$$

$$\text{so that } 0 = \frac{V_1}{8\ \Omega} + 12\text{ A} + \frac{V_1}{6\ \Omega} - \frac{V_2}{6\ \Omega} - 9\text{ A}$$

$$\text{or } V_1\left[\frac{1}{8\ \Omega} + \frac{1}{6\ \Omega}\right] - V_2\left[\frac{1}{6\ \Omega}\right] = -12\text{ A} + 9\text{ A} = -3\text{ A}$$

At V_2: $\Sigma I_i = \Sigma I_o$

$$I = \frac{V_2}{20\ \Omega} + \frac{V_2}{5\ \Omega}$$

$$\text{or } \frac{V_1}{6\ \Omega} - \frac{V_2}{6\ \Omega} - 9\text{ A} = \boxed{\frac{V_2}{20\ \Omega} + \frac{V_2}{5\ \Omega}}$$

$$\text{and } V_2\left[\frac{1}{6\ \Omega} + \frac{1}{20\ \Omega} + \frac{1}{5\ \Omega}\right] - V_1\left[\frac{1}{6\ \Omega}\right] = -9\text{ A}$$