

Homework 1

Due date: Mar. 3rd, 2021, Wednesday

Turn in your homework in class

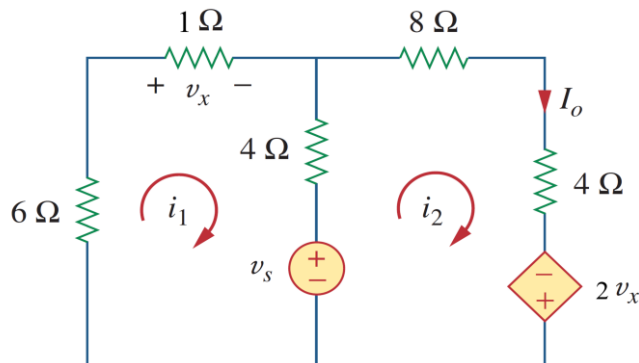
Rules:

- Work on your own. Discussion is permissible, but extremely similar submissions will be judged as plagiarism.
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

1、 For the circuit below,

- (1) find I_o when $v_s = 6V$,
 (2) find I_o when $v_s = 12V$.

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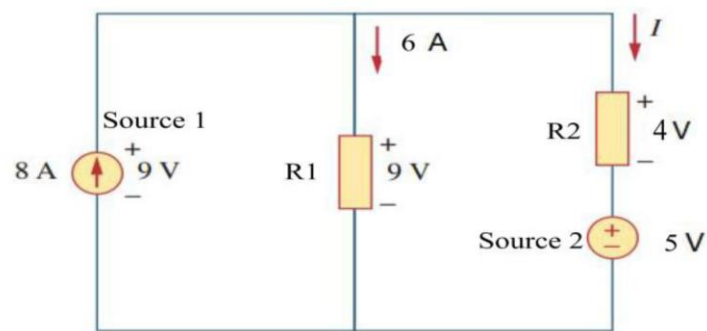
$$\begin{cases} (1+4+6)\Omega \cdot i_1 - 4\Omega \cdot i_2 + v_s = 0 & \text{--- (2)} \\ (8+4+4\Omega)i_2 - 4\Omega i_1 - 2v_x - v_s = 0 & \text{--- (2)} \\ v_x = i_1 & \text{--- (1)} \\ I_o = i_2 & \text{--- (1)} \end{cases}$$

$$I_o = i_2 = \frac{5}{152} v_s = 0.0329 v_s \text{ --- (2)}$$

$$\hookrightarrow v_s = 6V, \quad I_o = 0.197A \left(\frac{15}{76} A \right) \text{ --- (1)}$$

$$\hookrightarrow v_s = 12V, \quad I_o = 0.395A \left(\frac{15}{38} A \right) \text{ --- (1)}$$

2、 Find I and the power absorbed by each element in the circuit below.



$$8 = 6 + I \Rightarrow I = 2A \quad \text{--- (2)}$$

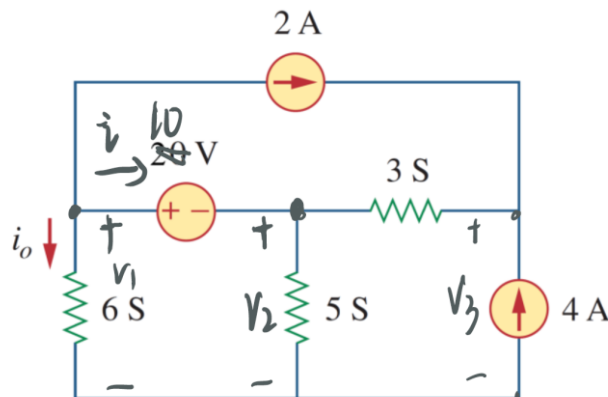
$$P_{\text{source},1} = -8 \times 9 = -72W \quad \text{--- (2)}$$

$$P_{R1} = 6 \times 9 = 54W \quad \text{--- (2)}$$

$$P_{R2} = 2 \times 4 = 8W \quad \text{--- (2)}$$

$$P_{\text{source},2} = 5 \times 2 = 10W \quad \text{--- (2)}$$

3、Apply nodal analysis to find i_o and the power dissipated in each resistor in the circuit.



$$\text{node 1 : } 6V_1 + i + 2 = 0 \quad \text{--- (2)}$$

$$\text{node 2 : } 5V_2 - i + 3(V_2 - V_3) = 0 \quad \text{--- (2)}$$

$$\text{node 3 : } 3(V_3 - V_2) - 4 - 2 = 0 \quad \text{--- (2)}$$

$$V_1 - V_2 = 10V \quad \text{--- (2)}$$

$$V_1 = \frac{54}{11}V$$

$$V_2 = -\frac{56}{11}V$$

$$V_3 = -\frac{34}{11}V$$

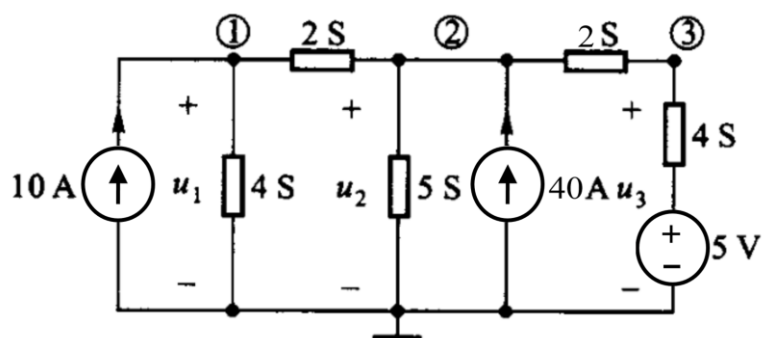
$$i_o = \frac{54}{11} \times 6 = \frac{324}{11} = 29.455W \quad \text{--- (2)}$$

$$P_1 = \frac{54}{11} \times \frac{324}{11} = 144.595W \quad \text{--- (2)}$$

$$P_2 = V_2^2 \cdot G_2 = \frac{56}{11} \cdot \frac{56}{11} \cdot 5 = 129.587W \quad \text{--- (2)}$$

$$P_3 = (V_2 - V_3)^2 \cdot G_3 = 2^2 \cdot 3 = 12W \quad \text{--- (2)}$$

4、Apply nodal analysis to find u_1 , u_2 and u_3 .



node ①: $4u_1 + 2(u_1 - u_2) = 10A$ ----- (2)

node ②: $5u_2 + 2(u_2 - u_1) + 2(u_2 - u_3) = 40$ ---- (2)

node ③: $2(u_3 - u_2) + 4(u_3 - 5) = 0$ ---- (2)

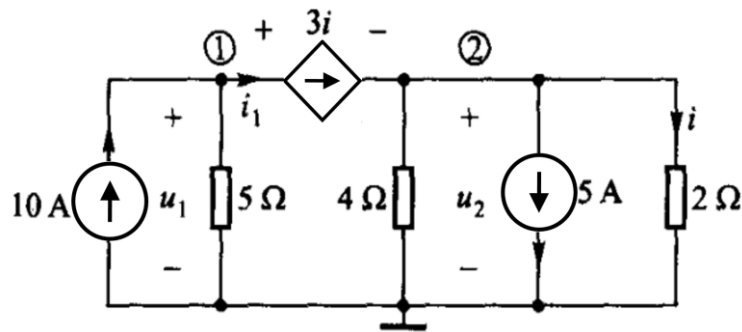
$u_1 = 3.84V$ ----- (2)

$u_2 = 6.52V$ ----- (2)

$u_3 = 5.51V$ ----- (2)

5、 Using nodal analysis, find u_1 and u_2 .

(8)



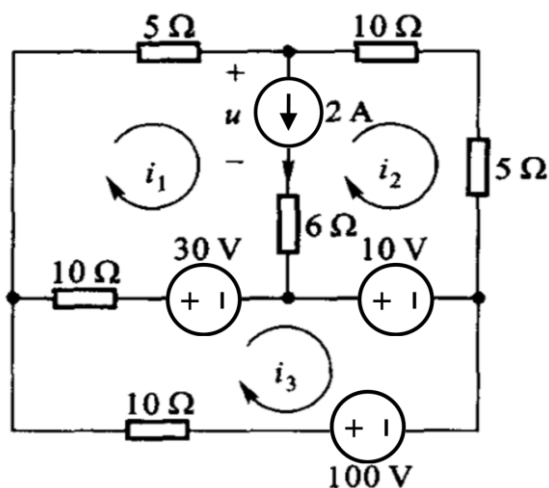
$$\text{node ① : } \frac{u_1}{5} + 3i = 10 \quad \text{--- (2)}$$

$$\text{node ② : } \frac{u_2}{4} + 5 + i = 3i \quad \text{--- (2)}$$

$$u_2 = 2i = \frac{20}{3} (6.67) \text{ V} \quad \text{--- (2)}$$

$$u_1 = 0 \text{ V} \quad \text{--- (2)}$$

6、 Using mesh analysis, find i_1 , i_2 , i_3 and u .



$$\text{mesh 1: } (5\Omega + 6\Omega + 10\Omega)i_1 - 6i_2 - 10i_3 + u = 30V \dots (2)$$

$$\text{mesh 2: } -6i_1 + (10\Omega + 5\Omega + 6\Omega)i_2 - u = 10V \dots (2)$$

$$\text{mesh 3: } -10i_1 + (10\Omega + 10\Omega)i_3 = -30V - 10V + 100V \dots (2)$$

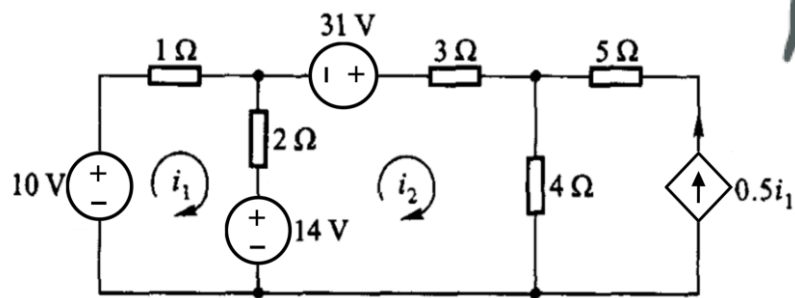
$$\text{And: } i_1 - i_2 = 2A \dots (2)$$

$$\begin{cases} (15\Omega)i_1 + (15\Omega)i_2 - (10\Omega)i_3 = 40V \\ -(10\Omega)i_1 + (20\Omega)i_3 = 60V \\ i_1 - i_2 = 2A \end{cases}$$

$$i_1 = 4A \quad i_3 = 5A \quad \dots (2, 2)$$

$$i_2 = 2A \quad u = 8V \quad \dots (2, 2)$$

7、 Using mesh analysis, find i_1 and i_2 .



$$\text{mesh 1 : } (1\Omega + 2\Omega)i_1 - (2\Omega)i_2 = -4V \quad \dots (3)$$

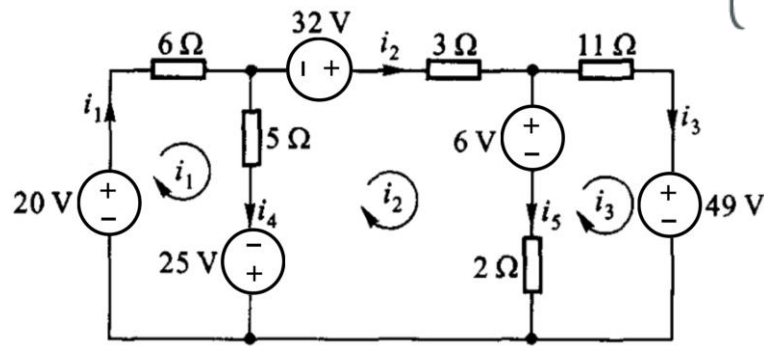
$$\begin{aligned} \text{mesh 2 : } & -(2\Omega)i_1 + (2\Omega + 3\Omega + 4\Omega)i_2 + (4\Omega) \times 0.5i_1 \\ & = 14V + 31V \quad \dots (3) \end{aligned}$$

$$\begin{cases} 3i_1 - 2i_2 = -4A \\ 9i_2 = 45A \end{cases}$$

$$i_1 = 2A \quad \dots (2)$$

$$i_2 = 5A \quad \dots (2)$$

8、 Using mesh analysis, find i_1 , i_2 , i_3 , i_4 and i_5 .



(18)

$$\text{mesh 1 : } (6\Omega + 5\Omega)i_1 - (5\Omega)i_2 = 25V + 20V \quad \dots (2)$$

$$\text{mesh 2 : } -(5\Omega)i_1 + (3\Omega + 2\Omega + 5\Omega)i_2 - (2\Omega)i_3 = 32V - 6V - 25V \quad \dots (3)$$

$$\text{mesh 3 : } -(2\Omega)i_2 + (11\Omega + 2\Omega)i_3 = -49V + 6V \quad \dots (3)$$

$$\begin{cases} 11i_1 - 5i_2 = 45A \\ -5i_1 + 10i_2 - 2i_3 = 1A \\ -2i_2 + 13i_3 = -43A \end{cases}$$

$$i_1 = 5A \quad \dots (2)$$

$$i_4 = i_1 - i_2 = 3A \quad \dots (2)$$

$$i_2 = 2A \quad \dots (2)$$

$$i_5 = i_2 - i_3 = 5A \quad \dots (2)$$

$$i_3 = -3A \quad \dots (2)$$