Assignment 3

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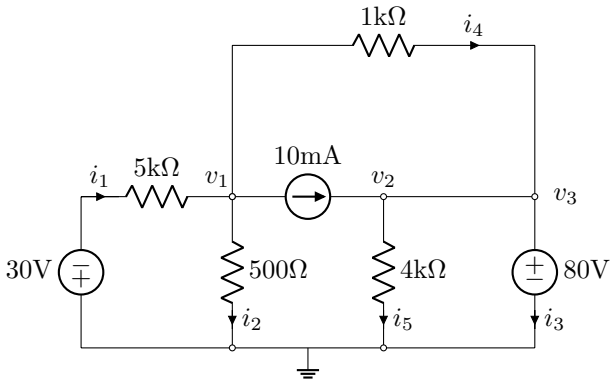
0.1 Problem 1

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:

$$-10\times10^{-3} = \frac{v_1-(-30)}{5000}+\frac{v_1-0}{500}+\frac{v_1-80}{1000}$$

$$\rightarrow v_1 = 20V$$

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

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

$$v_2 = v_3 = 80$$

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

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

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 throughout the circuit:

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

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

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

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

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

Power delivered throught the circuit:

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

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

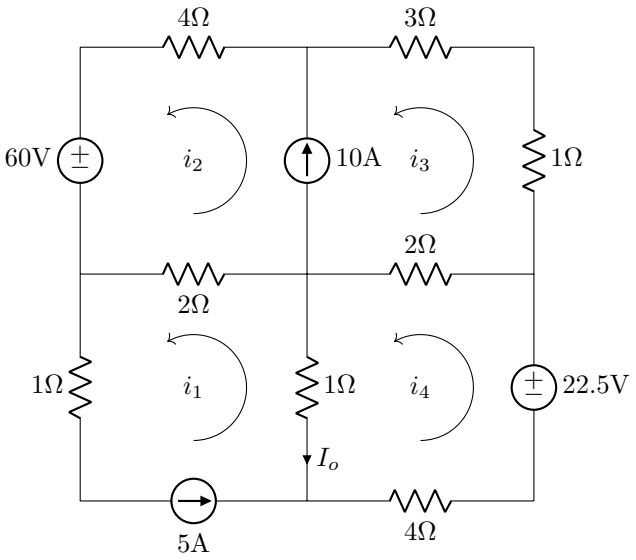
$$P_{80V} = 80 \times 0.07 = 5.6$$

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

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

0.2 Problem 2

Apply mesh analysis to the circuit and find I_o



$$I_o = i_1 - i_4$$

At i_1:

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

Between i_2 and i_3 (Supermesh):

$$i_2 - i_3 = 10A \rightarrow (2)$$

After merging mesh 2 and 3:

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

At i_4:

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

By solving equations 1, 2, 3 and 4:

$$i_1 =$$