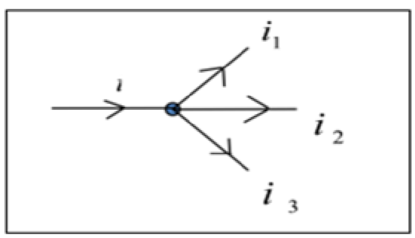
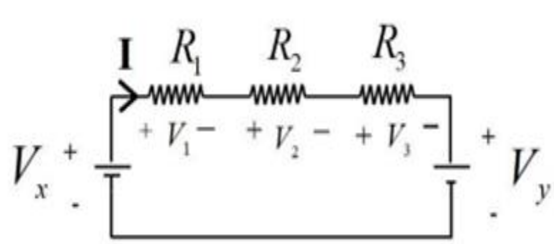
SR 22

St. Peter's Engineering College(Autonomous) Dullapally (P), Medchal, Hyderabad – 500100. QUESTION BANK					Dept.	:	ECE , CSE,CSD,CSC
					Academic Year 2023-24		
Subject Code	:	AS22-02ES01	**Subject**	:	**Basic Electrical Engineering**		
Class/Section	:	**B.Tech.**	**Year**	:	**I**	**Semester**	: **I**

BLOOMS LEVEL					
Remember	**L1**	**Understand**	**L2**	**Apply**	**L3**
Analyze	**L4**	**Evaluate**	**L5**	**Create**	**L6**

*****

Q. No	Question (s)	Marks	BL	CO
	UNIT - I			
1	**a) state and explain kirchhoff's current law** **Kirchhoff's current law (KCL)** The algebraic sum of current at given **node** is equals to zero.  As from the above figure $i = i_1 + i_2 + i_3$ $\boxed{i - i_1 - i_2 - i_3 = 0}$	1M	L2	C114.1
	b) state and explain kirchhoff's voltage law The algebraic sum of voltages in a **closed circuit** is equals to zero.  As from the above figure, $\boxed{V_x - V_1 - V_2 - V_3 - V_y = 0}$	1M	L2	C114.1

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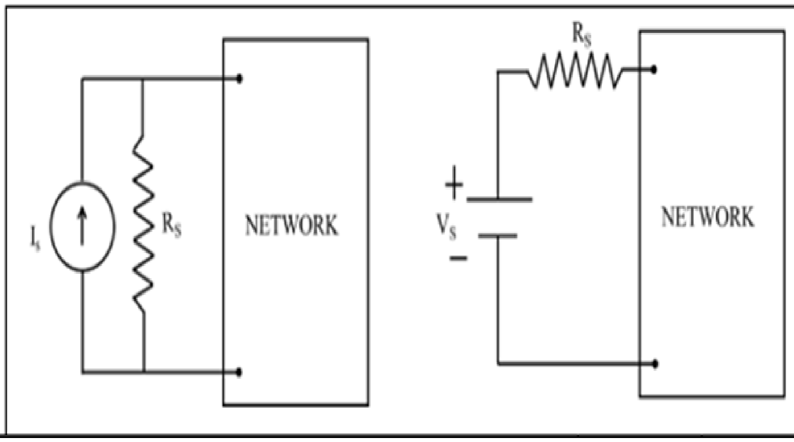
<td>c)
Explain source transformation technique.
Source transformation technique
A current source in parallel with source resistance can be replaced with a voltage source in series with the same source resistance, and vice -versa.

</td>
<td>1M</td>
<td>L2</td>
<td>C114.1</td>
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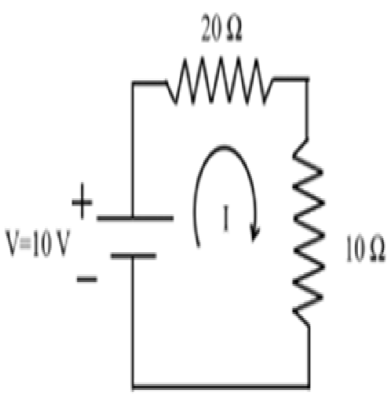
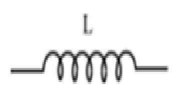
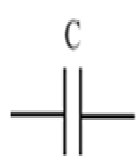
<td>d)
Find the current, I in the given network.


$$10-20i-10i=0$$
$$30i=10$$
$$\boxed{i=0.33A}$$</td>
<td>1M</td>
<td>L3</td>
<td>C114.1</td>
</tr>
</table>

<table>
<tr><td></td><td>e) Define Power
Power, P
Work done per unit time is called as power.
$$P=\frac{dw}{dt} \qquad P=\frac{dw}{dt}\times\frac{dQ}{dQ} \qquad P=\frac{dw}{dQ}\times\frac{dQ}{dt}=VI$$
$$\boxed{\begin{aligned}&P=VI\\&P=(IR)I=I^2R\\&P=VI=V\frac{V}{R}=\frac{V^2}{R}\end{aligned}}$$
Units: Watt</td><td>1M</td><td>L1</td><td>C114.1</td></tr>
<tr><td>2</td><td>a) Define resistance inductance and capacitance
<table>
<tr><td>Resistance, R</td><td></td><td>It is the ratio of voltage to the current.
$$\boxed{R=\frac{V}{I}}$$</td><td>Ohm</td></tr>
<tr><td>Inductance, L</td><td></td><td>Flux linkages per ampere current.
$$\boxed{L=\frac{N\phi}{I}}$$</td><td>Henry</td></tr>
<tr><td>Capacitance, C</td><td></td><td>Charge per unit potential.
$$\boxed{C=\frac{Q}{V}}$$</td><td>Farad</td></tr>
</table></td><td>3M</td><td>L1</td><td>C114.1</td></tr>
<tr><td></td><td>b)</td><td>3M</td><td>L1</td><td>C114.1</td></tr>
</table>

State and explain ohm's law. And write down its limitations.

Ohm's law

The current flowing through the given conductor is directly proportional to the applied voltage and inversely proportional to resistance of the conductor.

$$\boxed{I = \frac{V}{R}}$$

Limitations of Ohm's law

1. It is **applicable to only linear elements** only.
2. It is applicable at normal temperature and pressure **(NTP) conditions only.**

c) Classify various network elements

Network elements are classified into four types

i. Active and Passive elements

Active elements are the elements which **supplies** the energy.

Examples: Battery, DC generator, AC generator etc.

Passive elements are the elements which **consume** energy.

Examples: R, L and C

ii. Linear and nonlinear elements

For a given element if the **output is directly proportional to the input**, then the element is called linear element, otherwise it is a nonlinear element. Examples of linear elements are R,L and C and non-linear elements are diode, transistor.

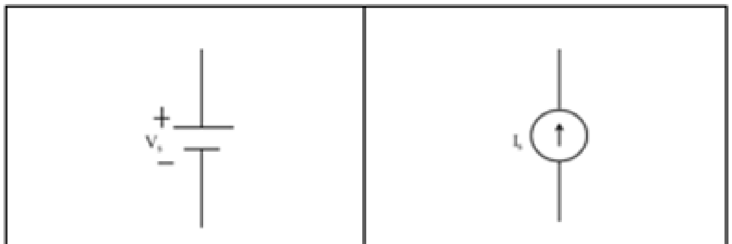
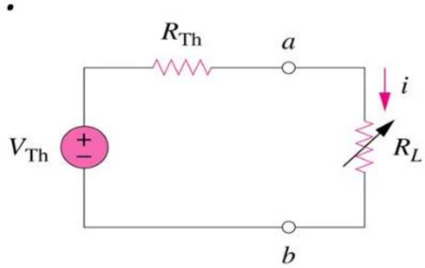
iii. Unilateral and bilateral element

If the element allows current in **only one direction** it is called unilateral element. Examples are diode and transistor.
If the element allows current in **both direction** is called bilateral element. Examples: R,L,C

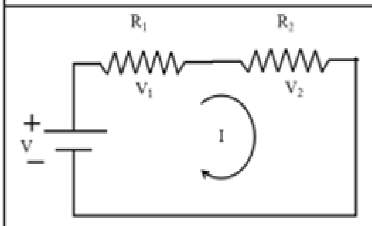
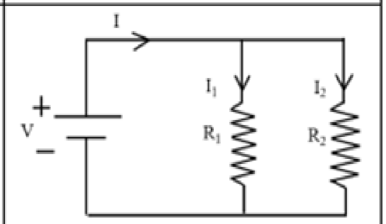
iv. Lumped and distributed elements

The elements which are **physically separable** are called lumped elements. Examples are R, L and C.
The elements which are **not physically separable** is called distributed elements. Examples: Transmission line parameters

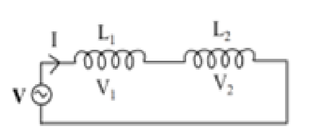
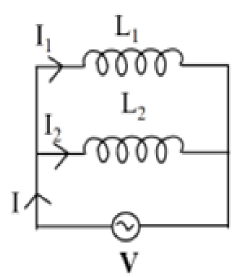
3M	L2	C114.1

	d) Explain various types of sources **Energy sources are classified into two types.** **i. Independent energy sources** The energy delivered by the source is doesn't depend upon the other elements in the network.  Independent voltage source — Independent current source **ii. Dependent energy sources** The energy delivered by the source is controlled by the voltage across or current flowing through the other elements in the network. They are four types: I. Voltage controlled voltage source (VCVS) II. Current controlled voltage source (CCVS) III. Voltage controlled current source (VCCS) IV. Current controlled current source (CCCS)	3M	L1	C114.1
	e) State and Explain Maximum Power Transfer Theorem ***Maximum Power Transfer Theorem:*** ***Statement:*** ***Maximum Power Transfer Theorem states that "maximum power is transferred from the source to the load when the load resistance is equal to the Thevenin's equivalent resistance".*** **i.e, $R_L = R_{TH}$** 	3M	L2	C114.1
3	**a) Derive Equivalent Resistance when two resistors are**	5M	L4	C114.1

connected in series and parallel

Resistors in series	Resistors in Parallel
	
$V = V_1 + V_2$ $V = IR_1 + IR_2$ $V = I(R_1 + R_2)$ $\frac{V}{I} = (R_1 + R_2)$ $\boxed{R_{eq} = (R_1 + R_2)}$	$I = I_1 + I_2$ $I = \frac{V}{R_1} + \frac{V}{R_2}$ $\frac{I}{V} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ $\frac{1}{R_{eq}} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ $\boxed{R_{eq} = \frac{R_1 R_2}{R_1 + R_2}}$

b) Derive Equivalent Inductance when two inductors are connected in series and parallel

Inductors in Series	Inductors in Parallel
	
$V = V_1 + V_2$ $V = L\frac{dI}{dt}$ $V_1 = L_1\frac{dI}{dt}$ $V_2 = L_2\frac{dI}{dt}$ $L\frac{dI}{dt} = L_1\frac{dI}{dt} + L_2\frac{dI}{dt}$ $L\frac{dI}{dt} = (L_1 + L_2)\frac{dI}{dt}$ $\boxed{L_{eq} = (L_1 + L_2)}$	$I = I_1 + I_2$ $I = \frac{1}{L}\int V\,dt$ $I_1 = \frac{1}{L_1}\int V\,dt$ $I_2 = \frac{1}{L_2}\int V\,dt$ $\frac{1}{L}\int V\,dt = \left(\frac{1}{L_1}\int V\,dt\right) + \left(\frac{1}{L_2}\int V\,dt\right)$ $\frac{1}{L}\int V\,dt = \left(\frac{1}{L_1} + \frac{1}{L_2}\right)\int V\,dt$ $\frac{1}{L_{eq}} = \left(\frac{1}{L_1} + \frac{1}{L_2}\right)$ $\boxed{L_{eq} = \frac{L_1 L_2}{L_1 + L_2}}$

5M	L4	C114.1

c) Derive Equivalent Capacitance when two capacitors are

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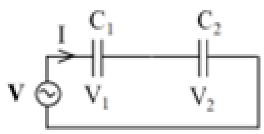
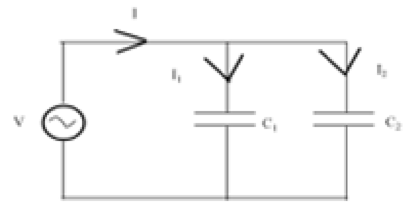
connected in series and parallel
<table>
<tr><th>Capacitors in Series</th><th>Capacitors in Parallel</th></tr>
<tr>
<td></td>
<td></td>
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<td>
$V = V_1 + V_2$
$V = \frac{1}{C}\int I\,dt$
$V_1 = \frac{1}{C_1}\int I\,dt$
$V_2 = \frac{1}{C_2}\int I\,dt$
$\frac{1}{C}\int I\,dt = \left(\frac{1}{C_1}\int I\,dt\right) + \left(\frac{1}{C_2}\int I\,dt\right)$
$\frac{1}{C}\int I\,dt = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)\int I\,dt$
$\frac{1}{C_{eq}} = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)$
$\boxed{C_{eq} = \frac{C_1 C_2}{C_1 + C_2}}$
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<td>
$I = I_1 + I_2$
$I = C\frac{dV}{dt}$
$I_1 = C_1\frac{dV}{dt}$
$I_2 = C_2\frac{dV}{dt}$
$C\frac{dV}{dt} = C_1\frac{dV}{dt} + C_2\frac{dV}{dt}$
$C\frac{dV}{dt} = (C_1 + C_2)\frac{dV}{dt}$
$\boxed{C_{eq} = (C_1 + C_2)}$
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<td>5M</td>
<td>L4</td>
<td>C114.1</td>
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d) Derive The Formula for Voltage Division Rule When two Resistors are Connected in Series
Resistors in Series
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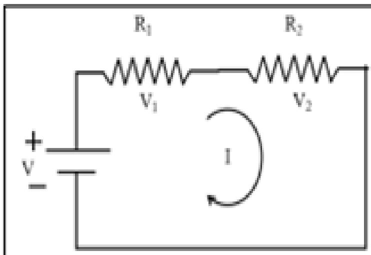
$\boxed{V_1 = V\frac{R_1}{R_1 + R_2}}$
$\boxed{V_2 = V\frac{R_2}{R_1 + R_2}}$
</td>
<td>
$V = V_1 + V_2$
$V = IR_1 + IR_2$
$V = I(R_1 + R_2)$
$\frac{V}{I} = (R_1 + R_2)$
$\boxed{R_{eq} = (R_1 + R_2)}$
$V_1 = IR_1 = \left(\frac{V}{R_1 + R_2}\right)R_1 = V\frac{R_1}{R_1 + R_2}$
$V_2 = IR_2 = \left(\frac{V}{R_1 + R_2}\right)R_2 = V\frac{R_2}{R_1 + R_2}$
</td>
</tr>
</table>
</td>
<td>5M</td>
<td>L4</td>
<td>C114.1</td>
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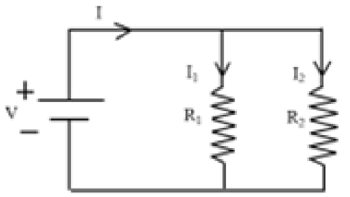
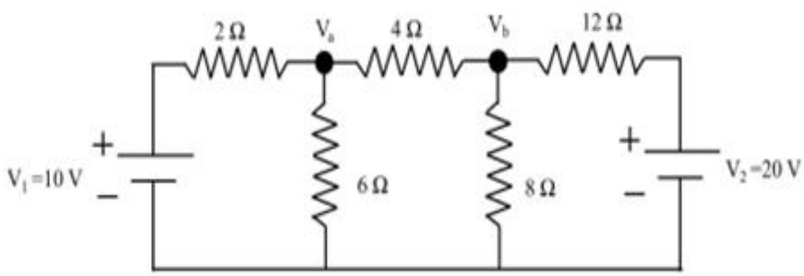
	e) Derive The Formula for current Division Rule When two Resistors are Connected in Parallel **Resistors connected in parallel**  $\boxed{I_1 = I\frac{R_2}{R_1+R_2}}$ $\boxed{I_2 = I\frac{R_1}{R_1+R_2}}$ $I = I_1 + I_2$ $I = \frac{V}{R_1} + \frac{V}{R_2}$ $\frac{I}{V} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ $\boxed{\frac{1}{R_{eq}} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)}$ $I_1 = \frac{V}{R_1} = \frac{IR_{eq}}{R_1} = \frac{I\frac{R_1R_2}{R_1+R_2}}{R_1} = I\frac{R_2}{R_1+R_2}$ $I_2 = \frac{V}{R_2} = \frac{IR_{eq}}{R_2} = \frac{I\frac{R_1R_2}{R_1+R_2}}{R_2} = I\frac{R_1}{R_1+R_2}$	5M	L4	C114.1
4	**a)** **Find the node voltages, V_a and V_b in the given network using nodal analysis.** 	10M	L5	C114.1

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Apply KCL at Node 1

$$\frac{V_a-10}{2}+\frac{V_a}{6}+\frac{V_a-V_b}{4}=0$$

$$V_a\left(\frac{1}{2}+\frac{1}{6}+\frac{1}{4}\right)-\frac{V_b}{4}=5$$

$$V_a\left(\frac{6+2+3}{12}\right)-\frac{V_b}{4}=5$$

$$0.91V_a-0.25V_b=5 \quad (1)$$

Apply KCL at Node 2

$$\frac{V_b-20}{12}+\frac{V_b}{8}+\frac{V_b-V_a}{4}=0$$

$$-0.25V_a+0.458V_b=1.66 \quad (2)$$

By solving Equations (1) and (2), one can get

$$V_a=7.63\ V$$

$$V_b=7.79\ V$$
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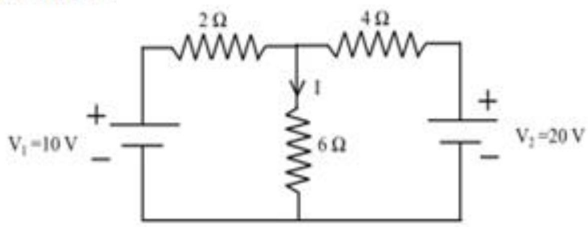
b) **State Super position theorem. Find the current flowing through 6 ohm resistor using Super position theorem.**



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<td>10M</td>
<td>L5</td>
<td>C114.1</td>
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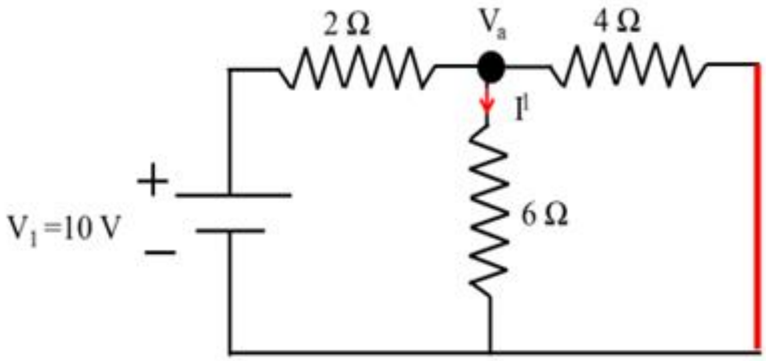
Statement of Super Position Theorem

"In a linear bilateral active circuit, the response at any branch when all sources acting simultaneously is equals to the algebraic sum of responses when individual sources alone."

Step 1: To find the current flowing through the 6 ohm resistor with

$V_1 = 10$ V and $V_2 = 0$ i.e. I^1

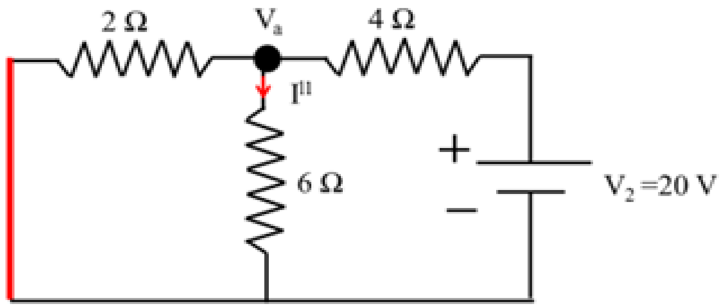
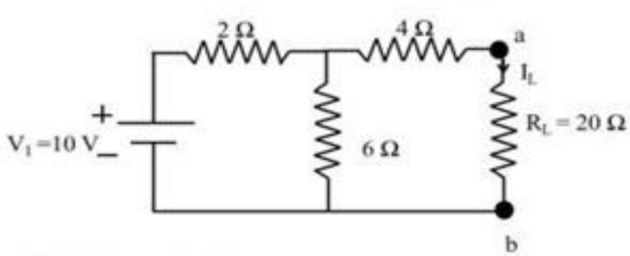


Apply KCL at node a

$$\frac{V_a - 10}{2} + \frac{V_a}{6} + \frac{V_a}{4} = 0$$

$$\Rightarrow V_a = 5.45 \text{ V}$$

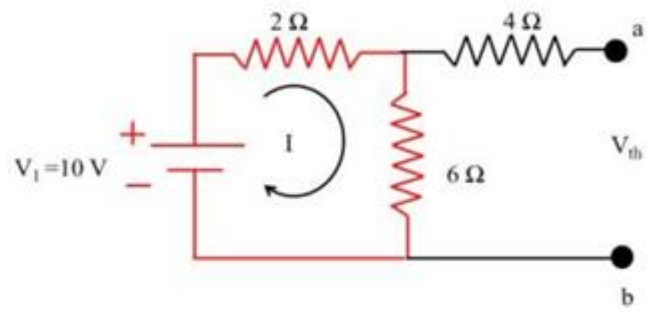
$$\therefore I_{6\Omega} = I^1 = \frac{V_a}{6} = 0.9 \text{ A}$$

		$\boxed{I^1 = 0.9 \text{ A}}$ **Step 2:** To find the current flowing through the 6 ohm resistor with $V_1 = 0$ V and $V_2 = 20$ i.e. I^{11}  Apply KCL at node a $$\frac{V_a}{2} + \frac{V_a}{6} + \frac{V_a - 20}{4} = 0$$ $$\Rightarrow V_a = 5.45 \text{ V}$$ $$\therefore I_{6\Omega} = I^{11} = \frac{V_a}{6} = 0.9 \text{ A}$$ $$\boxed{I^{11} = 0.9 \text{ A}}$$ **Step 3:** To find the total current flowing through the 6 ohm resistor when two voltages sources acting simultaneously $$\boxed{I = I^1 + I^{11} = 0.9 + 0.9 = 1.8 \text{ A}}$$			
	c)	**State Thevenin's theorem. Find the load current I_L using Thevenin's theorem**  	10M	L5	C114.1

Statement of Thevenin's Theorem

"A linear bilateral active circuit consisting of several voltage and or current sources and resistances across the load terminal (a and b) can be replaced with a single voltage source in series with a resistance"

Step 1: To find open circuit voltage across load terminals i.e. V_{th}



Apply KVL to the loop 1

$$10 - 2I - 6I = 0$$

$$8I = 10 \Rightarrow I = \frac{10}{8} = 1.25 \text{ A}$$

The 4 Ω resistor open, so current in the 4 Ω is zeroand voltage drop across 4 Ω is also equals to zero.

$$\therefore V_{th} = \text{Voltage drop across } 6\ \Omega \text{ resistor}$$

$$\therefore V_{th} = 6I = 6 \times 1.25 = 7.5 \text{ V}$$

$$\boxed{V_{th} = 7.5 \text{ V}}$$

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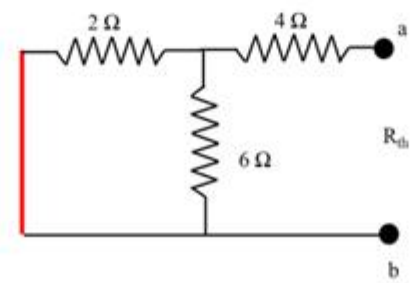
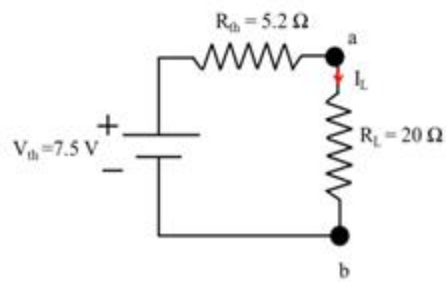
Step 2: To find equivalent resistance across load terminals i.e. R_{th}



$$R_{th} = \frac{2\times 6}{2+6} + 4 = 5.5\ \Omega$$

$$\boxed{R_{th} = 5.5\ \Omega}$$

Step 3: To find load current I_L



$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{7.5}{5.5+20} = 0.29\ \text{A}$$

$$\boxed{I_L = 0.29\ \text{A}}$$

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