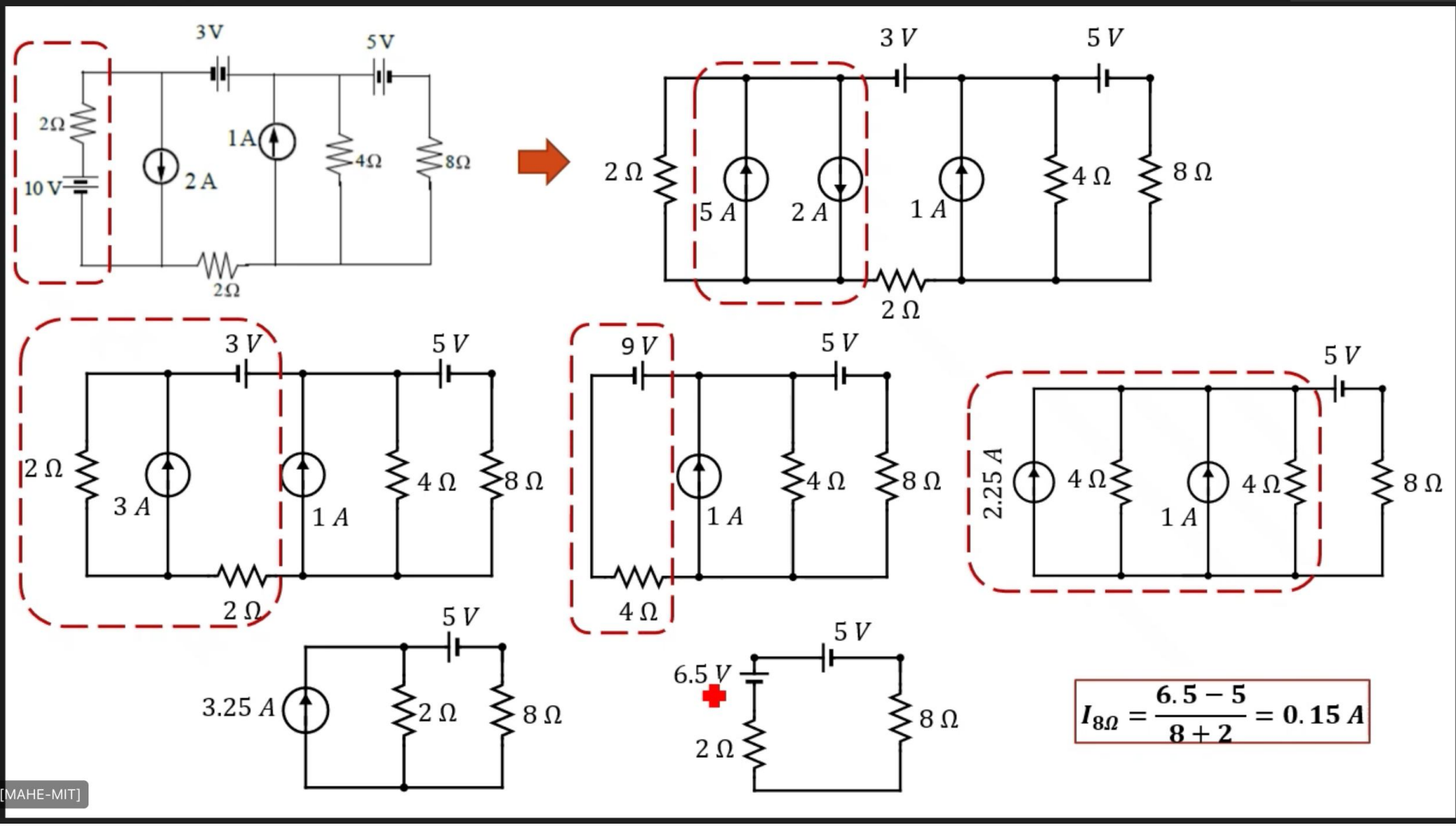
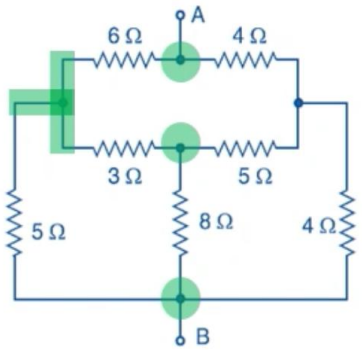
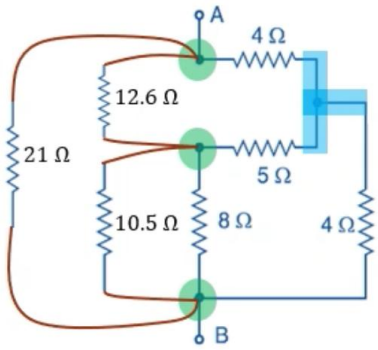
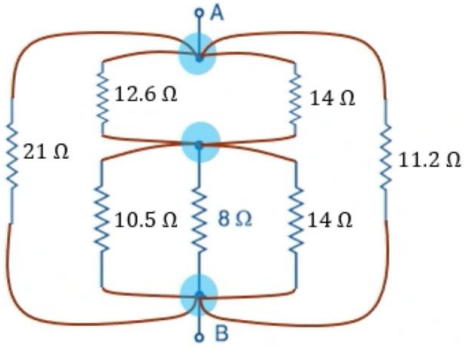
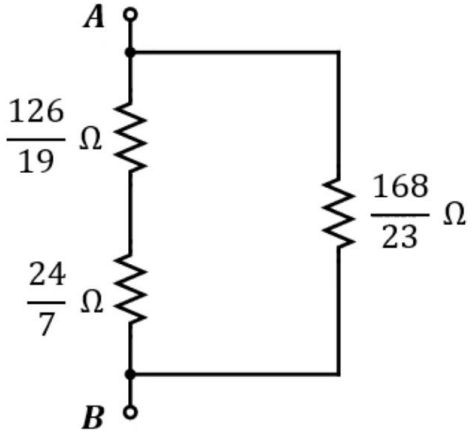


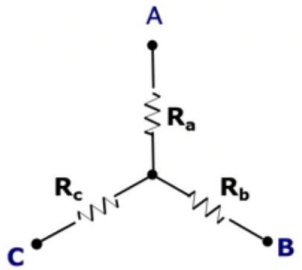


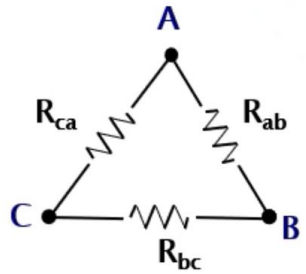






$$R_{AB} = 4.2317\ \Omega$$





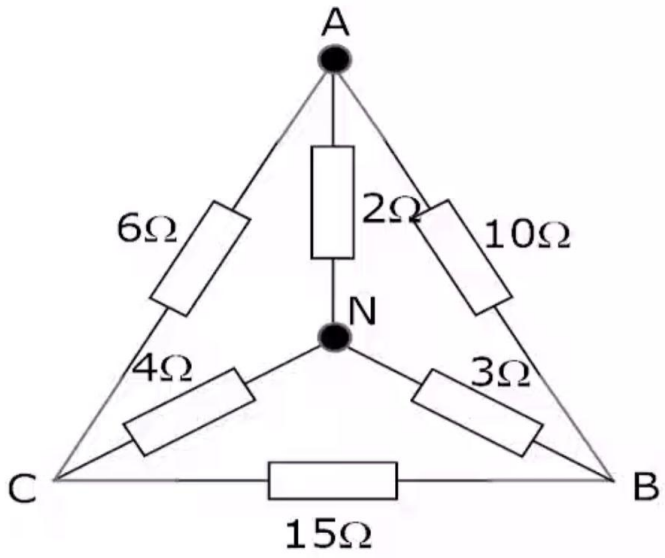
$$R_{ab} = R_a + R_b + \frac{R_a R_b}{R_c}$$

$$R_{bc} = R_b + R_c + \frac{R_b R_c}{R_a}$$

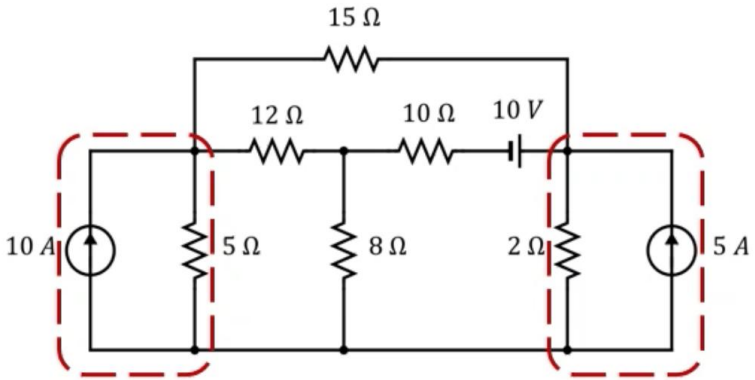
$$R_{ca} = R_c + R_a + \frac{R_a R_c}{R_b}$$

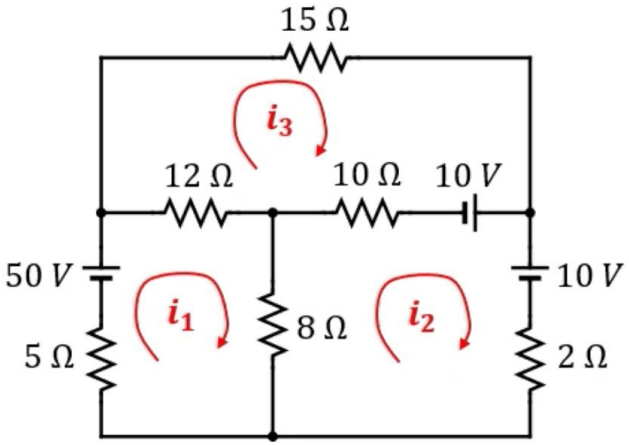
Self-Practice 2: Star-Delta Transformation

Calculate the equivalent resistance across the terminals **A** and **N** of the given network.



Ans: R_{AN} = 1.4741 Ω



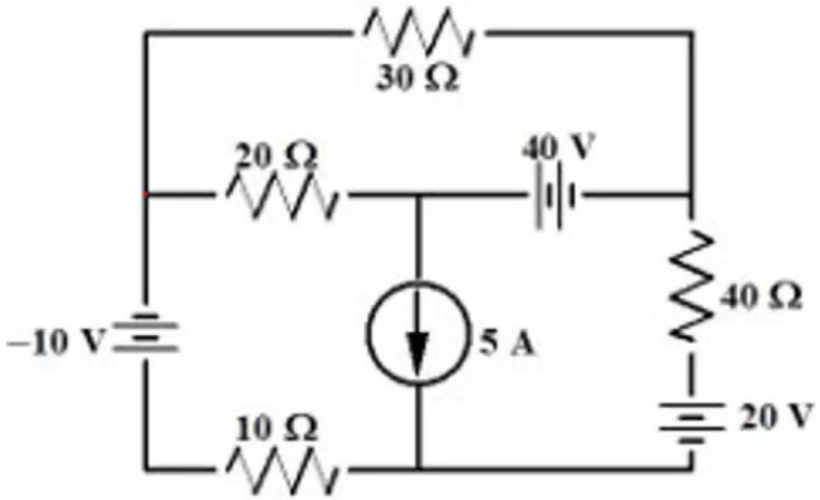


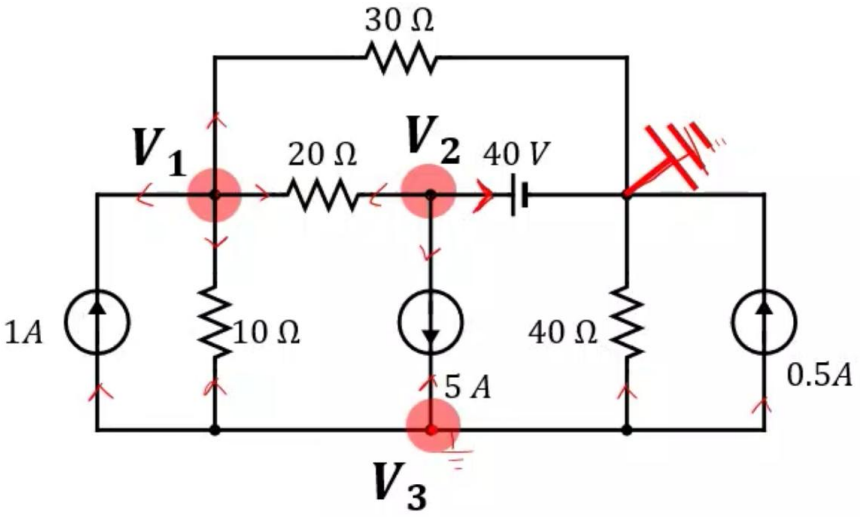
$$\begin{bmatrix} 25 & -8 & -12 \\ -8 & 20 & -10 \\ -12 & -10 & 37 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \\ -10 \end{bmatrix}$$

$$i_1 = 3.2608\ A$$
$$i_2 = 1.9633\ A$$
$$i_3 = 1.3179\ A$$

$$I_{8\Omega} = i_1 - i_2 = 1.2975\ A$$

$$\boldsymbol{P_{8\Omega} = I_{8\Omega}^2 \times 8 = 13.4680\ W}$$





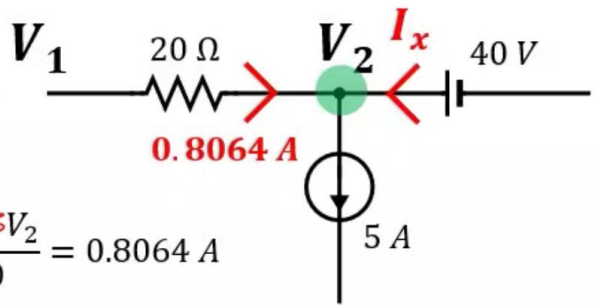
$V_2 = 40\ V$

$\frac{V_1 - V_2}{20} + \frac{V_1 - V_3}{10} + \frac{V_1}{30} - 1 = 0$ KCL at node 1

$\frac{V_3 - V_1}{10} + \frac{V_3}{40} - 5 + 1 + 0.5 = 0$ KCL at node 3

$V_1 = 56.1290\ V$

$V_3 = 72.9032\ V$



$\frac{V_1 - V_2}{20} = 0.8064\ A$

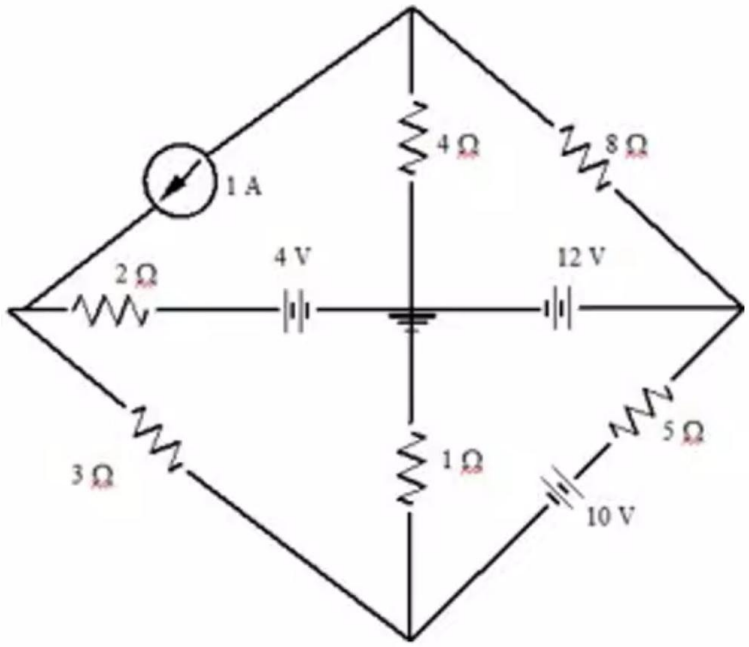
$0.8064 + I_x = 5$

$\boxed{I_x = 4.1936\ A}$

40 V battery is **discharging**

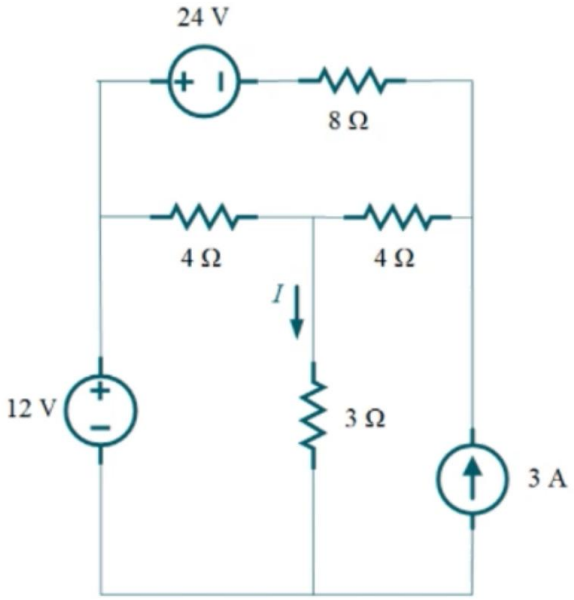
Self-Practice 4: Node Voltage Analysis

Find the voltage of **all nodes** using node voltage analysis.

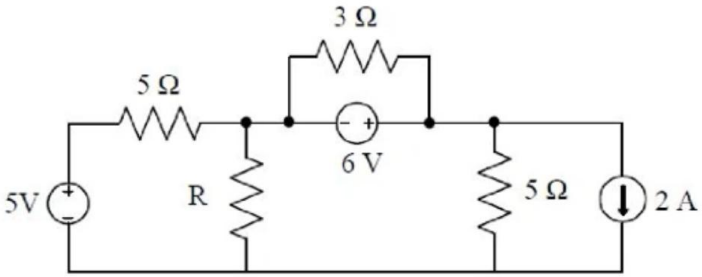


Self-Practice 5: Superposition Principle

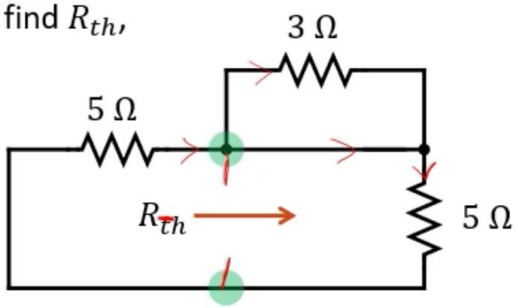
Find the current **I** using **superposition** theorem.



Ans:
Due to source 24 V: - 1 A
Due to source 12 V: 2 A
Due to source 3 A: 1 A
Total: 2 A

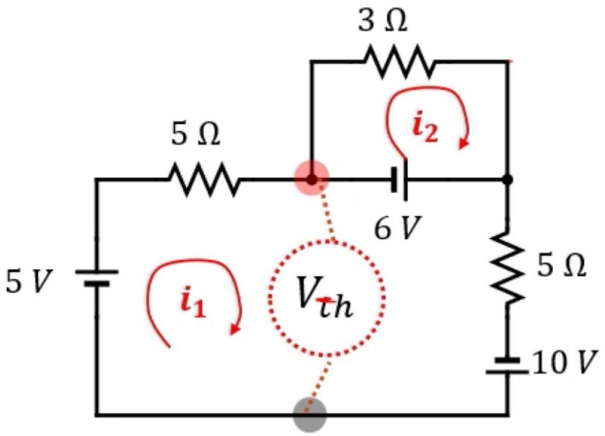


To find R_{th},



$$R_{th} = 2.5\ \Omega$$

To find V_{th} across load resistance R,



Applying KVL,

$$5 - 5(2.1) - V_{th} = 0$$

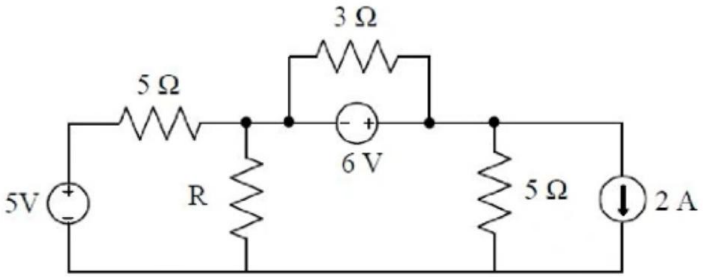
$$V_{th} = -5.5\ V$$

Maximum power transferred to load resistor 'R' will be,

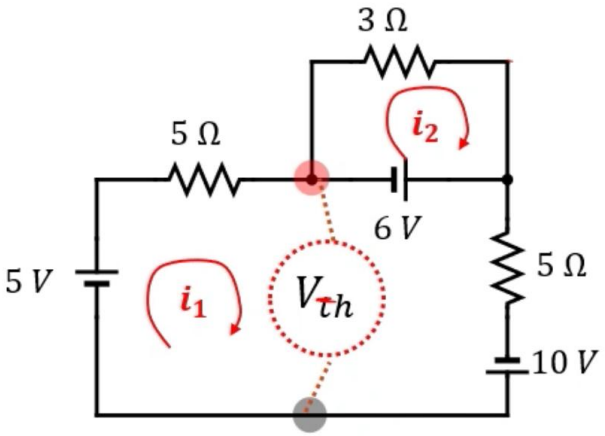
$$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{5.5^2}{4 \times 2.5} = 3.025\ W$$

$$5 - (5)(i_1) + 6 - 5(i_1) + 10 = 0 \qquad i_1 = 2.1\ \text{A}$$

$$-3i_2 - 6 = 0 \qquad i_2 = -2\ \text{A}$$



To find V_{th} across load resistance R,



$5 - (5)(i_1) + 6 - 5(i_1) + 10 = 0$ $\quad i_1 = 2.1\ \mathbf{A}$

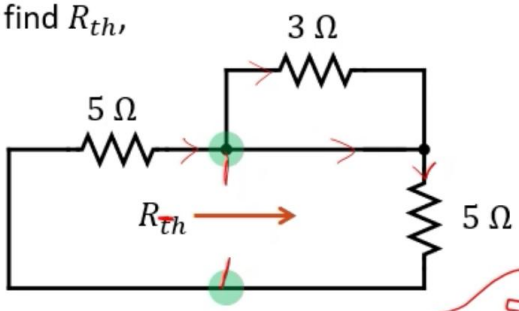
$-3i_2 - 6 = 0$ $\quad i_2 = -2\ \mathbf{A}$

Applying KVL,

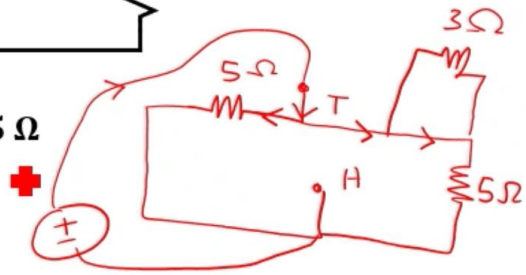
$5 - 5(2.1) - V_{th} = 0$

$\boldsymbol{V_{th} = -5.5\ V}$

To find R_{th},



$\boldsymbol{R_{th} = 2.5\ \Omega}$



Maximum power transferred to load resistor 'R' will be,

$$\boldsymbol{P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{5.5^2}{4 \times 2.5} = 3.025\ W}$$

Self-Practice 6: Thevenin's and MPTT

Determine the value of the load resistance to be connected across terminals **A & B** such that maximum power is transferred to it. Also, find the **maximum power** transferred.

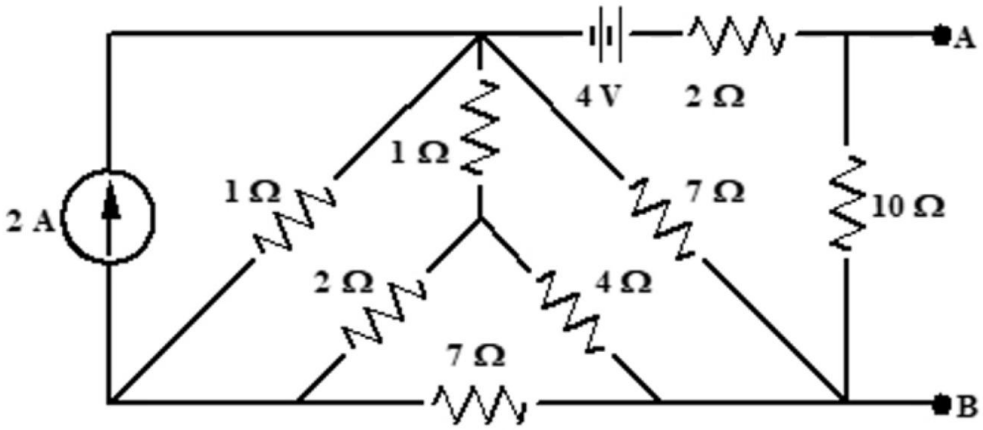


Fig. 1A

Miscellaneous 1

Two purely resistive incandescent bulbs have the following ratings:

Bulb 1: 120 V, 60 W **Bulb 2: 240 V, 480 W**

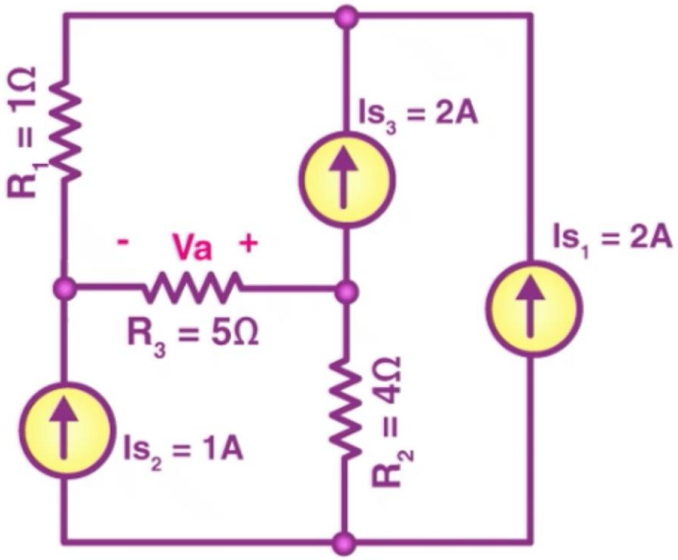
a) Both of them are connected in series across a voltage source.
   i. Which bulb will glow brighter and why?
   ii. What is the maximum voltage that can be applied so that none of the bulbs fuse?

b) Now both of them are connected in parallel across a voltage source.
   i. Which bulb will glow brighter and why?
   ii. What is the maximum voltage that can be applied so that none of the bulbs fuse?

Ans: (a) – (i) Bulb 1 will glow brighter as P1 > P2, (ii) Max. voltage = 180 V
(b) – (i) Bulb 2 will glow brighter as P2 > P1, (ii) Max. voltage = 120 V

Miscellaneous 2

Find $\mathbf{V_a}$ using nodal analysis and verify using mesh analysis



Self-Practice 6: Thevenin's and MPTT

Determine the value of the load resistance to be connected across terminals **A & B** such that maximum power is transferred to it. Also, find the **maximum power** transferred.

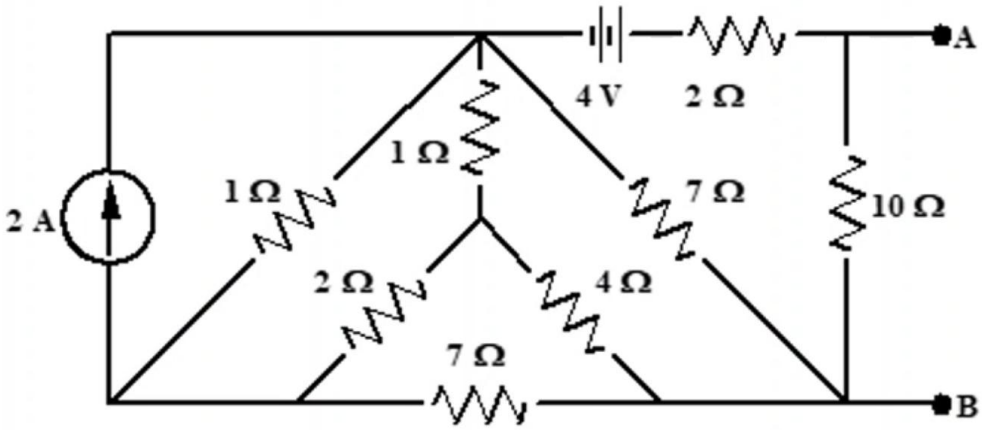


Fig. 1A

Ans: 2.923 Ω and 0.9098 W

Assessment

Brief Overview

Component	Marks	Details	
Internal	50	In-Semester Test 1	15
		In-Semester Test 2	15
		Weekly assignments via LMS Brightspace	20
External	50	End Semester Examination	