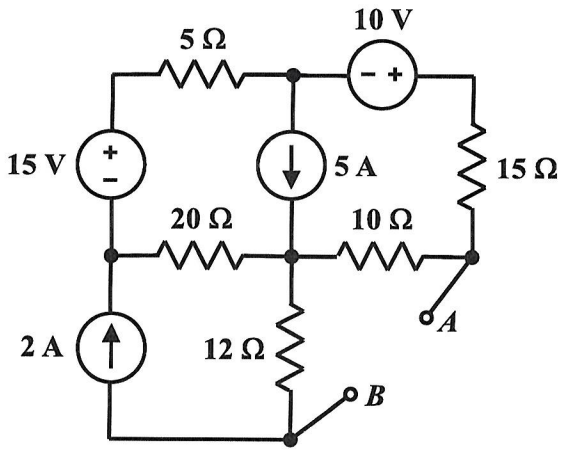
EE 2240

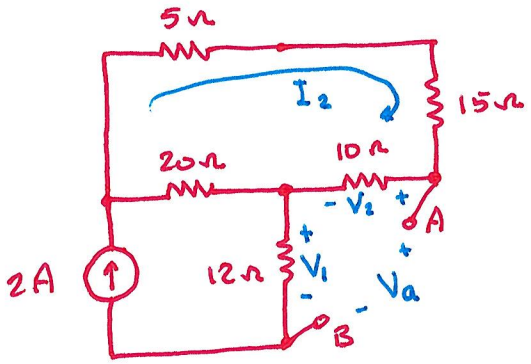
Homework Problem #039



Find the Thévenin equivalent circuit with respect to terminals *A* and *B*.

Use the superposition method to determine V_{oc}:

Circuit 1:



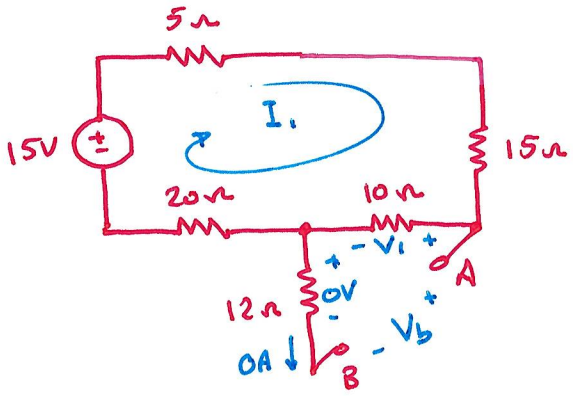
$V_1 = (12\Omega)(2A) = 24V$

$I_2 = \frac{20\Omega}{20\Omega + 5\Omega + 15\Omega + 10\Omega}(2A) = \frac{20}{50}(2A) = 0.8A$

$V_2 = (10\Omega)\, I_2 = 8V$

$V_a = V_2 + V_1 = 8V + 24V = 32V$

Circuit 2:



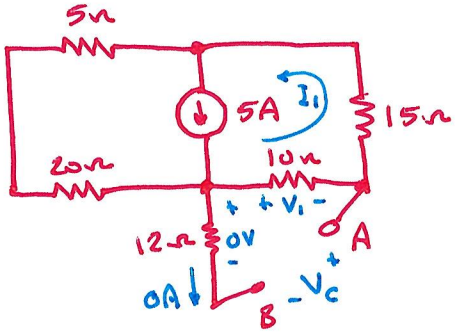
$$I_1 = \frac{15V}{5\Omega + 15\Omega + 10\Omega + 20\Omega}$$

$$= \frac{15}{50} A = 0.3\,A$$

$$V_1 = (10\Omega)\, I_1 = 3V$$

$$V_b = V_1 + 0 = 3V$$

Circuit 3:



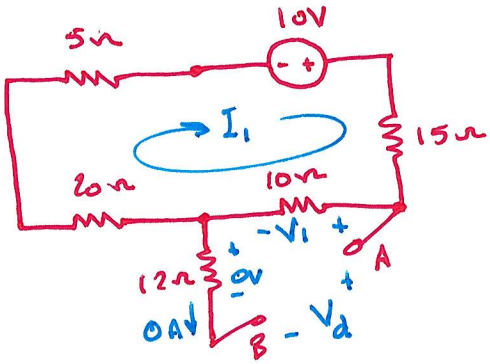
$$I_1 = \frac{5\Omega + 20\Omega}{5\Omega + 20\Omega + 10\Omega + 15\Omega}\,(5A)$$

$$= \frac{25}{50}(5A) = 2.5\,A$$

$$V_1 = (10\Omega)\, I_1 = 25V$$

$$V_c = -V_1 + 0 = -25V$$

Circuit 4:



$$I_1 = \frac{10V}{5\Omega + 20\Omega + 10\Omega + 15\Omega}$$

$$= \frac{10}{50} A = 0.2\,A$$

$$V_1 = (10\Omega)\, I_1 = 2V$$

$$V_d = V_1 + 0 = 2V$$

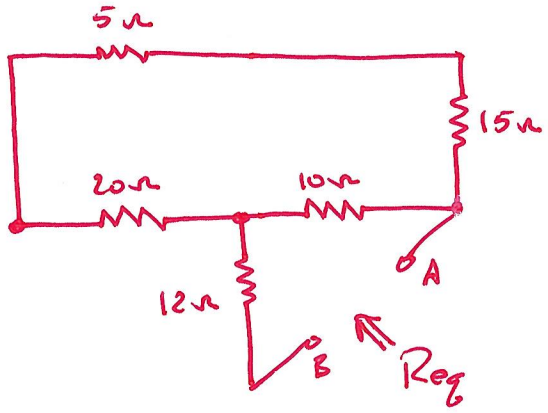
$$V_{OC} = V_a + V_b + V_c + V_d$$

$$= 32V + 3V - 25V + 2V$$

$$= 12V$$

$$\therefore V_T = V_{OC} = 12V$$

For the Thévenin resistance, turn off all independent sources, and determine the equivalent resistance between terminals A and B.



$$R_{eq} = 12\Omega + 10\Omega \parallel (20\Omega + 5\Omega + 15\Omega)$$

$$= 12\Omega + 10\Omega \parallel 40\Omega$$

$$= 12\Omega + \frac{(10\Omega)(40\Omega)}{10\Omega + 40\Omega}$$

$$= 12\Omega + 8\Omega$$

$$= 20\Omega$$

$$\therefore R_T = R_{eq} = 20\Omega$$

The Thévenin equivalent circuit w.r.t. terminals A and B is, therefore: