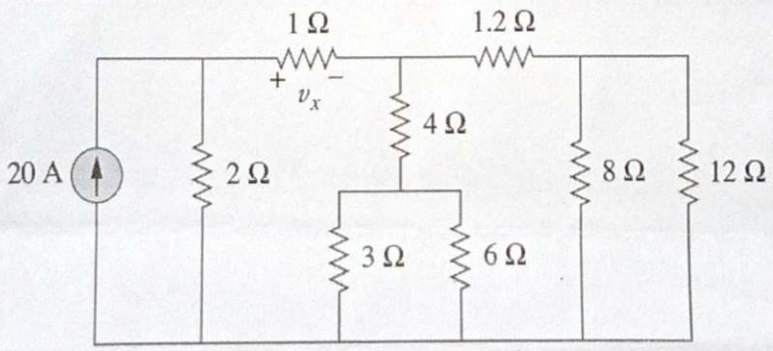
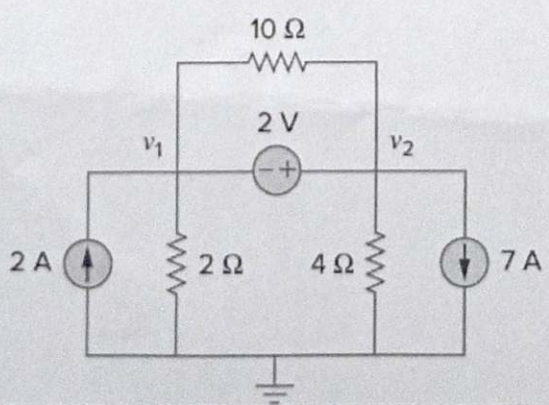
Daffodil International University

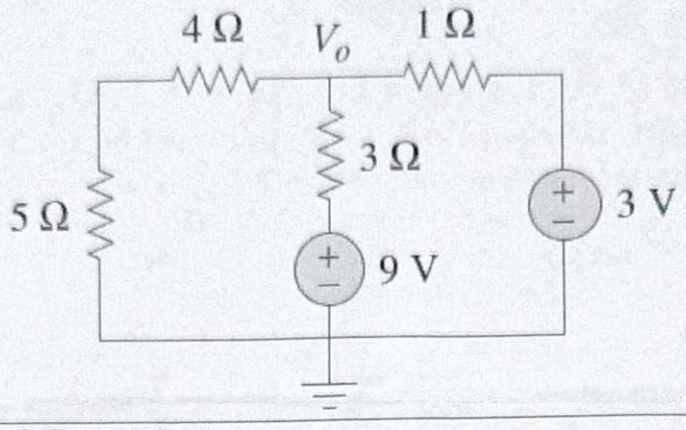
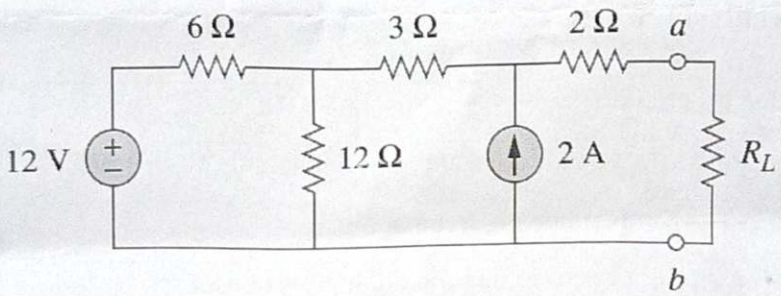
Faculty of Science & Information Technology
Department of Computer Science & Engineering
Midterm Examination, Fall 2025
Course Code: CSE 121 , Course Title: Electrical Circuits
Level:1 Term:3 Batch: 68

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?	5×1=5	CO1
	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.		
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 Ω 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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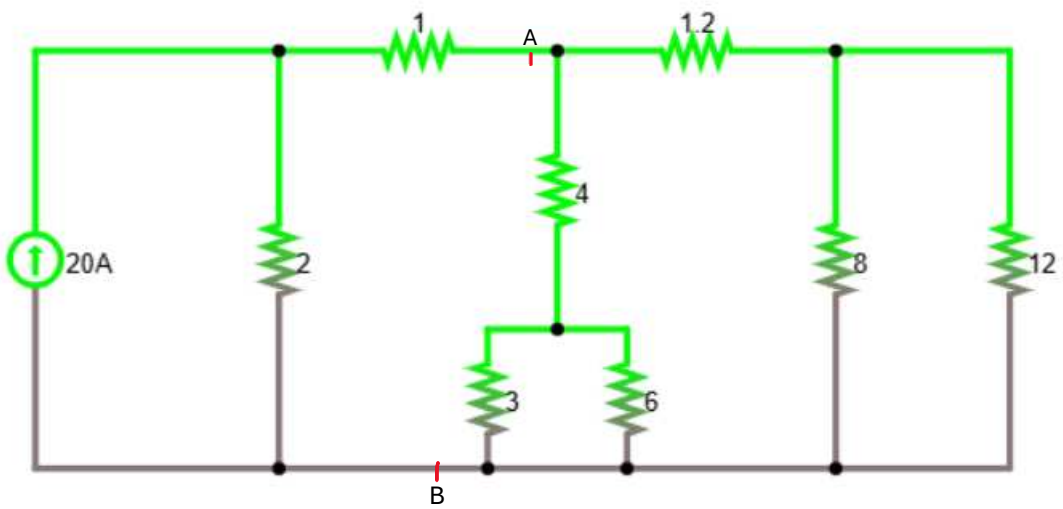
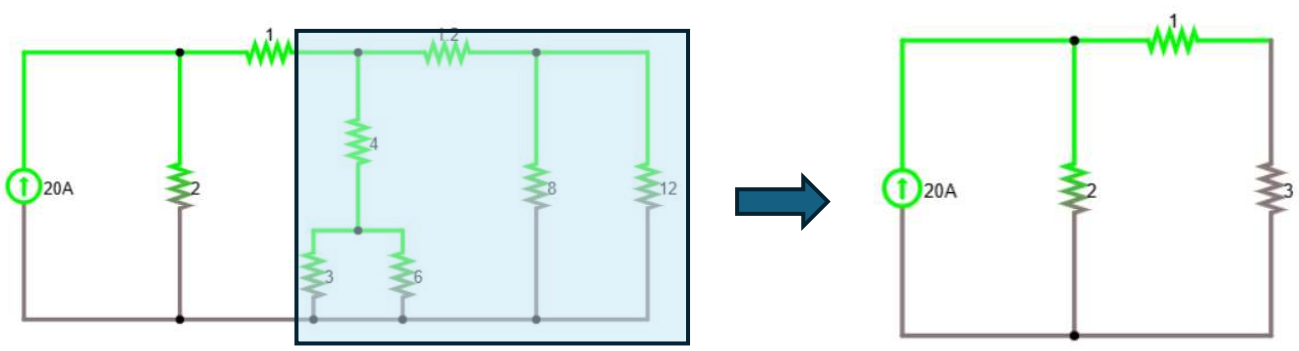
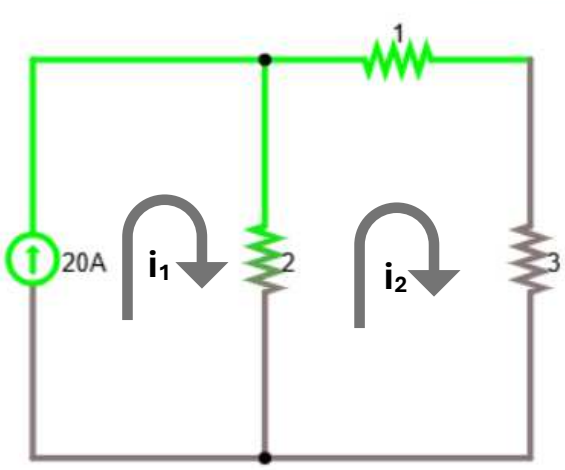
Answer: 2(a)

Give Circuit:



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





From the circuit we get:

$i_1 = 20A$

Applying KVL at node-2:

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

⇨ $i_2 = 6.67$ A

So, Voltage through 1Ohm resistor

$V_0 = i_2 R = 6.67 \times 1 = 6.67$ v

Again, Current through 2Ohm resistor

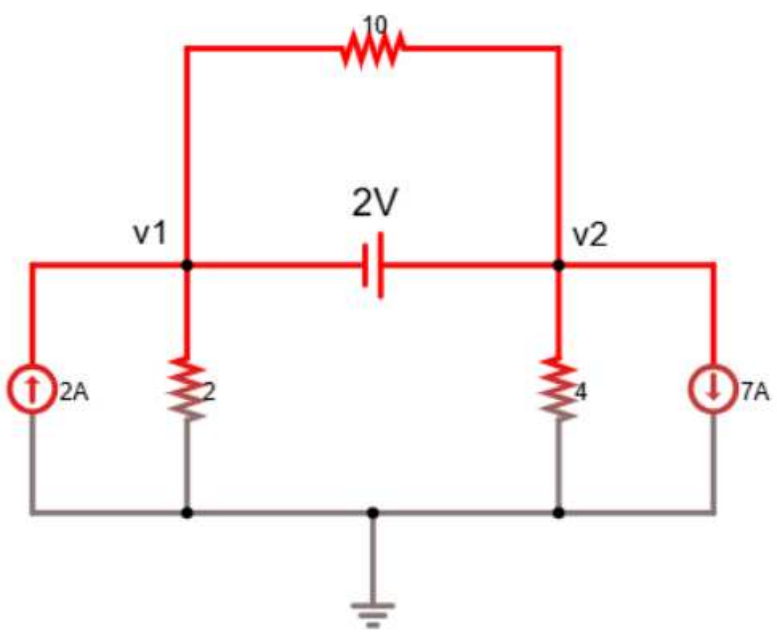
$I_{R2} = i_1 - i_2 = 20-6.67 = 13.33A$

So, Power Absorbed by 2Ohm resistor ,

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

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:

$$-2 + \frac{v1}{2} + \frac{v1-v2}{10} + \frac{v2-v1}{10} + \frac{v2}{4} + 7 = 0$$

⇨ $2v1 + v2 = -20$ ----------(i)

Supernode equation:

$v2 - v1 = 2$

⇨ $v1 - v2 = -2$ ----------(ii)

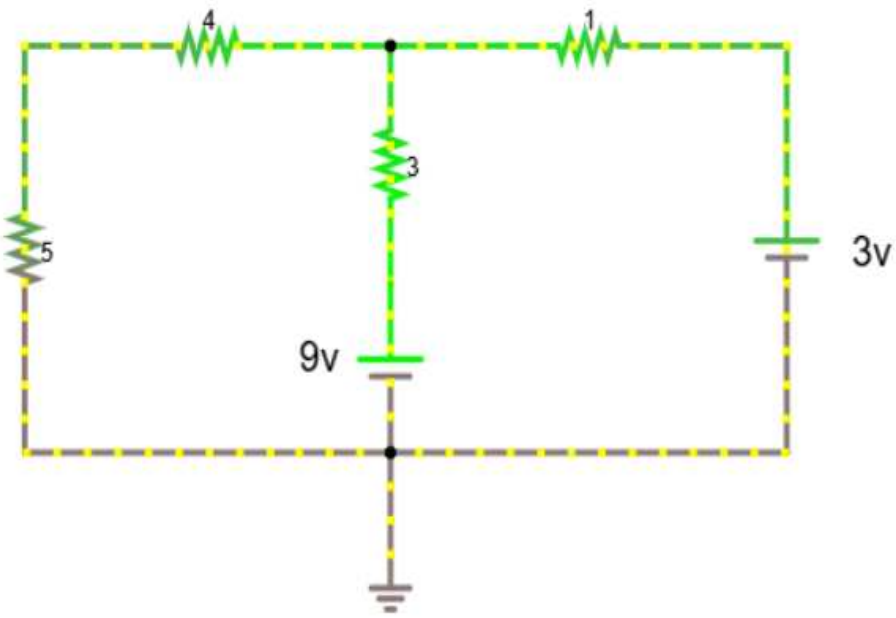
By solving equations:

$v1 = -7.33$ v

$v2 = -5.33$ v

Answer: 3(a)

Given Circuit:

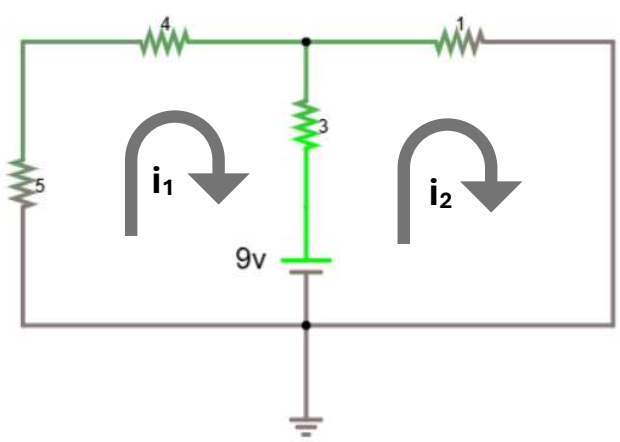


For 9v voltage source current through the 3Ohm resistor:

Applying KVL to loop-1:

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

⇨ $12i_1 - 2i_2 = -9$ ---------(1)



Applying KVL to loop-2:

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

⇨ $-3i_1 + 4i_2 = 9$ ----------(2)

Solving two equations:

$i_1 = -0.231$

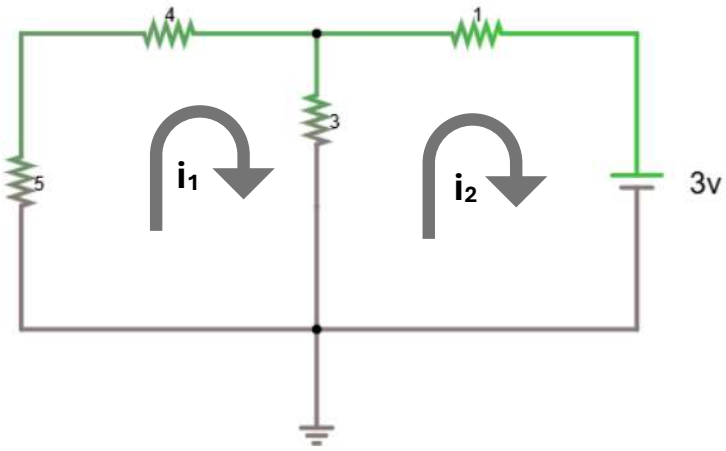
$i_2 = 2.076$

Current through 3Ohm resistor

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

$=2.307$ A

For 3V voltage source current through 3Ohm resistor:



Applying KVL to loop-1:

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

⇨ $12i_1-3i_2=0$ ------(i)

Applying KVL to loop-2:

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

⇨ $3i_1 – 4i_2 = 3$ --------(ii)

By solving equations:

$i_1 = - 0.231$

$i_2 = - 0.923$

Current through 3Ohm resistor for 3V voltage source

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

$= -0.692$ A

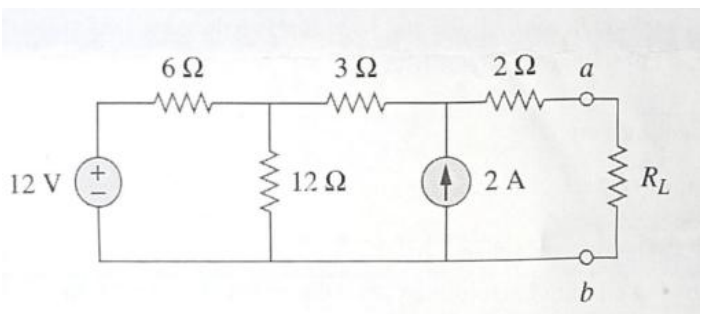
Total current through 3Ohm resistor:

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

$= 1.615$ A

Answer 3(b)

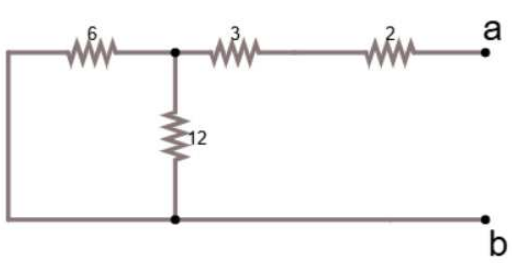
Given Circuit



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

$R_{Th} = (6||12)+3+2$ Ohm

$= 9$ Ohm



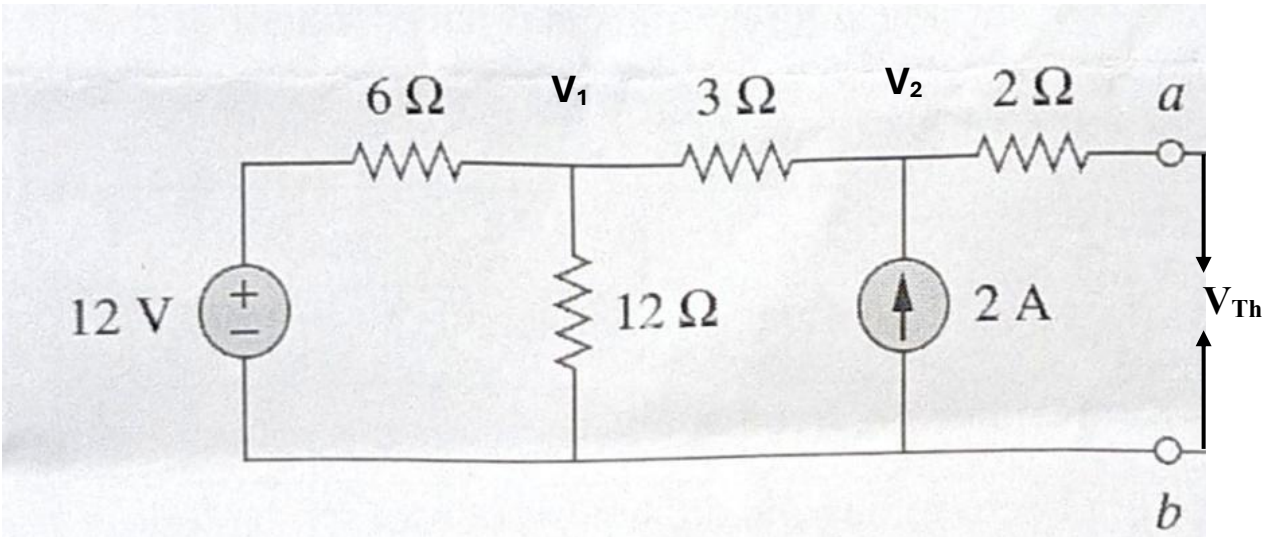
ii) The **Maximum Power Transfer Theorem** states that the maximum power is delivered to a load resistor R_L when R_L is equal to the

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

$R_L = R_{Th} = 9\text{Ohm}$

iii)

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



Applying KCL to Node-1:

$$\frac{v1 - 12}{6} + \frac{v1 - v2}{3} + \frac{v1}{12} = 0$$

⇨ $7V_1 - 4V_2 = 24$ ----------(1)

Applying KCL to Node-2:

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

⇨ $-V_1 + V_2 = 6$ ----------(2)

By solving equations, we get

$V_1 = 16$

$V_2 = 22$

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

Maximum Power,

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