GATE-2021-BM-Q3

EE23BTECH11015 - DHANUSH V NAYAK*

Question: Three resistive loads are connected to ideal voltage and current source as shown in circuit below. The voltage V_{AB} across terminals A and B is equal to

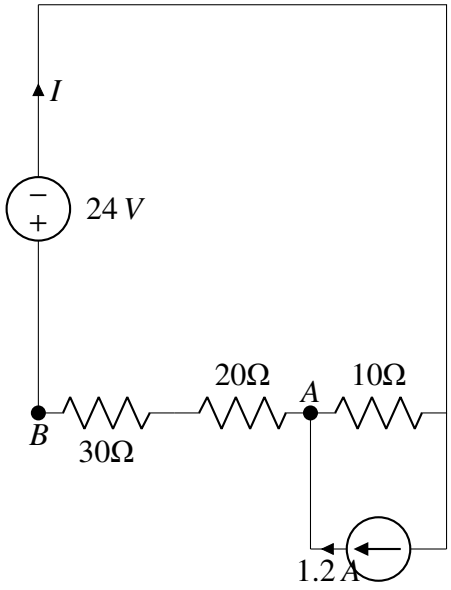

Fig. 1. Circuit Diagram

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Solution:

Parameter	Description
$I\,(1)$	Current only due to voltage source
$I\,(2)$	Current only due to current source
I	Total Current by superposition
V_{AB}	Voltage across terminal A and B
R_{eq}	Equivalent Resistance

TABLE 1
PARAMETER TABLE

Using the superposition principle, First, consider the voltage source only:

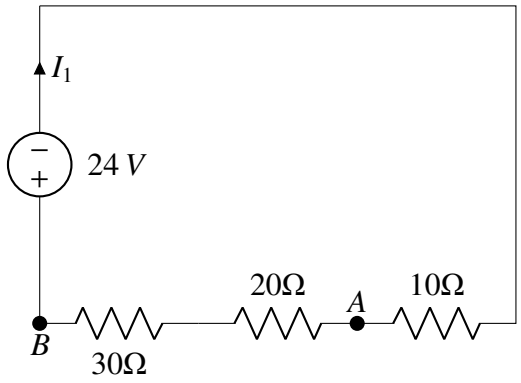

Fig. 2. Circuit considering only voltage source

$$V = I_1 R_{eq} \tag{1}$$
$$R_{eq} = 30 + 20 + 10 = 60\Omega \tag{2}$$
$$\tag{3}$$

Therefore:

$$I_1 = -\frac{24}{60} \tag{4}$$
$$= -0.4A \tag{5}$$

Now, considering current source only

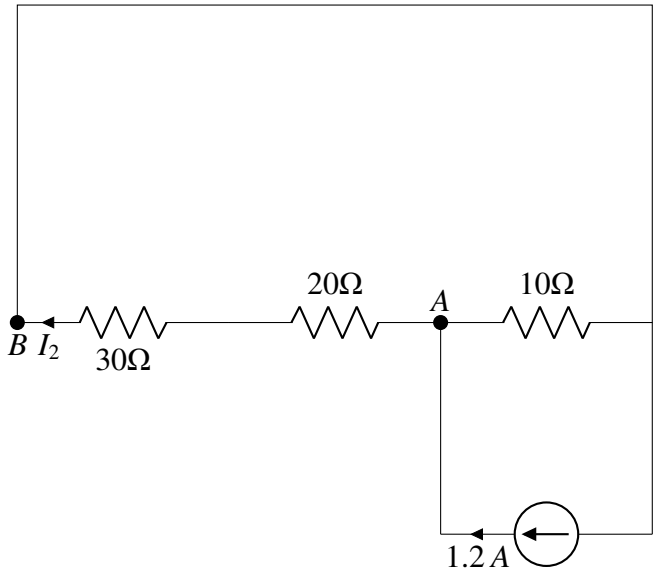

Fig. 3. Circuit considering only current source

Writing KVL around the loop:

$$30\,(I_2) + 20\,(I_2) + 10\,(I_2 - 1.2) = 0 \quad (6)$$

$$60I_2 - 12 = 0 \quad (7)$$

$$I_2 = 0.2A \quad (8)$$

By superposition :

$$I = I_1 + I_2 \quad (9)$$

Using (5) and (8) in (9)

$$I = -0.2A \quad (10)$$

Thus,

$$V_{AB} = 50 \times I \quad (11)$$

From (10)

$$V_{AB} = -10V \quad (12)$$