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Electric Circuits (ENGR 210)

Assignment 3

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1. Use the node-voltage method to find the total power dissipated in the circuit Figure 1.

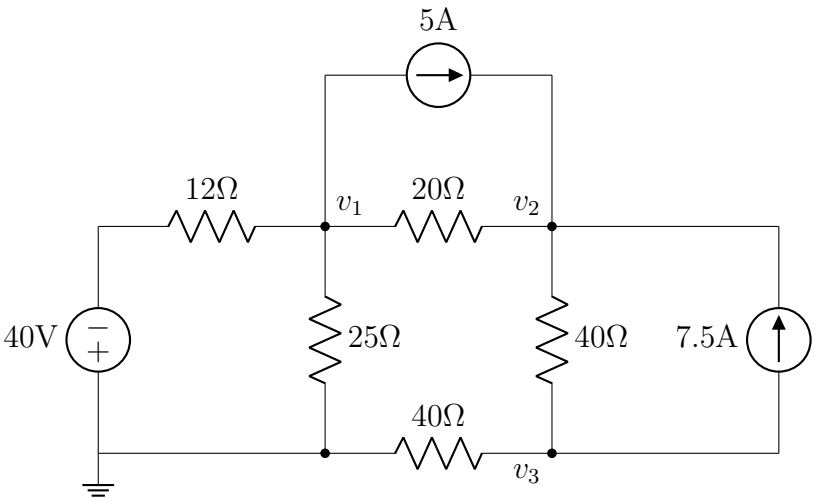

Figure 1

$$v_1 : \frac{v_1 + 40}{12} + \frac{v_1}{25} + \frac{v_1 - v_2}{20} + 5 = 0 \tag{1}$$

$$v_2 : \frac{v_2 - v_1}{20} + \frac{v_2 - v_3}{40} - 5 = 0 \tag{2}$$

$$v_3 : \frac{v_3}{40} + \frac{v_3 - v_2}{40} + 7.5 = 0. \tag{3}$$

$$52v_1 - 15v_2 = -2500 \tag{4}$$

$$-2v_1 + 3v_2 - v_3 = 500 \tag{5}$$

$$2v_3 - v_2 = -300 \tag{6}$$

$$v_1 = -10V \tag{7}$$

$$v_2 = 132V \tag{8}$$

$$v_3 = -84V \tag{9}$$

$$P_d(40V) = -\frac{v_1 + 40}{12} \cdot 40V = -100W \tag{10}$$

$$P_d(5A) = -5A \cdot (v_2 - v_1) = -710W \tag{11}$$

$$P_d(7.5A) = -7.5A \cdot (v_2 - v_3) = -1620W. \tag{12}$$

$$P_d(R) = \frac{v^2}{R} \tag{13}$$
$$P_d(12\Omega) = \frac{(-40 - v_1)^2}{12} = 75W \tag{14}$$
$$P_d(25\Omega) = \frac{(-10)^2}{25} = 4W \tag{15}$$
$$P_d(20\Omega) = \frac{(v_1 - v_2)^2}{20} = 1008.2W \tag{16}$$
$$P_d(40\Omega)_1 = \frac{(v_2 - v_3)^2}{40} = 1166.4W \tag{17}$$
$$P_d(40\Omega)_2 = \frac{v_3^2}{40} = 176.4W. \tag{18}$$

$$\Sigma P_d = 0 \tag{19}$$
$$\Sigma P_d(R) = 2430W. \tag{20}$$

2. Use the mesh-current method to find the total power dissipated in the circuit Figure 2.

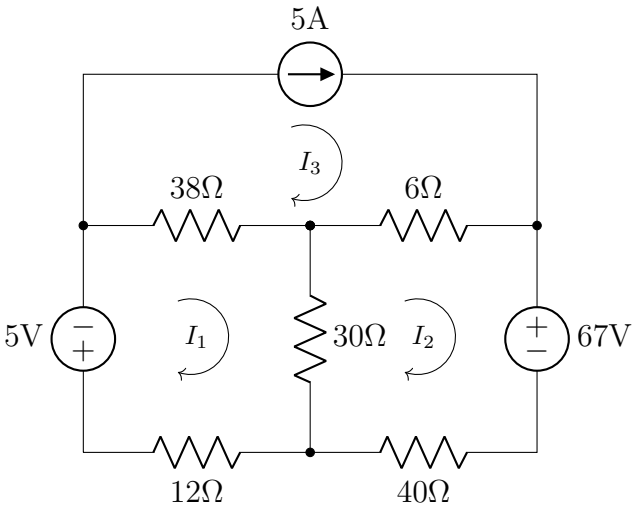

Figure 2

$$I_1 : 38(I_1 - I_3) + 30(I_1 - I_2) + 12I_1 = -5 \tag{21}$$
$$I_2 : 30(I_2 - I_1) + 6(I_2 - I_3) + 40I_2 = -67 \tag{22}$$
$$I_3 : I_3 = 5. \tag{23}$$

$$I_1 = 2.5A \tag{24}$$
$$I_2 = 0.5A. \tag{25}$$

$$P_d(5A) = -I_3 \cdot (67 - 5) = -310W \tag{26}$$
$$P_d(5V) = -5 \cdot I_1 = -12.5W \tag{27}$$
$$P_d(67V) = -67 \cdot I_2 = -33.5W \tag{28}$$
$$. \tag{29}$$

$$P_d(38\Omega) = 38 \cdot (I_1 - I_3)^2 = 237.5W \tag{30}$$
$$P_d(30\Omega) = 30 \cdot (I_1 - I_2)^2 = 120W \tag{31}$$
$$P_d(12\Omega) = 12 \cdot I_1^2 = 75W \tag{32}$$
$$P_d(6\Omega) = 6 \cdot (I_2 - I_3)^2 = 121.5W \tag{33}$$
$$P_d(40\Omega) = 40 \cdot I_2^2 = 10W. \tag{34}$$

$$\Sigma P_d = 208W. \tag{35}$$