ASSIGNMENT #1

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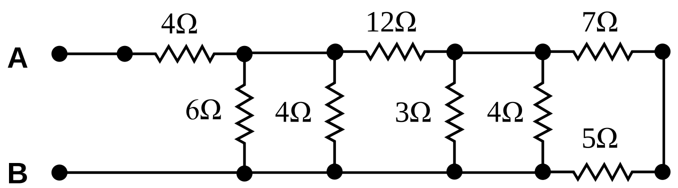
Question #1

Find the equivalent resistance R_{AB} of the network given below. Draw the circuit diagram of each step otherwise you will lose your marks.

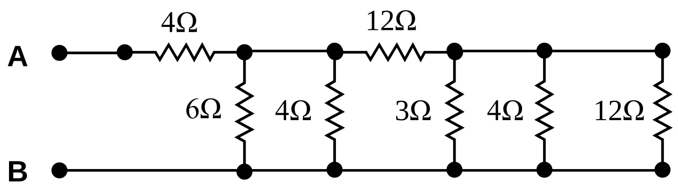


Solution

STEP 01

We start from the right hand side, as 5Ω and 7Ω are connected in series, so using resistance in series formula $R_{eq} = R_1 + R_2$ so the combined effect will be

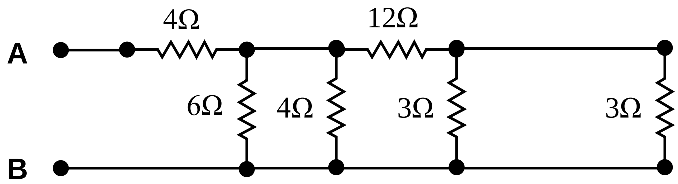
$$R_{eq} = 5 + 7 = 12k\Omega$$



STEP 02

As 12Ω and 4Ω are parallel, so using resistance in parallel formula $R_{eq} = \frac{(R_1 R_2)}{(R_1 + R_2)}$

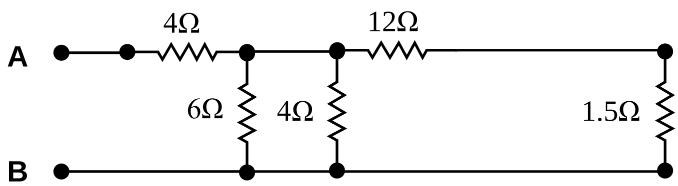
$$R_{eq} = \frac{(12)(4)}{(12+4)} = \frac{48}{16} = 3k\Omega$$



STEP 03

As 3Ω and 3Ω are parallel, so again using resistance in parallel formula $R_{eq} = \frac{(R_1 R_2)}{(R_1 + R_2)}$

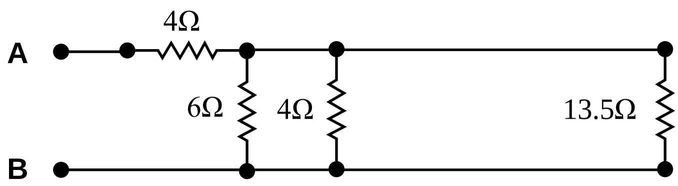
$$R_{eq} = \frac{(3)(3)}{(3+3)} = \frac{9}{6} = 1.5k\Omega$$



STEP 04

As 12Ω and 1.5Ω are connected in series, so using series formula $R_{eq} = R_1 + R_2$

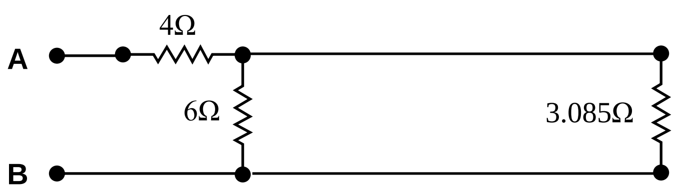
$$R_{eq} = 12 + 1.5 = 13.5k\Omega$$



STEP 05

As 4Ω and 13.5Ω are parallel, so using resistance in parallel formula $R_{eq} = \frac{(R_1 R_2)}{(R_1 + R_2)}$

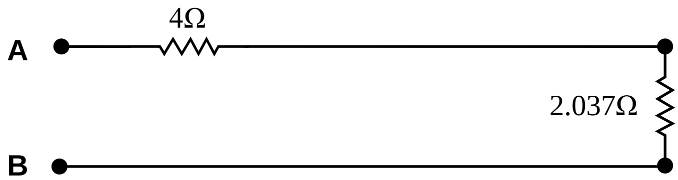
$$R_{eq} = \frac{(4)(13.5)}{(4+13.5)} = \frac{54}{17.5} = 3.085k\Omega$$



STEP 06

As 6Ω and 3.085Ω are parallel, so again using resistance in parallel formula $R_{eq} = \frac{(R_1 R_2)}{(R_1+R_2)}$

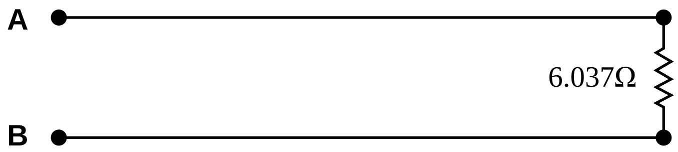
$$R_{eq} = \frac{(6)(3.085)}{(6+3.085)} = \frac{18.51}{9.085} = 2.037k\Omega$$



STEP 07

As 4Ω and 2.037Ω are connected in series, so using series formula $R_{eq} = R_1 + R_2$

$$R_{eq} = 4 + 2.037 = 6.037k\Omega$$



Answer

$R_{AB} = 6.037k\Omega$

Question #2

For the given below parallel network, find the following things:

1. Determine source current I_s
2. Calculate I_1 and I_2 and demonstrate that $I_s = I_1 + I_2$
3. Calculate the power dissipated to each resistance.
4. Determine the power delivered by the source, and compare it to the total power dissipated by the resistive elements.

Solution

1) Determine source current I_s

First we calculate the equivalent resistance in the circuit, as R_1 and R_2 are in parallel so using resistance in parallel formula $R_{eq} = \frac{(R_1 R_2)}{(R_1+R_2)}$

$$R_{eq} = \frac{(6)(3)}{(6+3)} = \frac{18}{9} = 2k\Omega$$

Now using **Ohm's law,** $V = IR$ to find the source current I_s

$V = I_s R_{eq}$

As we know the voltage is 12, therefore to know I_s we simply divide R_{eq} by voltage

$12 = I_s(2k)$

$$I_s = \frac{12}{2k}$$

As we know the symbol k is equivalent to 1000, so we simplify

$$I_s = \frac{12}{2(1000)} = \frac{6}{1000} = 0.006$$

We finally get the answer 0.006 which is equivalent to $I_s = 6mA$

Answer

$$I_s = 6mA$$

2) Calculate I_1 and I_2 and demonstrate that $I_s = I_1 + I_2$

As we know that if the resistances are connected in parallel, so the source voltage is equivalent to $V_s = V_1 = V_2$

For calculating the current of I_1 we use **Ohm's law,** $V = IR$

$V = I_1 R_1$

As we know the voltage is 12, therefore to know I_1 we simply divide R_1 by voltage

$12 = I_1(6k)$

$$I_1 = \frac{12}{6k}$$

$$I_1 = \frac{12}{6(1000)} = \frac{2}{1000} = 0.002$$

We get the answer 0.002 which is equivalent to $I_1 = 2mA$

For calculating the current of I_2 we use **Ohm's law,** $V = IR$

$V = I_2R_2$

As we know the voltage is 12, therefore to know I_2 we simply divide R_2 by voltage

$12 = I_2(3k)$

$$I_2 = \frac{12}{3k}$$

$$I_2 = \frac{12}{3(1000)} = \frac{4}{1000} = 0.004$$

We get the answer 0.004 which is equivalent to $I_2 = 4mA$

Hence, we proved that $\boldsymbol{I_s = I_1 + I_2}$

$6mA = 2mA + 4mA$

Answer

$$6mA = 6mA$$

3) Calculate the power dissipated to each resistance.

As we know the formula to calculate the power is $P = VI$

For calculating the power dissipated by R_1

$P_1 = VI_1$

$$P_1 = (12)(2m) = 24m = \frac{24}{1000} = 0.024watt$$

For calculating the power dissipated by R_2

$P_2 = VI_2$

$$P_2 = (12)(4m) = 48m = \frac{48}{1000} = 0.048watt$$

Answer

$$P_1 = 0.024watt$$
$$P_2 = 0.048watt$$

4) **Determine the power delivered by the source, and compare it to the total power dissipated by the resistive elements.**

As we know the formula to calculate the power is $P = VI$

For calculating the total power dissipated by I_s

$P_s = VI_s$

$P_s = (12)(6m) = 72m = \frac{72}{1000} = 0.072watt$

Here, we compare the resistive elements to the power dissipated by the source

$P_s = P_1 + P_2$

$0.072 = 0.024 + 0.048$

So the power delivered by the source is equal to the power dissipated by the resistive elements.

Answer

$0.072watt = 0.072watt$

Question #3

Given below is a simple circuit containing a bulb (lamp), battery and two switches, describe the current flow in the circuit and bulb (glow or not) for each given condition:

1. When switch 1 is connected and switch 2 is not connected.
2. When switch 1 and switch 2 both are not connected.
3. When both switches are connected.

Answer #1

The current will flow through S1 and will not flow through S2. The bulb will glow because there is a path available (through S1) for current to reach the bulb.

Answer #2

When both switches are not connected, then the current will not flow and the bulb will not glow because there is no path available through which current can reach the bulb.

Answer #3

When both switches are connected, then the current will flow through both the switches and the bulb will glow because there is a path available for current to reach the bulb.