

## Assignment 3

Yahia Hany Gaber : 231000412

## 0.1 Problem 1

- a) Use the node-voltage method to find  $i_1$ ,  $i_2$  and  $i_3$ .  
b) Find if the power dissipated in the circuit equals the power developed.

a)  
At  $v_1$ :

$$-10 \times 10^{-3} = \frac{v_1 - (-30)}{5000} + \frac{v_1 - 0}{500} + \frac{v_1 - 80}{1000}$$

$$\rightarrow v_1 = 20V$$

$$\therefore i_1 = \frac{v_1 - (-30)}{5000} = \frac{20 - (-30)}{5000} = 0.01A$$

$$\therefore i_2 = \frac{v_1 - 0}{500} = \frac{20}{500} = 0.04A$$

$$v_2 = v_3 = 80$$

$$i_4 = \frac{v_1 - 80}{1000} = \frac{20 - 80}{1000} = -0.06A$$

$$i_5 = \frac{80 - 0}{4000} = 0.02A$$

KCL at  $v_3$ :

$$\therefore 0.01 + i_4 = i_5 + i_3 \rightarrow i_3 = 0.01 + (-0.06) - 0.02$$

$$\rightarrow i_3 = -0.07A$$

b)

Power absorbed:

Power delivered:

$$P_{5k\Omega} = I^2 \times R = (0.01)^2 \times 5000 = 0.5W$$

$$P_{30V} = V \times I = 30 \times 0.01 = 0.3W$$

$$P_{500\Omega} = (0.04)^2 \times 500 = 0.8W$$

$$P_{10mA} = (v_2 - v_1) \times I = 60 \times 0.01 = 0.6$$

$$P_{4k\Omega} = (0.02)^2 \times 4000 = 1.6W$$

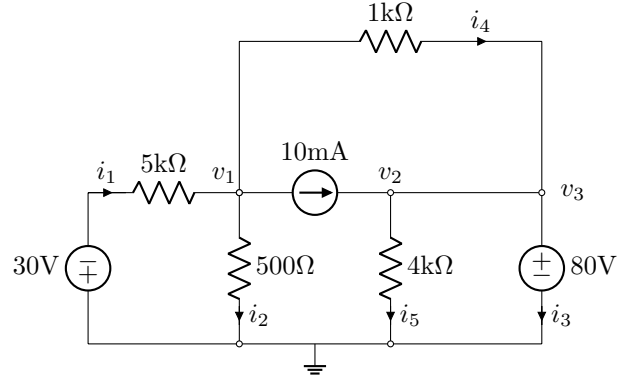
$$P_{80V} = 80 \times 0.07 = 5.6$$

$$P_{1k\Omega} = (0.06)^2 \times 1000 = 3.6W$$

$$\therefore P_{abs} = 0.5 + 0.8 + 1.6 + 3.6 = 6.5W$$

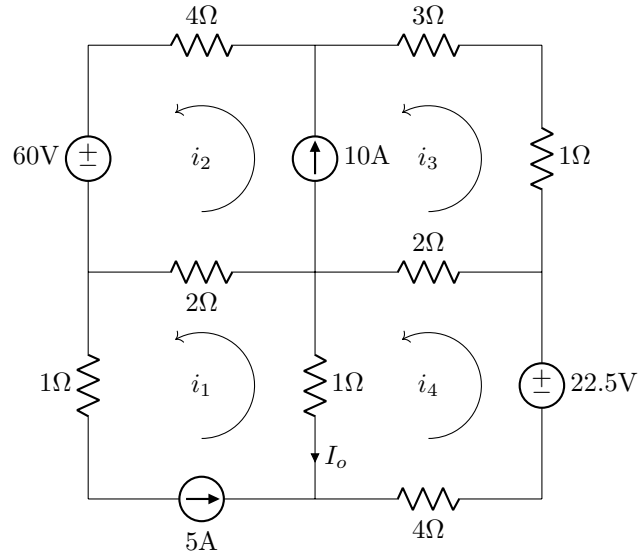
$$\therefore P_{del} = 0.3 + 0.6 + 5.6 = 6.5W$$

$$\therefore P_{abs} = P_{del} = 6.5W$$



## 0.2 Problem 2

Apply mesh analysis to the circuit and find  $I_o$



$$I_o = i_4 - i_1$$

At  $i_1$ :

$$i_1 = 5A$$

$$0 = i_1(1 + 2 + 1) - i_2(2) - i_4(1) \rightarrow 1$$

Between  $i_2$  and  $i_3$  (Supermesh):

$$i_2 - i_3 = 10A$$

After merging mesh 2 and 3:

$$-60 = i_2(2 + 4) + i_3(2 + 1 + 3) - i_1(2) - i_4(2) \rightarrow 2$$

At  $i_4$ :

$$22.5 = i_4(4 + 2 + 1) - i_3(2) - i_1(1) \rightarrow 3$$