



Daffodil International University

Faculty of Science & Information Technology

Department of Computer Science & Engineering

Midterm Examination, Fall 2025

Course Code: CSE 121 , Course Title: Electrical Circuits

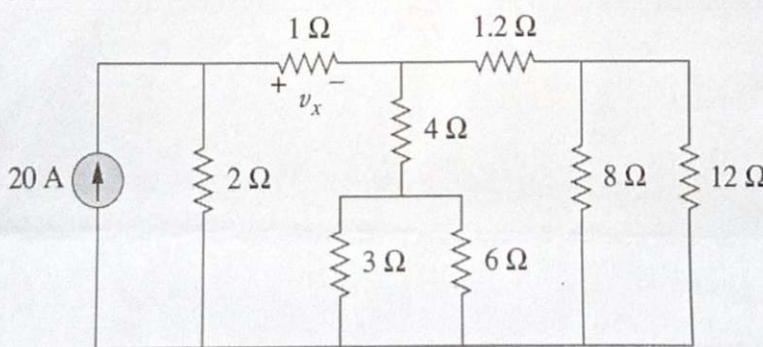
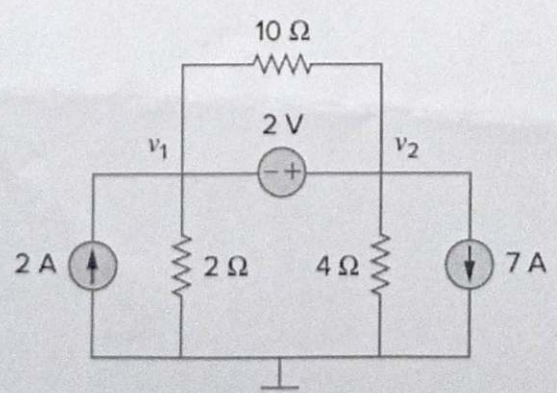
Level:1 Term:3 Batch: 68

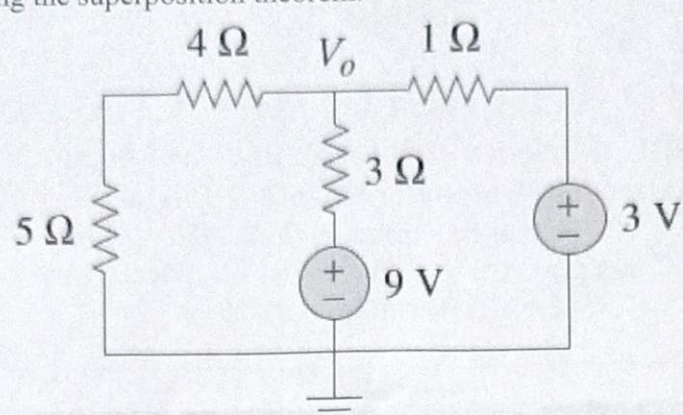
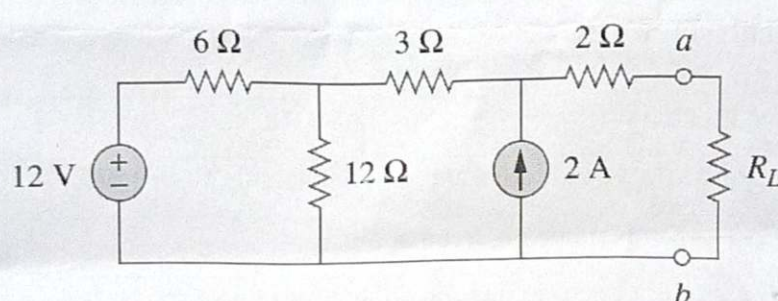
Time: 01:30 Hrs

Marks: 25

Answer ALL Questions [Optional]

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

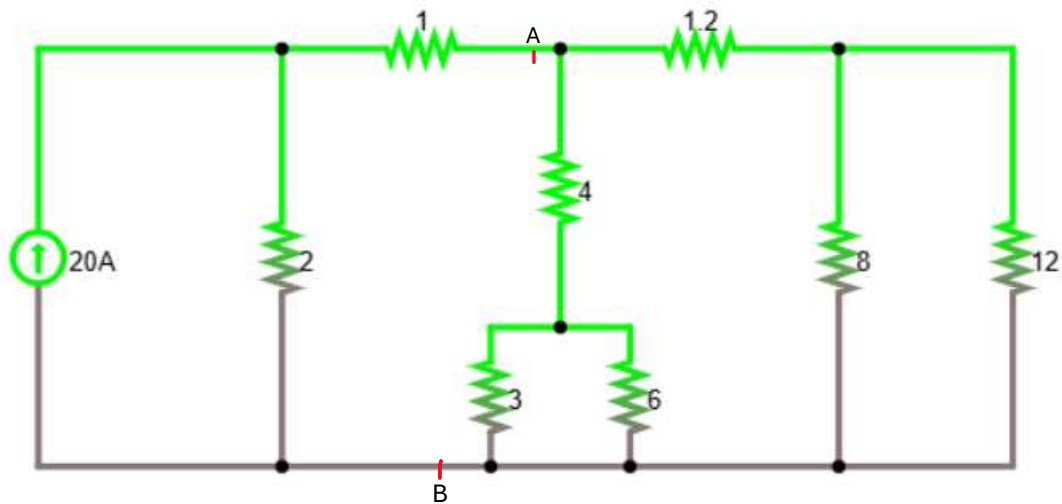
1.	a) What is node and branch? b) If the length of a conductor is doubled and its radius is reduced to half of its original value, what will be its new resistance? c) Define open and short circuit. d) How does temperature affect conductors and semiconductors? e) Explain the concept of a supernode in circuit analysis.	5×1=5	CO1
2.	a) Solve the following circuit to determine v_x and the power absorbed by the 2Ω resistor. 	5	CO2
	b) Solve the following circuit using nodal analysis to identify node voltages. 	5	

3.	a) Examine the following circuit to determine the current through the $3\ \Omega$ resistor using the superposition theorem. 	5	CO3
	b) Analyze the following circuits to- i) Determine the Thevenin equivalent resistance at terminals a-b. ii) Find R_L for maximum power deliverable to R_L. iii) Determine that maximum power. 	5	

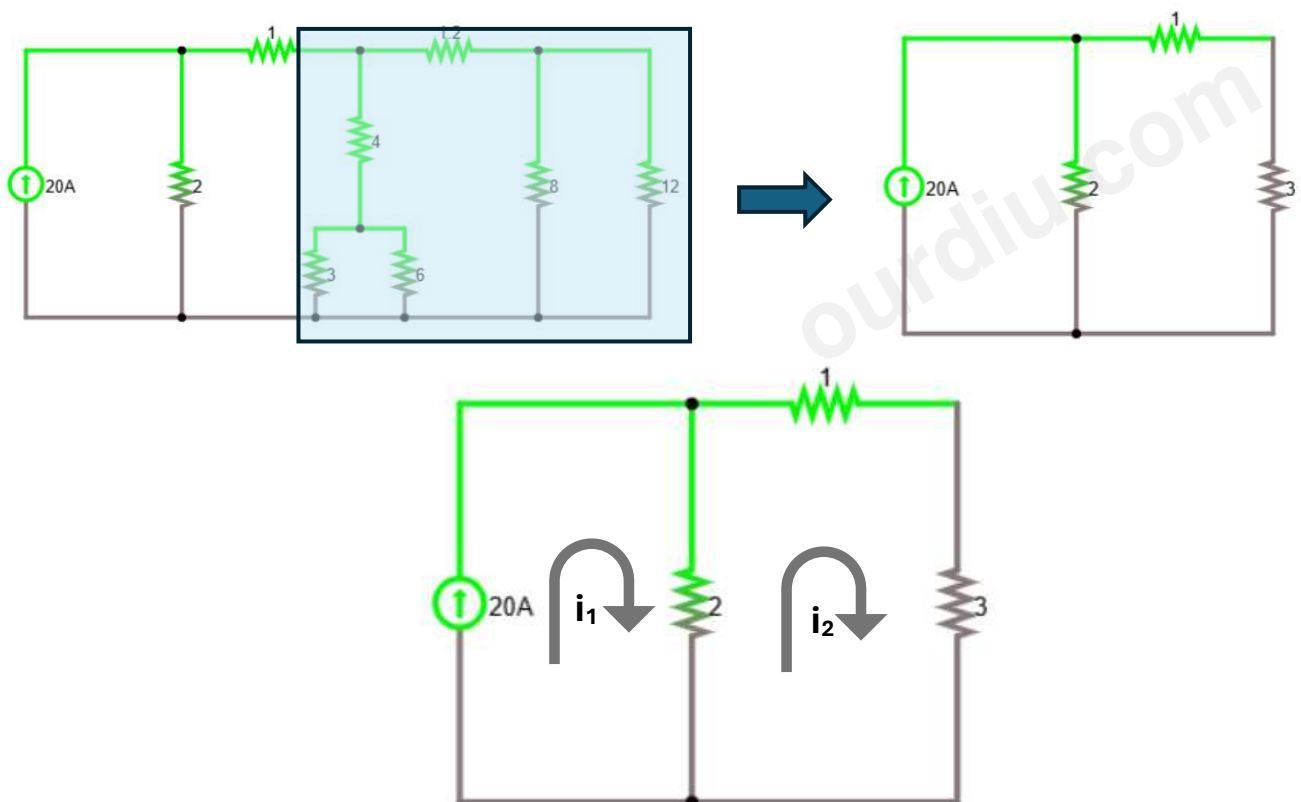
Solved by:
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Answer: 2(a)

Give Circuit:



Calculate equivalent resistance of the right portion of A and B.



From the circuit we get:

$$i_1 = 20\text{A}$$

Applying KVL at node-2:

$$2(i_2 - 20) + i_2 + 3 i_2 = 0$$

$$\Rightarrow i_2 = 6.67\text{ A}$$

So, Voltage through 1 Ohm resistor

$$V_0 = i_2 R = 6.67 \times 1 = 6.67\text{ v}$$

Again, Current through 2 Ohm resistor

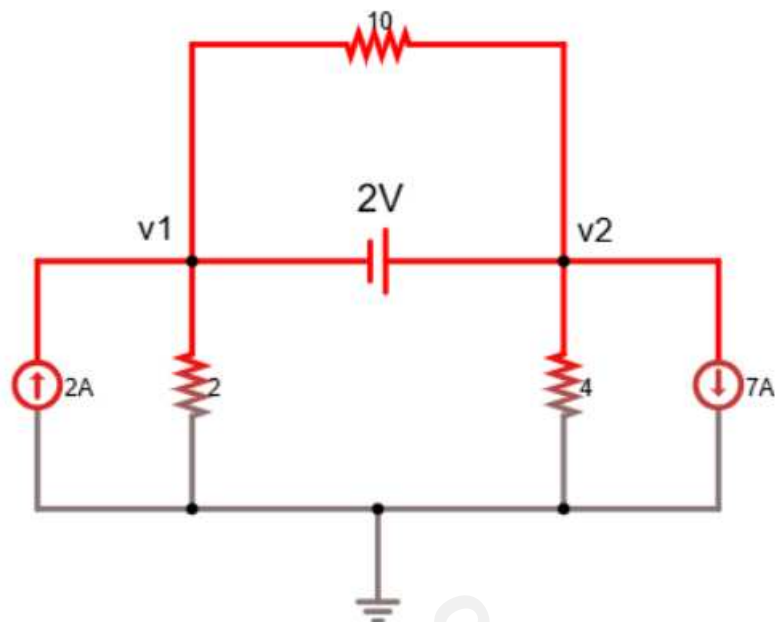
$$I_{R2} = i_1 - i_2 = 20 - 6.67 = 13.33\text{A}$$

So, Power Absorbed by 2 Ohm resistor ,

$$P = (I_{R2})^2 R = (13.33)^2 \times 2 = 355.56\text{W}$$

Answer: 2(b)

Given Circuit:



There is a voltage source between node-1 and node-2. So, node-1 and node-2 forms a Supernode.

Applying KCL at supernode:

$$-2 + \frac{v_1}{2} + \frac{v_1 - v_2}{10} + \frac{v_2 - v_1}{10} + \frac{v_2}{4} + 7 = 0$$

$$\Rightarrow 2v_1 + v_2 = -20 \text{ -----(i)}$$

Supernode equation:

$$v_2 - v_1 = 2$$

$$\Rightarrow v_1 - v_2 = -2 \text{ -----(ii)}$$

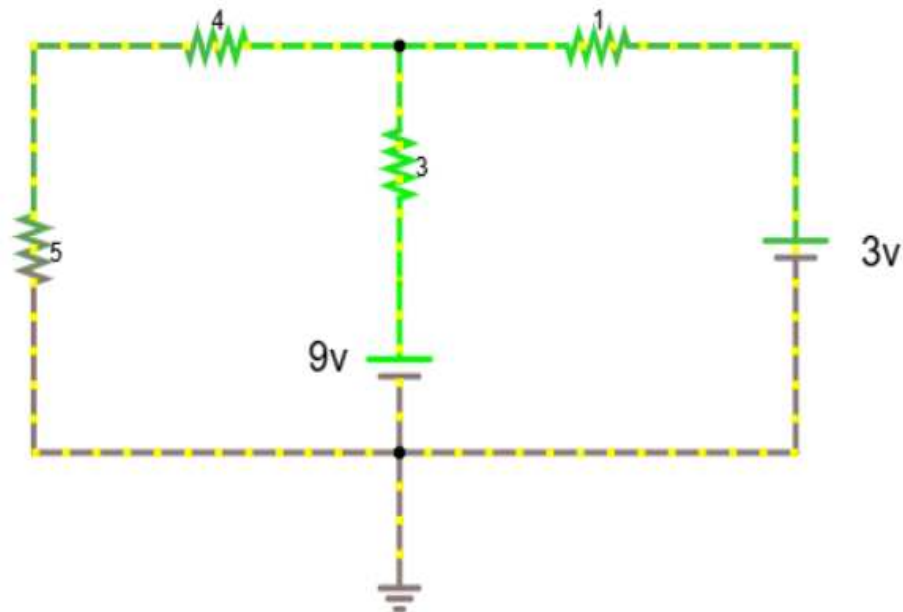
By solving equations:

$$v_1 = -7.33 \text{ v}$$

$$v_2 = -5.33 \text{ v}$$

Answer: 3(a)

Given Circuit:



For 9v voltage source current through the 3Ohm resistor:

Applying KVL to loop-1:

$$5i_1 + 4i_1 + 3(i_1 - i_2) + 9 = 0$$

$$\Rightarrow 12i_1 - 2i_2 = -9 \text{ -----(1)}$$

Applying KVL to loop-2:

$$3(i_2 - i_1) + i_2 - 9 = 0$$

$$\Rightarrow -3i_1 + 4i_2 = 9 \text{ -----(2)}$$

Solving two equations:

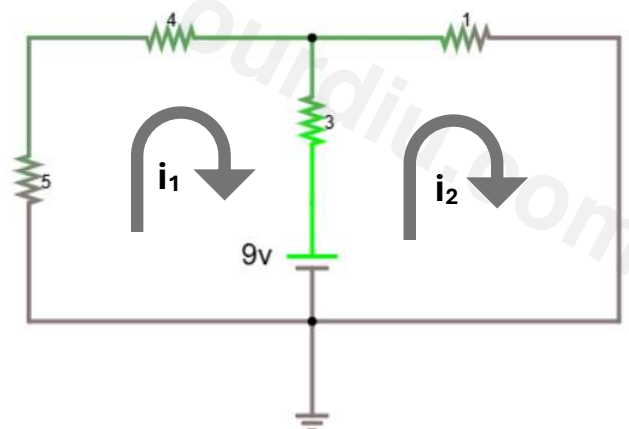
$$i_1 = -0.231$$

$$i_2 = 2.076$$

Current through 3Ohm resistor

$$I_{9V} = i_2 - i_1 = 2.076 - (-0.231)$$

$$= 2.307 \text{ A}$$



For 3V voltage source current through 3Ohm resistor:

Applying KVL to loop-1:

$$3i_1 + 4i_1 + 3(i_1 - i_2) = 0$$

$$\Rightarrow 12i_1 - 3i_2 = 0 \quad \text{-----(i)}$$

Applying KVL to loop-2:

$$3(i_2 - i_1) + i_2 + 3 = 0$$

$$\Rightarrow 3i_1 - 4i_2 = 3 \quad \text{-----(ii)}$$

By solving equations:

$$i_1 = -0.231$$

$$i_2 = -0.923$$

Current through 3Ohm resistor for 3V voltage source

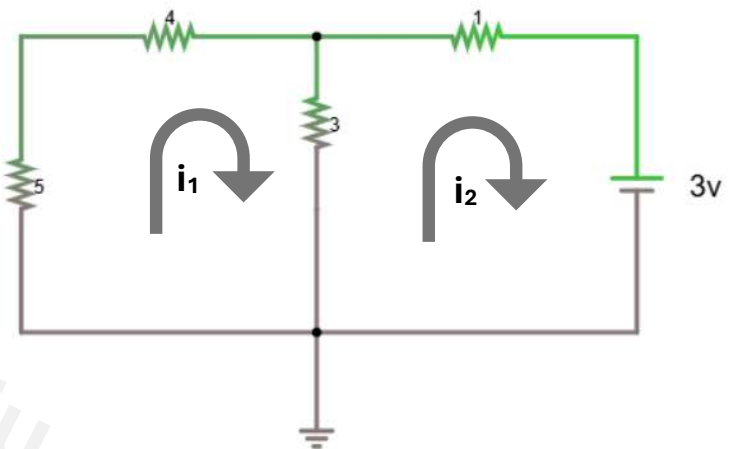
$$I_{3V} = i_2 - i_1 = -0.923 - (-0.231)$$

$$= -0.692 \text{ A}$$

Total current through 3Ohm resistor:

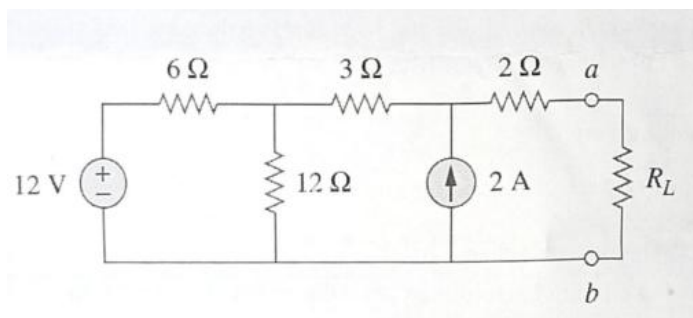
$$I = I_{9V} + I_{3V} = 2.307 + (-0.692) \text{ A}$$

$$= 1.615 \text{ A}$$



Answer 3(b)

Given Circuit

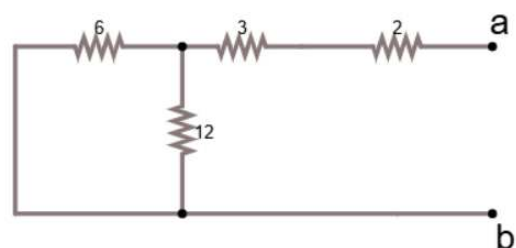


i) Detach the Current and voltage sources to calculate Thevenin equivalent resistance:

$$R_{Th} = (6 \parallel 12) + 3 + 2 \text{ Ohm}$$

$$= 9 \text{ Ohm}$$

ii) The **Maximum Power Transfer Theorem** states that the maximum power is delivered to a load resistor R_L when R_L is equal to the

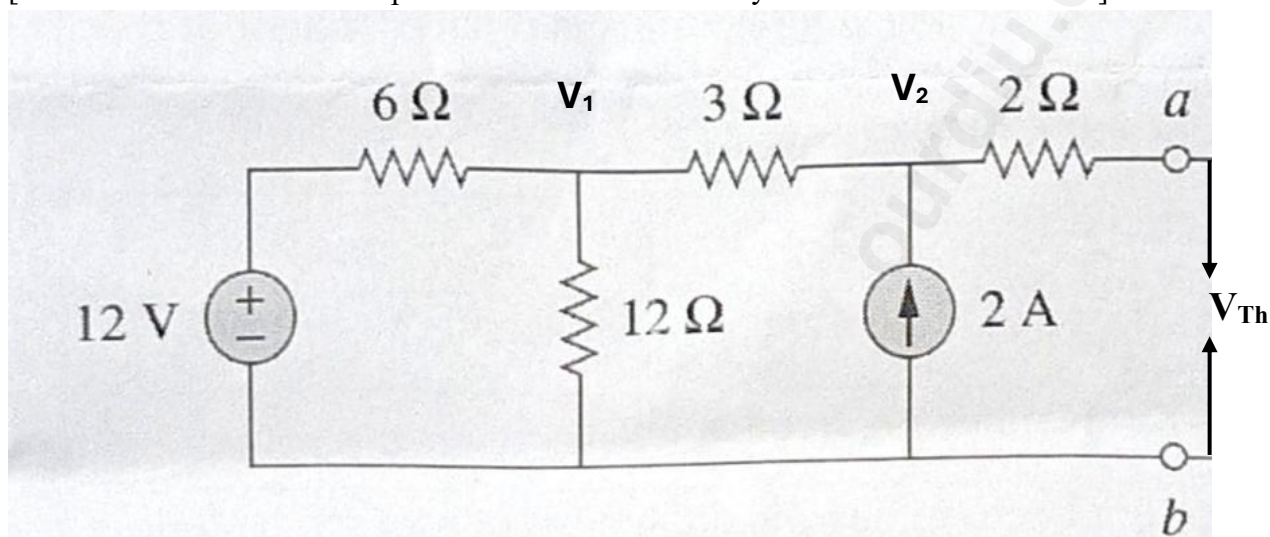


Thevenin equivalent resistance R_{Th} of the source network as seen from the load terminals.

$$R_L = R_{Th} = 90\Omega$$

iii)

[**Note:** This solution contains possible inaccuracies. Kindly cross-check and confirm.]



Applying KCL to Node-1:

$$\frac{v_1 - 12}{6} + \frac{v_1 - v_2}{3} + \frac{v_1}{12} = 0$$

$$\Rightarrow 7V_1 - 4V_2 = 24 \text{ -----(1)}$$

Applying KCL to Node-2:

$$\frac{V_2 - V_1}{3} - 2 = 0$$

$$\Rightarrow -V_1 + V_2 = 6 \text{ -----(2)}$$

By solving equations, we get

$$V_1 = 16$$

$$V_2 = 22$$

So, $V_{Th} = V_2 = 22V$

Maximum Power,

$$P_{Max} = \frac{V_{Th}^2}{4R_{Th}} = \frac{22^2}{4 \times 9} = 13.44W$$