



جامعة الأهرام الكندية
AHRAM CANADIAN UNIVERSITY

Lecture (03)

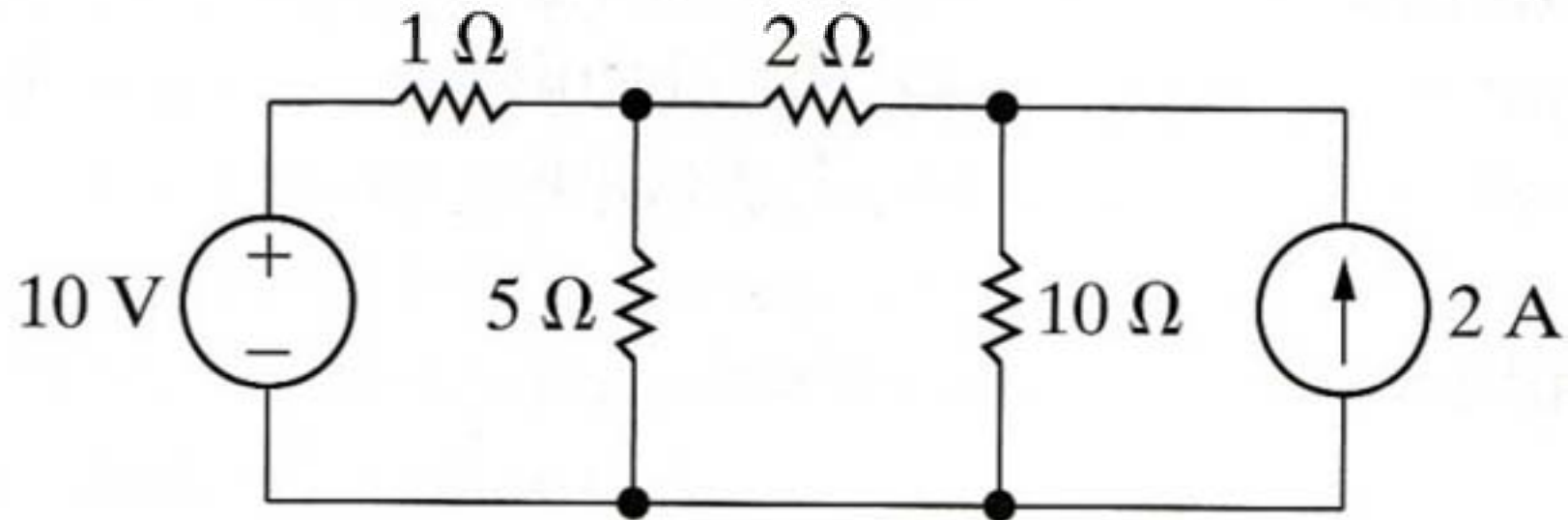
Advanced Circuit Analysis Techniques

Node Voltage

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Example 1

Find the current of each branch



Example 1 solution

KCL @ 1:

$$(V_1 - 10)/1 + (V_1 - V_2)/2 + V_1/5 = 0$$

$$V_1(1 + \frac{1}{2} + \frac{1}{5}) + V_2(-\frac{1}{2}) = 10 \times 10$$

$$17V_1 - 5V_2 = 100 \rightarrow 1$$

KCL @ 2:

$$(V_2 - V_1)/2 + V_2/10 - 2 = 0$$

$$V_1(-\frac{1}{2}) + V_2(\frac{1}{2} + \frac{1}{10}) = 10 \times 10$$

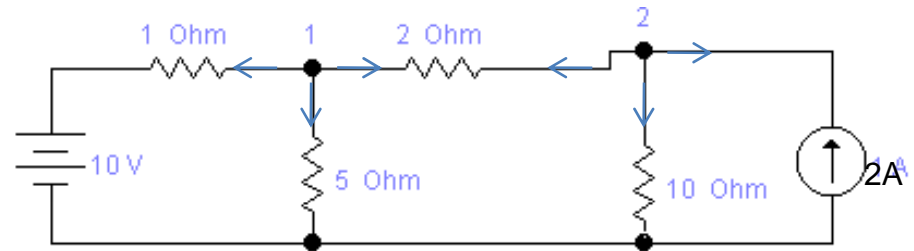
$$-5V_1 + 6V_2 = 20 \rightarrow 2 \quad \times 5$$

$$-25V_1 + 30V_2 = 100 \rightarrow 2'$$

$$-102V_1 - 30V_2 = 600 \rightarrow 1' \text{ (from eq1 X 6)}$$

$$77V_1 = 700$$

³ $V_1 = 9.09V \rightarrow (1)$



Example 1 solution (2)

$$V_2 = 10.91\text{V} \rightarrow (2)$$

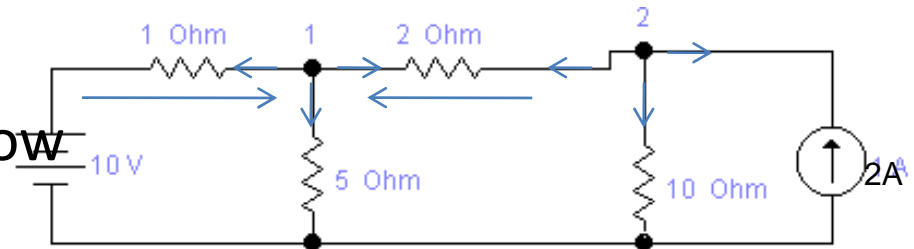
Now getting current from Ohm's law

$$I_{1\Omega} = (10 - 9.09) / 1 = 0.91\text{A}$$

$$I_{5\Omega} = (9.09) / 5 = 1.818\text{A}$$

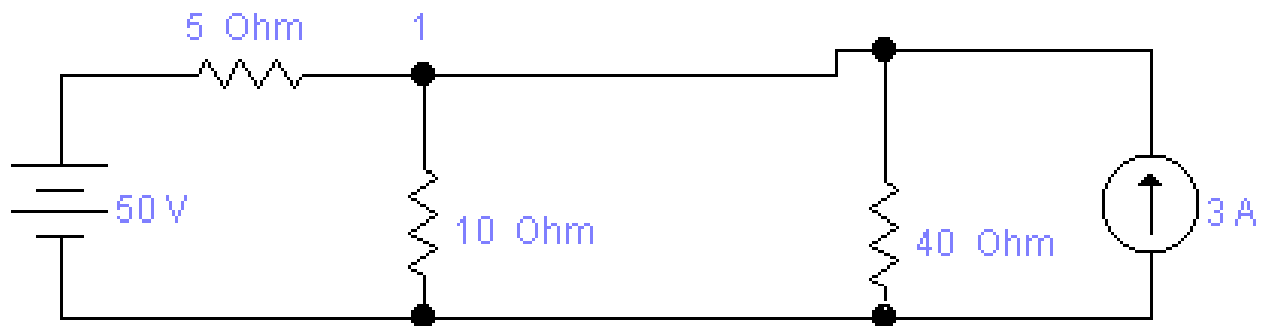
$$I_{2\Omega} = (10.91 - 9.09) / 2 = 0.91\text{A}$$

$$I_{10\Omega} = 10.91 / 10 = 1.091\text{A}$$



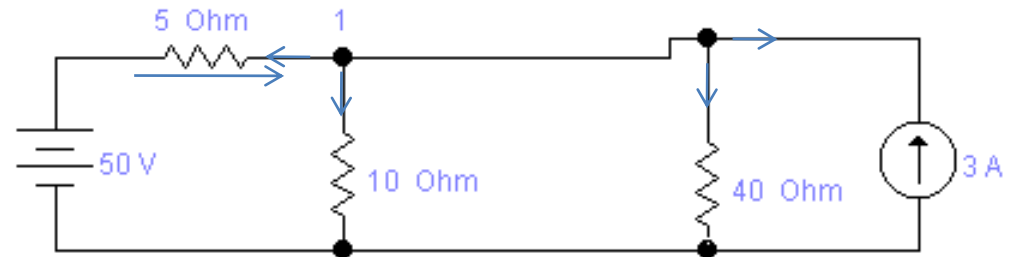
Example 2

- Find $I_{5\Omega}$, $I_{10\Omega}$, $I_{10\Omega}$



Example 2 Solution

KCL @ 1



$$(V_1 - 50)/5 + V_1/10 + V_1/40 - 3 = 0$$

$$V_1(1/5 + 1/10 + 1/40) - 3 = 0$$

$$V_1(13/40) = 3$$

$$V_1 = 40V \rightarrow 1$$

applying Ohm's law to get current

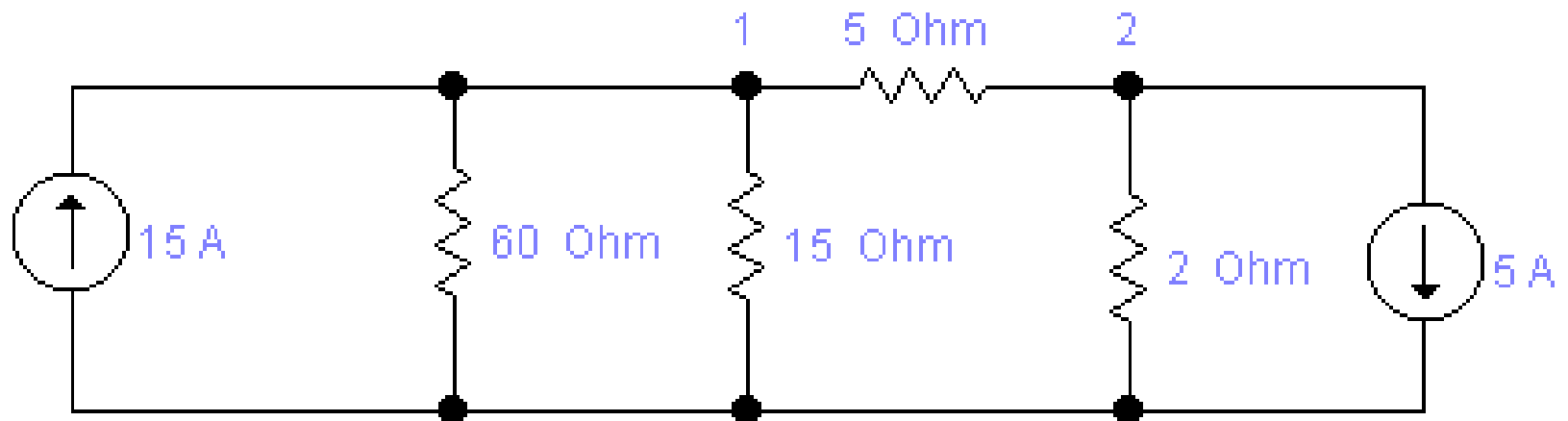
$$I_{5\Omega} = (50 - 40)/5 = 2A$$

$$I_{10\Omega} = 40/10 = 4A$$

$$I_{40\Omega} = 40/40 = 1A$$

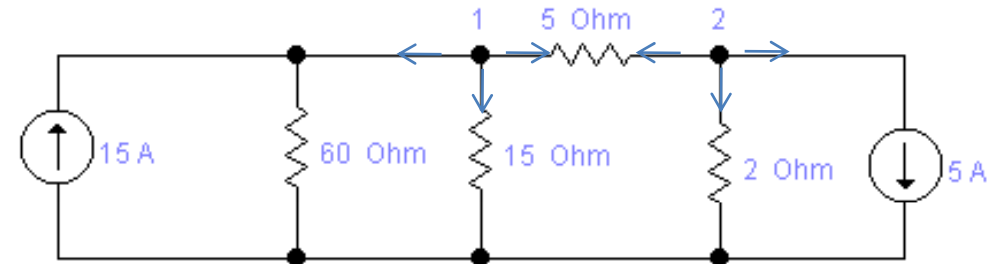
Example 3

Find $V_{60\Omega}$, V_{5A} , $I_{5\Omega}$, P_{15A} , P_{5A}



Example 3 Solution

KCL @1



$$-15 + V_1/60 + V_1/15 + (V_1 - V_2)/5 = 0$$

$$V_1(1/60 + 1/15 + 1/5) - V_2(1/5) = 15$$

$$V_1(17/60) - V_2(1/5) = 15 \quad \times 60$$

$$17xV_1 - 12xV_2 = 900 \quad \rightarrow 1$$

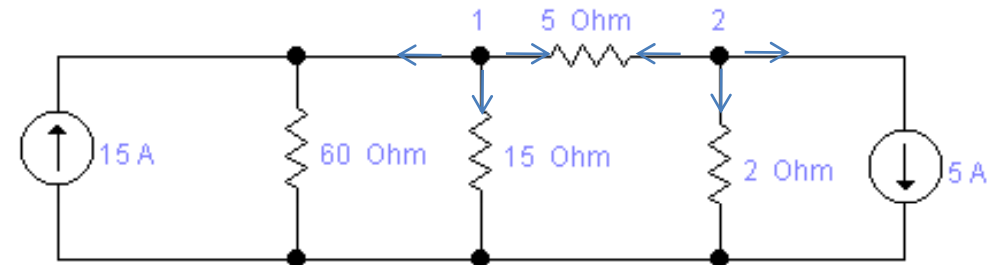
KCL @2

$$5 + V_2/2 + (V_2 - V_1)/5 = 0$$

$$V_1(-1/5) + V_2(1/2 + 1/5) = -5 \quad \times 10$$

$$-2xV_1 + 7xV_2 = -50 \quad \rightarrow 2$$

Example 3 Solution (2)



Multiplying 1 by 2 and 2 by 17

$$34xV_1 - 24xV_2 = 1800 \rightarrow 1'$$

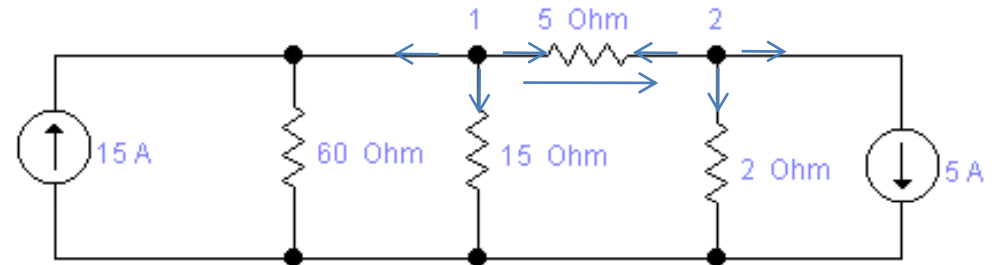
$$-34xV_1 + 119xV_2 = -850 \rightarrow 2'$$

$$95xV_2 = 950$$

$$V_2 = 10V = V_{5A}$$

$$V_1 = (900+210)/17=60V = V_{60\Omega}$$

Example 3 Solution (3)



Now applying Ohm's law to find currents

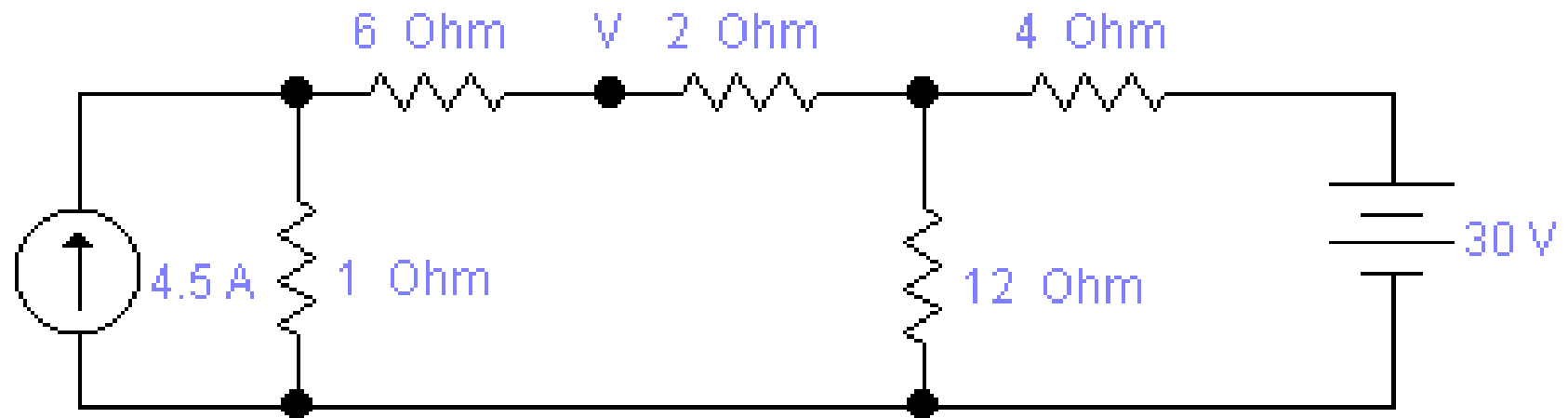
$$I_{5\Omega} = (60 - 10) / 5 = 10 \text{ A}$$

$$P_{15\text{A}} = -15 \times 60 = -900 \text{ W, Generating}$$

$$P_{5\text{A}} = 5 \times 10 = 50 \text{ W, dissipating}$$

Example 4

Find V



Example 4 solution

KCL @ a

$$-4.5 + V_a/1 + (V_a - V_b)/8 = 0$$

$$V_a(1 + 1/8) - V_b(1/8) = 4.5$$

$$9V_a - V_b = 36 \quad \rightarrow 1$$

KCL @ b

$$(V_b - 30)/4 + V_b/12 + (V_b - V_a)/8 = 0$$

$$-V_a(1/8) + V_b(1/4 + 1/12 + 1/8) = 30/4 \quad \text{X24}$$

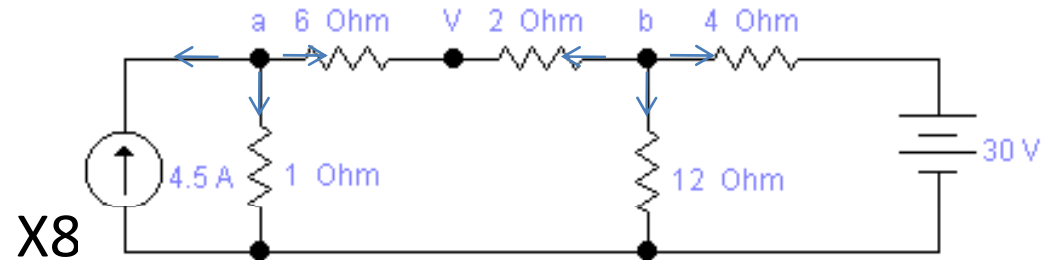
$$-3V_a + 11V_b = 180 \quad \rightarrow 2$$

multiplying 1 by 11

$$-99V_a - 11V_b = 396 \quad \rightarrow 1'$$

$$96V_a = 576$$

$$^{12} V_a = 6V$$



Example 4 solution (2)

$$V_b = 9 \times 6 - 36 = 18V$$

KVL

$$V = V_b - V_a = 15V \rightarrow$$

Thanks, See you next week ISA