BE Theory Assignment # 01

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BE Assignment #01

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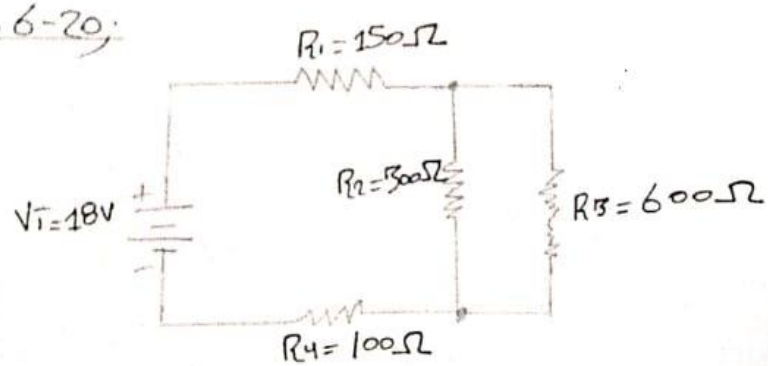
Questions from Grob's Basic Electronics Pg#191

(11th Edition).

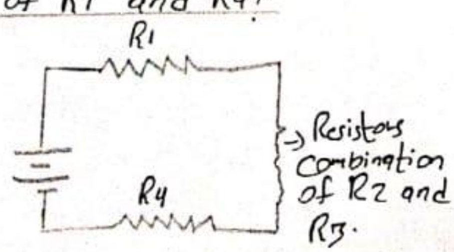
Problem 6-9;

Q; In Fig. 6-20;



(Fig. 6-20)

a) Total Resistance of R_1 and R_4?



Solution;

∴ R_1 and R_4 are connected in Series.

∴ $R_{1+4} = R_1 + R_4$

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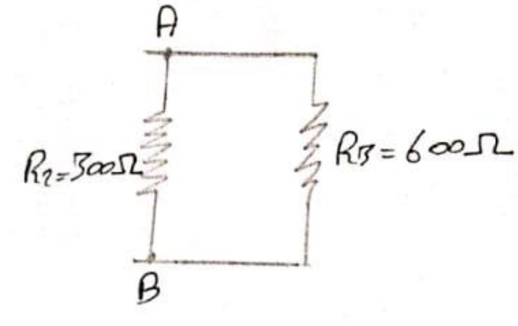
$\Rightarrow R_{1+4} = 150\Omega + 100\Omega$

$\Rightarrow R_{1+4} = 250\Omega$ Ans.

b) Equivalent Resistance of R_2 and R_5 accross points AB?



Solution;

∴ R_2 and R_5 are connected in Parallel.

∴ Formula will be used here is;

$$\frac{1}{R_1} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

$$\therefore \frac{1}{R_{T_1}} = \frac{1}{R_2} + \frac{1}{R_5}$$

$$\frac{1}{R_{T_1}} = \frac{1}{300} + \frac{1}{600}$$

$$\frac{1}{R_{T_1}} = \frac{600 + 300}{(300)(600)}$$

$$\frac{1}{R_{T_1}} = \frac{9\cancel{00}}{1800\cancel{00}}$$

$$\frac{1}{R_{T_1}} = \frac{\cancel{9}^{\cancel{3}\,1}}{\cancel{1800}} \quad \begin{array}{r} -600 \\ 200 \end{array}$$

$$\frac{1}{R_{T_1}} = \frac{1}{200}$$

$$\boxed{R_{T_1} = 200\Omega} \text{ Ans.}$$

c) Total Resistance, R_T?

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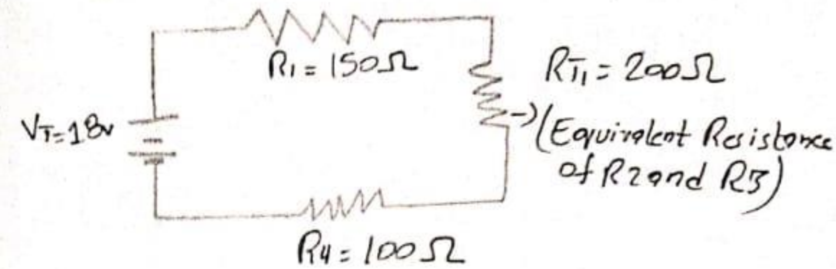

Solution;

$\because$ R_1, R_{T_1} and R_4 are in Series now So;

$\therefore$ Formula;

$$\therefore R_T = R_1 + R_{T_1} + R_4$$

$$\Rightarrow R_T = 150 + 200 + 100$$

$$\Rightarrow \boxed{R_T = 450\Omega} \text{ Ans.}$$

d) Total current in the circuit, I_T?

Solution;

To calculate Current (I_T), using Ohm's law;

$$\therefore V = IR \text{ (Ohm's law)}$$

$$\therefore V_T = I_T R_T$$

$$\Rightarrow 18 = I_T (450) \quad \because \boxed{V_T = 18v}, \boxed{R_T = 450\Omega}$$

$$\Rightarrow I_T = \frac{18}{450}$$

$$\Rightarrow \boxed{I_T = 0.04 \text{ amp.}} \text{ Ans.}$$

e) How much current flows into point B and away from point A?

Ans; If we are finding Current's Intensity through a specific path on the circuit, first we need voltage at that component. For that, we uses "Voltage divider formula".

$$\Rightarrow \text{Voltage divider formula} = V_1 = \frac{R_1}{R_1 + R_2 + R_3} (V_{total})$$

(Rem. part on next page).

∴ Now, Calculating voltage across point A and B;

∴ Substituting the components;

$$V_{AB} = \left(\frac{R_{T_1}}{R_1 + R_4 + R_{T_1}}\right)(V_{Total})$$

∴ Here, R_{T_1} is the combined resistance of 2 parallel circuits R_2 and R_1, which is 200Ω.

$$\therefore\ V_{AB} = \left(\frac{200}{150+300+200}\right)(18).$$

$$\Rightarrow \boxed{V_{AB} = 8 \text{volts}}\ \text{Ans.}$$

∴ Now we know voltage that flows across A and B (V_{AB}), $\boxed{V_{AB} = 8 \text{ volts}}$, and the resistance through R_2, $\boxed{R_2 = 300\Omega}$

∴ Now finding current (I_{AB}) across A and B;

$$\therefore V_{AB} = I_{AB} \cdot R_2 .$$

$$I_{AB} = \frac{V_{AB}}{R_2}$$

$$I_{AB} = \frac{8}{300}$$

$$\boxed{I_{AB} = 0.0266 \text{ amp.}}\ \text{Ans.}$$

Problem 6-12;

Q; In Fig. 6-22;

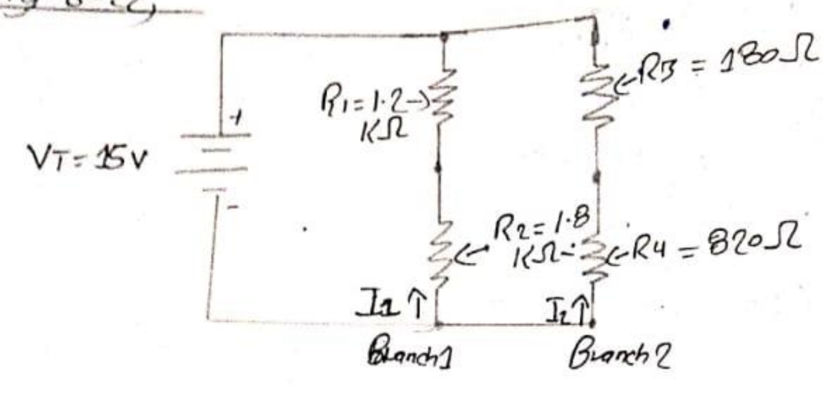

Fig. 6-22.

a) Total resistance of branch 1?

Solution;

∴ Considering that the both resistors are connected in series.

$\therefore R_{B1} = R_1 + R_2$

$\Rightarrow R_{B1} = 1.2K\Omega + 1.8K\Omega$

$\Rightarrow \boxed{R_{B1} = 3000\Omega}$ Ans

b) Total Resistance across Branch 2?

Solution;

∴ Also here considering both Resistors are connected in Series.

$\therefore R_{B2} = R_3 + R_4$

$\Rightarrow R_{B2} = 180 + 820$

$\Rightarrow \boxed{R_{B2} = 1000\Omega}$ Ans.

c) Branch Currents I_1 and I_2?

Solution;

∴ Current is parallel, so voltage will be same everywhere.

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⊙ For I_1;

∴ Using Ohm's Law;

$$V_T = I_1 R_{B1}.$$

$$15 = I_1 (R_1 + R_2)$$

$$15 = I_1 (1200 + 1800)$$

$$15 = I_1 (3000).$$

$$\boxed{I_1 = 0.005 \text{ amp.}}$$ Ans:

⊙ For I_2;

∴ Using Ohm's Law;

$$V_T = I_2 R_{B2}$$

$$15 = I_2 (1000)$$

$$I_2 = \frac{15}{1000}$$

$$\boxed{I_2 = 0.015 \text{ amp}}$$ Ans

d) Total current of the circuit? I_T?

Solution;

∴ Total current $= I_T = I_1 + I_2$.

$$\Rightarrow I_T = 0.005 \text{amp} + 0.015 \text{amp}.$$

$$\Rightarrow I_T = 5 \text{m.amp} + 15 \text{m.amp}.$$

$$\Rightarrow \boxed{I_T = 20 \text{mAmp. or } 0.02 \text{amp}}$$ Ans.

e) Total Resistance (R_T) of the circuit?

Solution;

∴ Total Resistance of circuit $= \frac{1}{R_T} = \frac{1}{R_{B1}} + \frac{1}{R_{B2}}$ (∴ Since the Branches are in parallel).

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$$\Rightarrow \frac{1}{R_T} = \frac{1}{R_{B1}} + \frac{1}{R_{B2}}$$

$$\Rightarrow \frac{1}{R_T} = \frac{1}{3000} + \frac{1}{1000}$$

$$\Rightarrow \frac{1}{R_T} = \frac{1}{750}$$

$$\Rightarrow \boxed{R_T = 750\Omega} \text{ Ans.}$$

f) Values of V_1, V_2, V_3 and V_4?

Solution;

⊙ ∴ For that, foreach we will be using Voltage divider formula.

⊙ For V_1;

$$V_1 = \frac{R_1}{R_1+R_2}(V_T)$$

$$V_1 = \frac{1200}{1200+1800}(15)$$

$$\boxed{V_1 = 6v} \text{ Ans}$$

⊙ For V_2;

$$V_2 = \frac{R_2}{R_1+R_2}(V_T)$$

$$V_2 = \frac{1800}{1200+1800}(15)$$

$$\boxed{V_2 = 9v} \text{ Ans}$$

⊙ for V_3;

$$V_3 = \frac{R_3}{R_3+R_4}(V_T)$$

$$V_3 = \frac{180}{180+820}(15)$$

$$\boxed{V_3 = 2.7v} \text{ Ans}$$

⊙ For V_4;

$$V_4 = \frac{R_4}{R_3+R_4}(V_T)$$

$$V_4 = \frac{820}{180+820}(15)$$

$$\boxed{V_4 = 12.3v} \text{ Ans}$$

Problem 6-20;

Q; In Fig. 6-30;

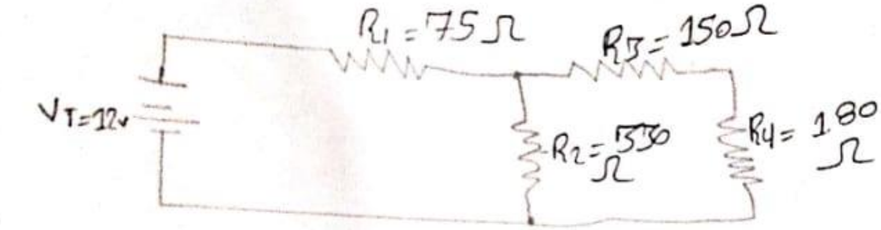

Fig. 6-30;

Q; In Fig: 6-30, Solve for R_T, I_T, V_1, V_2, V_3, V_4, I_1, I_2, I_3 and I_4.

Solution;

- For R_T;

(i) R_{34}; (∵ Since it is in series).

$R_{34} = R_3 + R_4$

$R_{34} = 150 + 180$

$\boxed{R_{34} = 330\,\Omega}$

(ii) R_{234}; (∵ Since R_2 and R_{34} are in parallel).

$$\frac{1}{R_{234}} = \frac{1}{R_2} + \frac{1}{R_{34}}$$

$$= \frac{1}{330} + \frac{1}{330}$$

$$\frac{1}{R_{234}} = \frac{1}{165}$$

$\boxed{R_{234} = 165\,\Omega}$

- $R_T = R_{1234}$ (∵ Since R_1 and R_{234} are in series).

$R_T = R_1 + R_{234}$.

$\boxed{R_T = 75 + 165 = 240\,\Omega}$ Ans.

⊙ For I_T;

∴ Using Ohm's law;

$$\therefore V_T = I_T R_T$$

$$I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{12}{240} \quad \because R_T = 240\Omega, \; V_T = 12v.$$

$$\boxed{I_T = 0.050A} \text{ Ans.}$$

OR;

$$\boxed{I_T = 50mA} \text{ Ans}$$

⊙ For V_1;

∴ Using voltage divider formula;

$$V_1 = \frac{R_1}{R_1 + R_{234}} (V_T)$$

$$V_1 = \frac{75}{75 + 165} (12)$$

$$\boxed{V_1 = 3.75v} \text{ Ans.}$$

⊙ For V_2;

∴ For that again using voltage divider formula.

$$V_2 = \frac{R_{234}}{R_1 + R_{234}} (V_T)$$

$$V_2 = \frac{165}{75 + 165} (12)$$

$$\boxed{V_2 = 8.25v} \text{ Ans}$$

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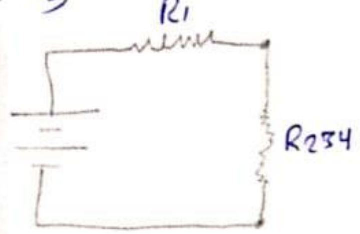
⊙ For V_3;

∴ To calculate V_3:



∴ For V_3 first we have to calculate the current using Kirchoff law.

$$\therefore I_T = I_1 + I_2 + I_3$$

∴ Current divider formula;

$$\therefore I_1 = \frac{R_T}{R_1}(I_T)$$

$$I_1 = \frac{240}{75}(0.05)$$

⊙ $\boxed{I_1 = 0.16A}$

⊙ For I_2;

$$I_2 = \frac{R_T}{R_2}(I_T)$$

$$I_2 = \frac{240}{330}(0.05)$$

$\boxed{I_2 = 0.036\ A}$

⊙ For I_3;

$$I_3 = \frac{R_T}{R_3}(I_T)$$

$\boxed{I_3 = 0.08\ A}$

⊙ For I_4;

$$I_4 = \frac{R_T}{R_4}(I_T)$$

$\boxed{I_4 = 0.0667A}$

⊙ ∴ Now using these value to find V_3 and V_4.

⊙ For V_3 (continued);

$$V_3 = I_3 R_3.$$

$$V_3 = 0.08 \times 150$$

$\boxed{V_3 = 12V}$

⊙ For V_4;

$$V_4 = I_4 \times R_4$$

$$V_4 = 0.0667 \times 180$$

$\boxed{V_4 = 12V}$.

Problem 6-35.

Q; In fig. 6-44, assume that the bridge is balanced when $R_1 = 1K\Omega$, $R_3 = 34{,}080\Omega$, $R_2 = 5K\Omega$.

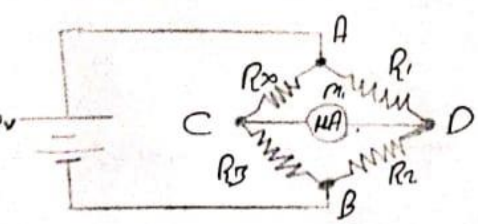


Fig-6-44.

a) The value of the unknown resistor, R_x. if the bridge is balanced, that means that the Galvanometer reads $0\mu A$ at the moment.

Solution;

∴ Using the Wheatstone bridge formula;

$$\frac{I_1 R_x}{I_1 R_v} = \frac{I_2 R_2}{I_2 R_1} \Rightarrow$$

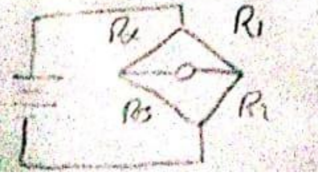
$$\boxed{R_x = \frac{R_2}{R_1}(R_v)}$$

∴ $R_1 = 1000\Omega$

∴ $R_2 = 5000\Omega$

∴ $R_3 = 34{,}080\Omega$

∴ $R_x = ?$



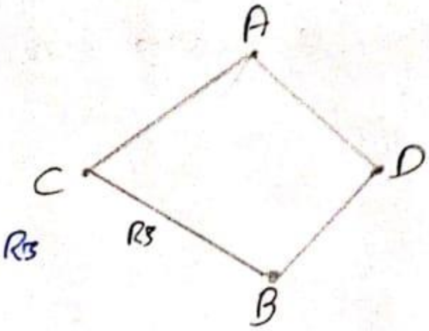
$$\frac{I_1 R_2}{I_1 R_3} = \frac{I_2 R_3}{I_2 R_x} \Rightarrow \frac{R_2}{R_1} = \frac{R_3}{R_x}$$

$$\Rightarrow R_x = \frac{R_3}{R_2} \times R_1$$

$$R_x = \frac{1000}{5000} \times 34080.$$

$$\boxed{R_x = 6816\Omega} \text{ Ans}$$

b) The voltages V_{CB} and V_{DB}.

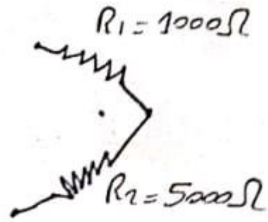


$V_{CB} = I_2 R_3$

$V_{DB} = I_1 R_2$.

Solution;

To find voltage through components, first we will find I_1 and I_2.



∴ R_1 and R_2 are in series;

$$V_T = I_{R_1 R_2}(R_1 + R_2)$$

$$I_1 = \frac{V_T}{R_1 + R_2}$$

$$I_1 = \frac{10}{1000 + 5000}$$

$$\boxed{I_1 = 1.667mA} \text{ or } \boxed{I_1 = 0.001667A}$$

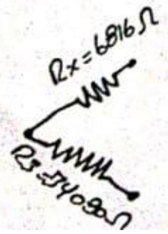
Here; V_{DB} = V at R_2.

$$V_{DB} = I_1 R_2$$

$$V_{DB} = (0.001667)(5000)$$

$$\boxed{V_{DB} = 8.33V}$$

For I_2;



∴ R_x and R_3 are in series;

$$V_T = I_{R_xR_3}(R_x+R_3)$$

$$I_{R_xR_3} = \frac{V_T}{R_x+R_3}$$

$$I_{R_xR_3} = \frac{10}{6816+34080}$$

$$I_{R_xR_3} = 0.000245A$$

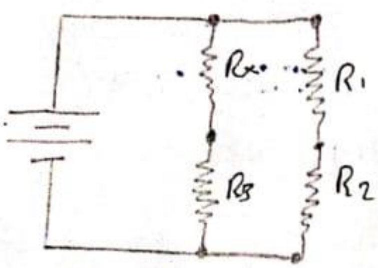
Here; $V_{CB} = V$ at R_3

$$V_{CB} = I_2 R_3$$

$$V_{CB} = (0.000245)(34080)$$

$$V_{CB} = 8.33V$$

c) Total current, I_T, flowing to and from voltage source:



Answer;

Rearranged the circuit in such a way, that we removed the middle wire, the wire on which Galvanometer was connected, that was done because as we saw, 0V was it P.D and the readings on Galvano-meter showed 0μA. Which means no current passing through that wire. So, while measuring total current, that wire was useless.

i) Calculating the resistance of the circuit.

∴ R_1 and R_2 are in series;

$$R_{12} = R_1 + R_2 = 1000+5000$$

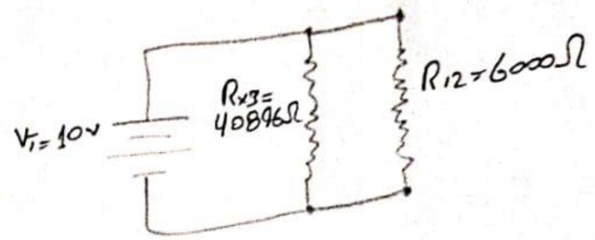
$$R_{12} = 6000\Omega$$

∴ R_x and R_3 are also in series;

$$R_{3x} = R_x + R_3 = 6816+34080$$

$$R_{x3} = 40896\,\Omega$$

Summed up diagram for R_{12} and R_{x3};



(i) Now Total Resistance = R_T;

$$\frac{1}{R_T} = \frac{1}{R_{12}} + \frac{1}{R_{x3}}$$ ∴ (Since R_{12} and R_{x3} are now in Parallel)

$$\frac{1}{R_T} = \frac{1}{6000} + \frac{1}{40896}$$

$$\frac{1}{R_T} = \frac{46896}{245376000}$$

$$\boxed{R_T = 5232.34591\,\Omega}$$

(ii) Calculating total current (I_T);

$$V_T = I_T R_T \quad (\because \text{Ohm's Law})$$

$$10 = I_T \times (5232.34591)$$

$$\boxed{I_T = 1.911 mA}$$

OR;

$$\boxed{I_T = 0.0019A}$$

Game SS:

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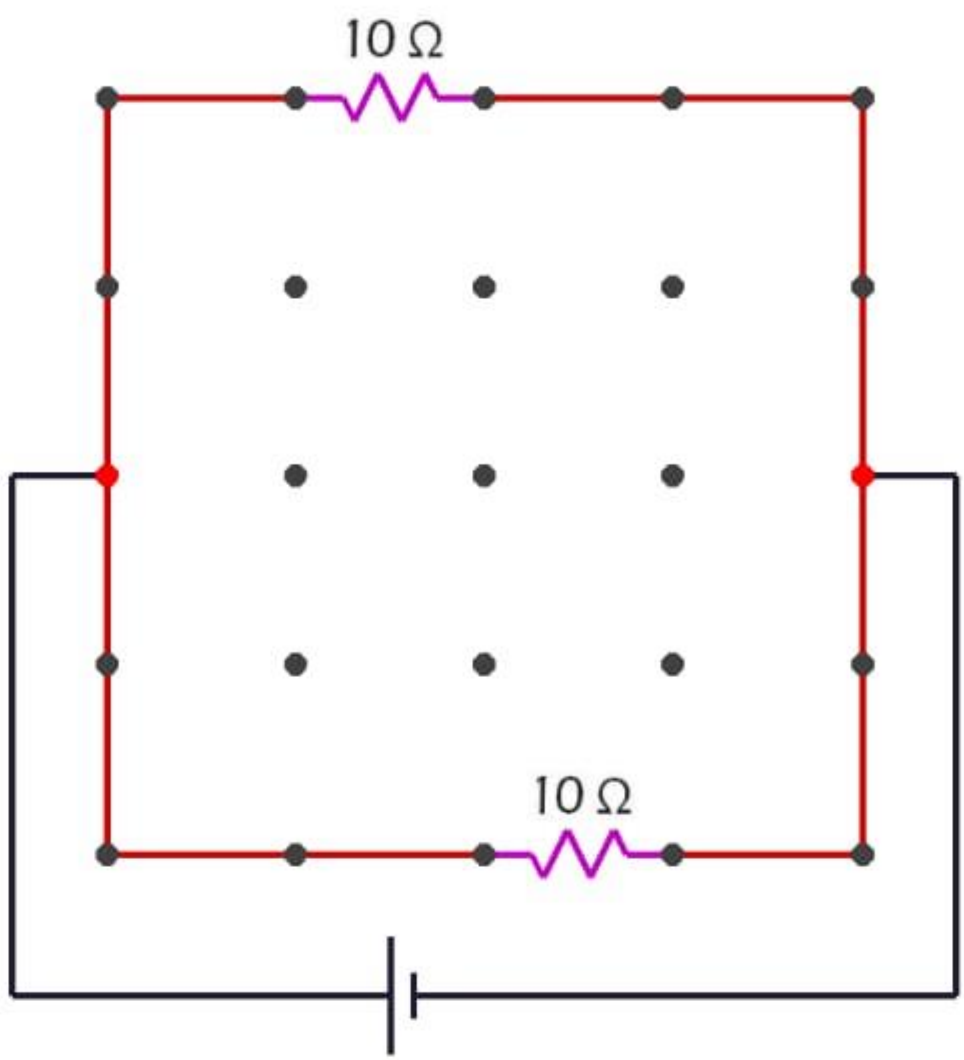
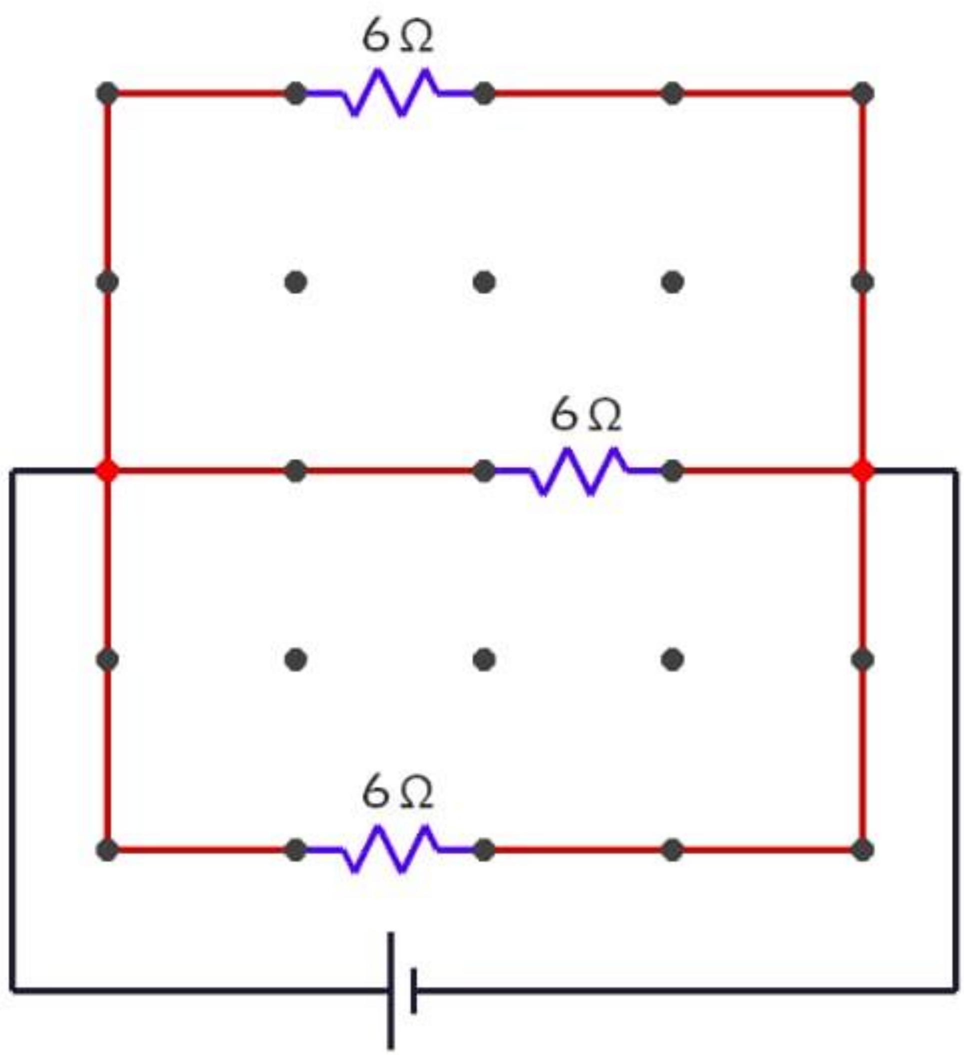
Level Two

Connect two resistances of 10 ohms each to get an equivalent resistance of 5 ohms.



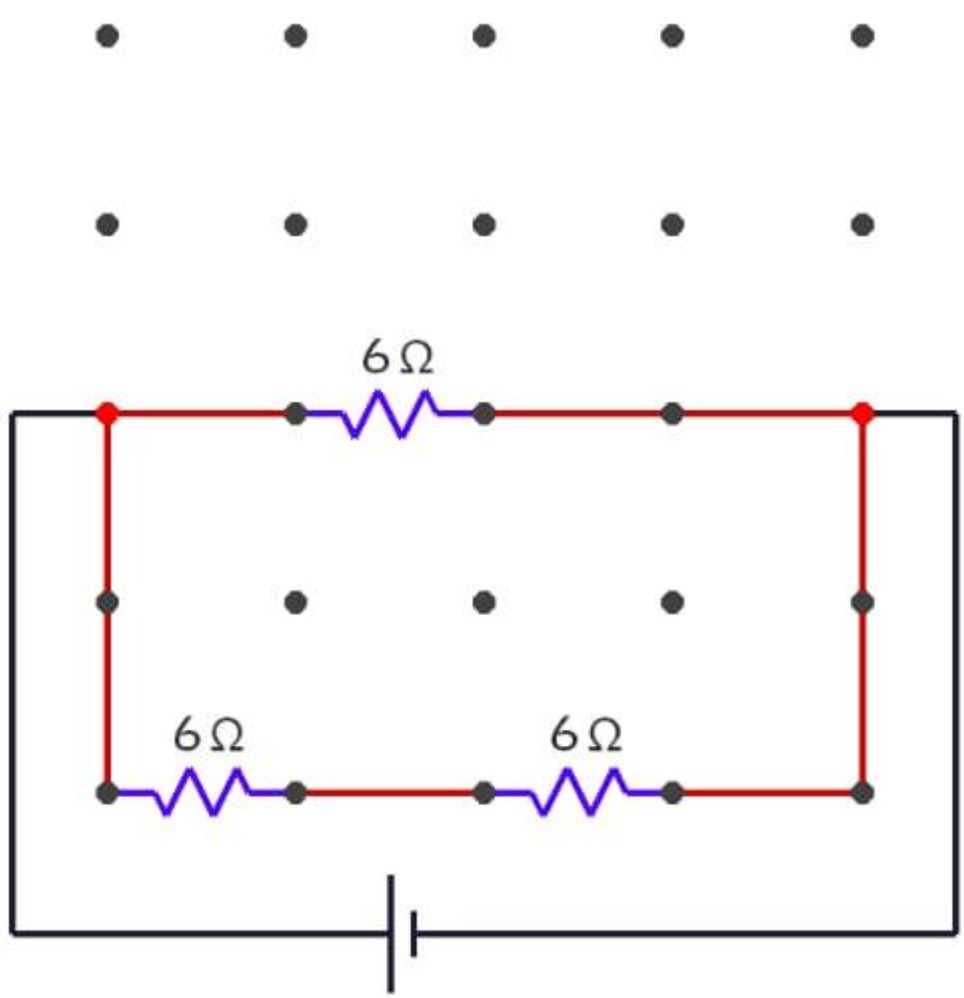
Level Three

Connect three resistances (6 ohms each) to get an equivalent resistance of 2 ohms.



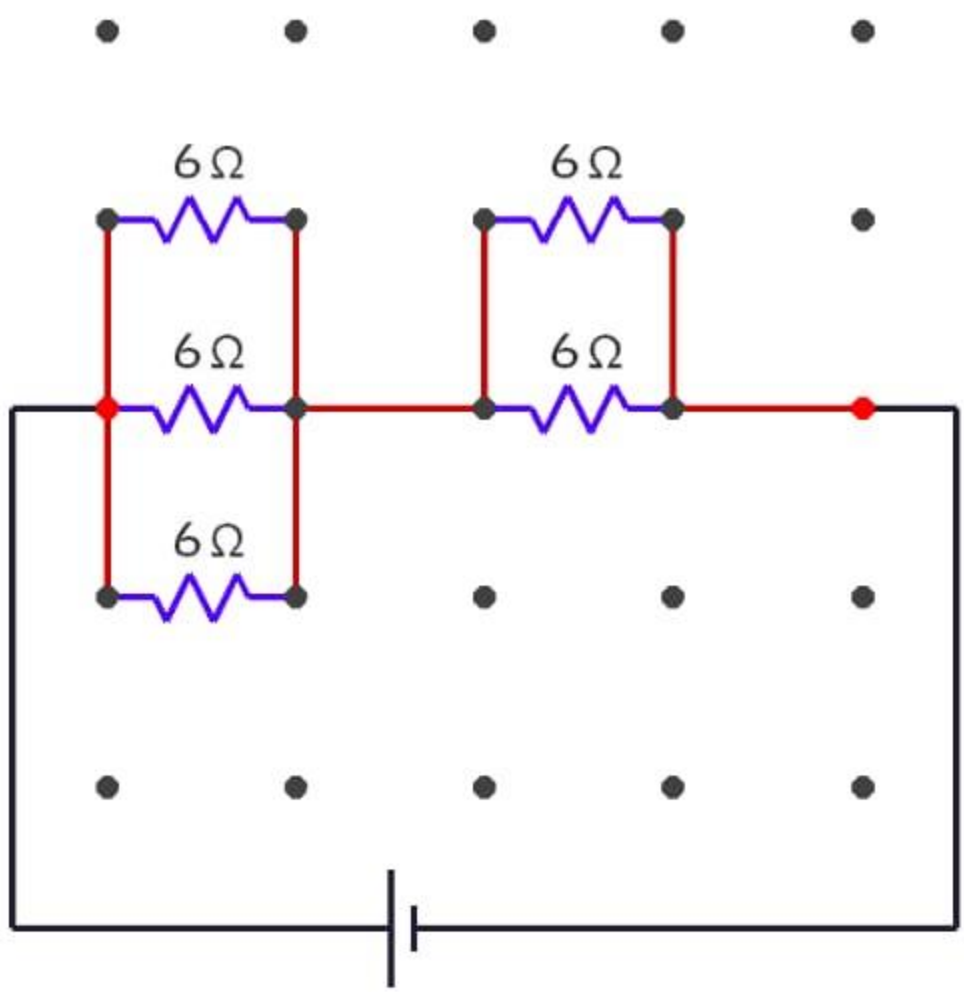
Level Four

Connect 3 resistances (6 ohms each) to get an equivalent resistance of 4 ohms.



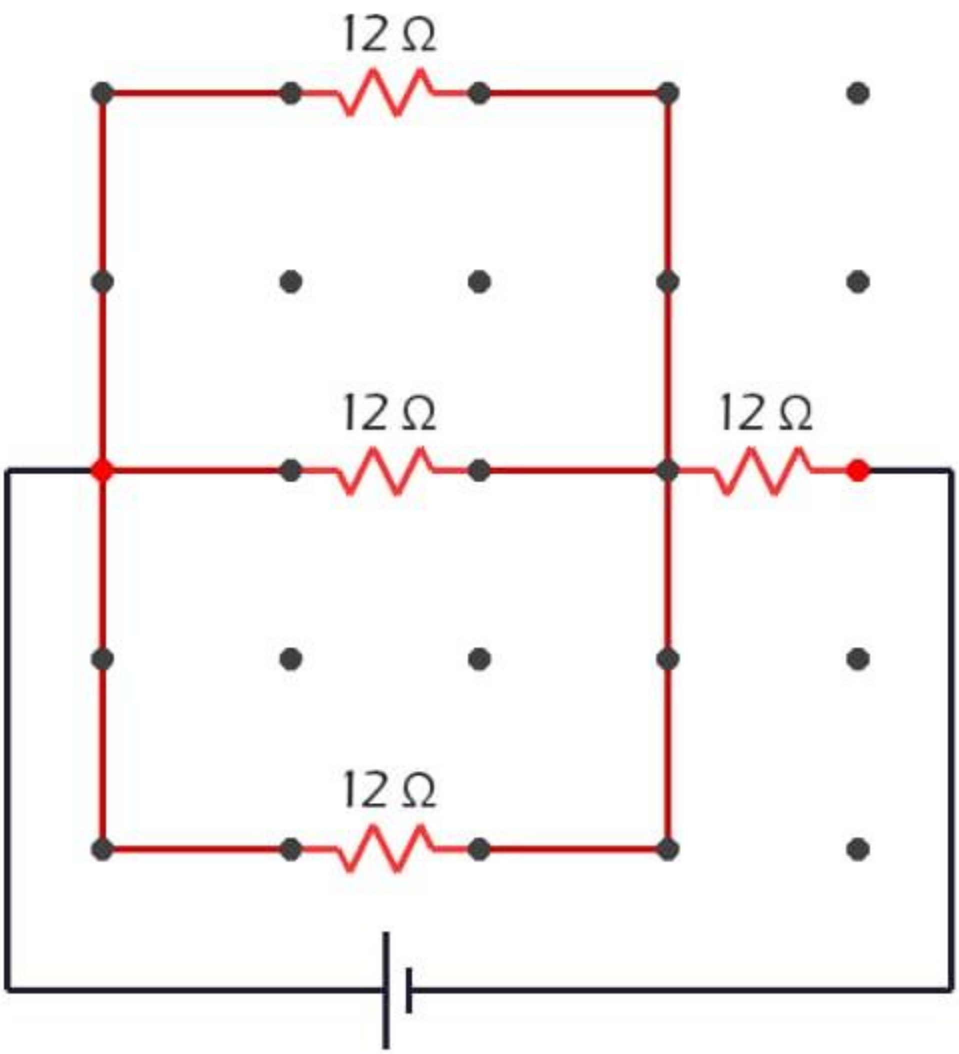
Level Five

Connect 5 resistances (6 ohms each) in a circuit to get an equivalent resistance of 5 ohms.



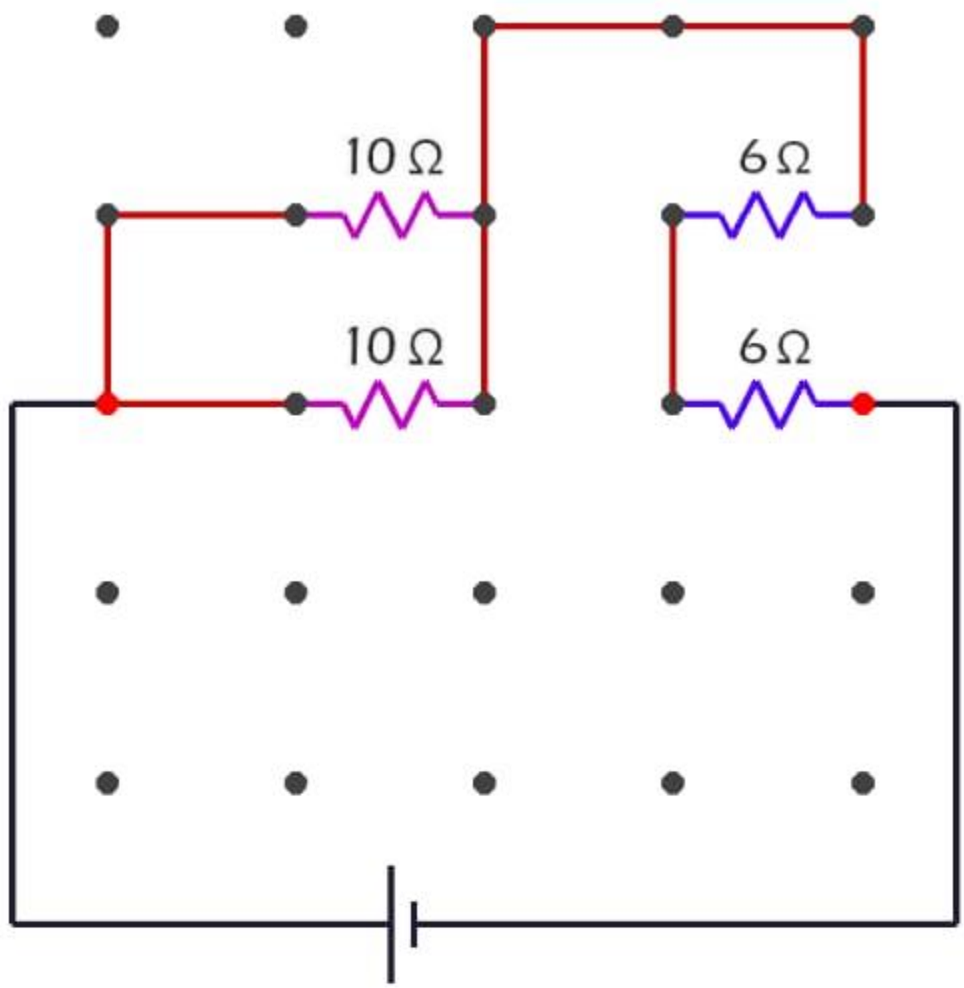
Level Six

Connect some more resistances (of 12 ohms each) and make a circuit with an equivalent resistance of 16 ohms.



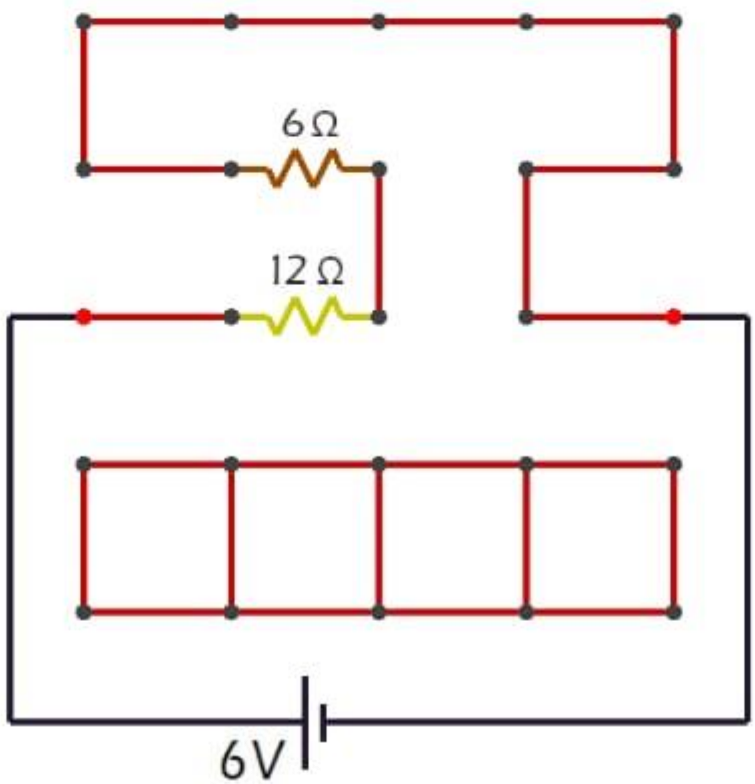
Level Eight

Connect the given resistances to make a circuit with an equivalent resistance of 17 ohms.



Level Ten

Connect the given resistances in series and find the voltage drop across the 12 ohm resistance.



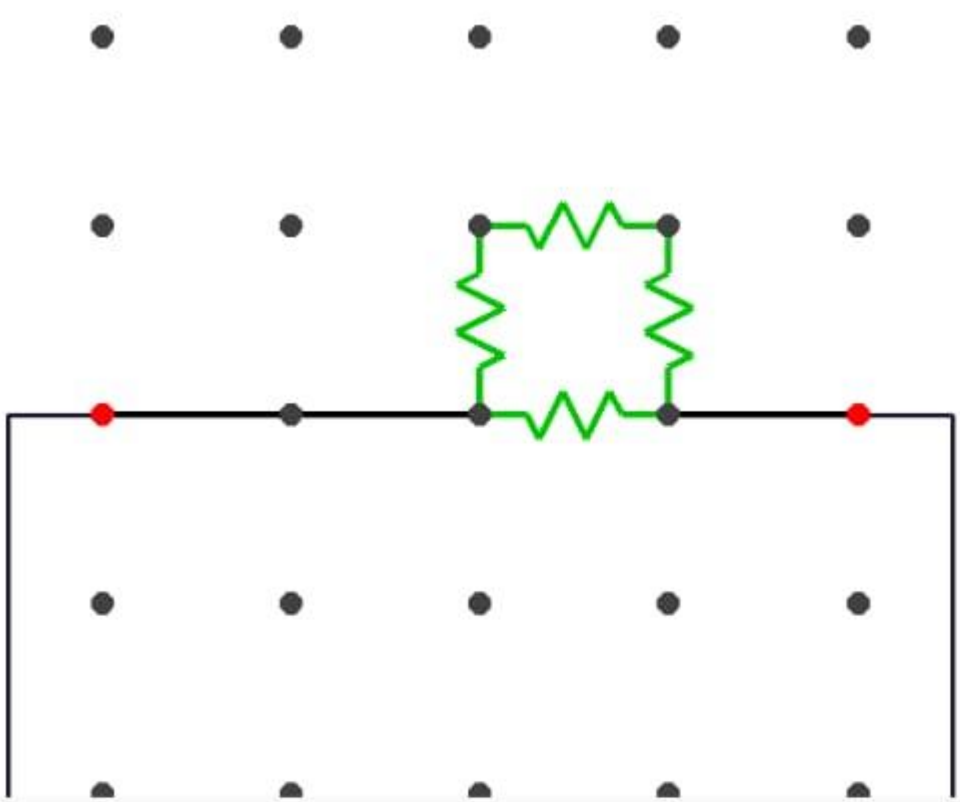
Answer (in volts) = 4

DONE! BACK

1 2 3 –

Level Ten

All the resistances are of 12 ohms. Find the equivalent resistance of the circuit.



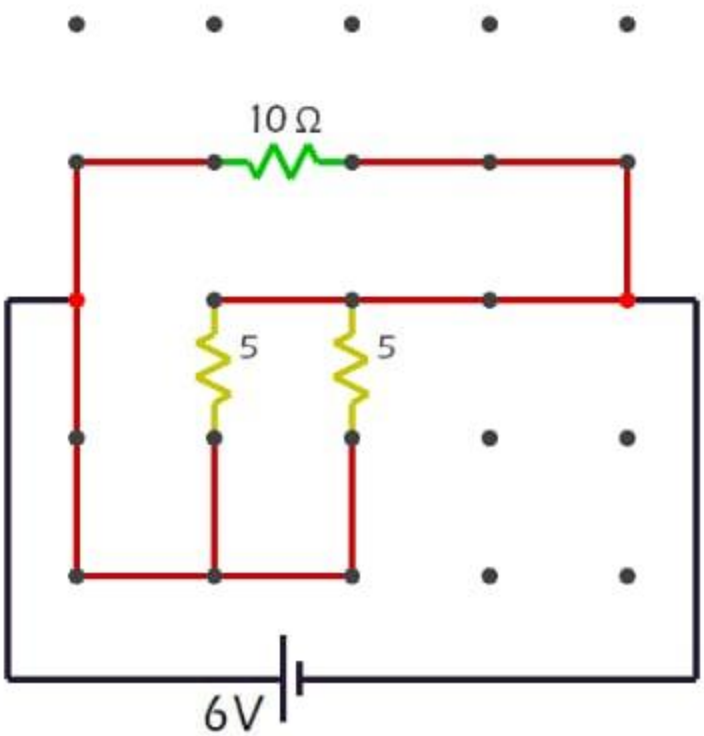
Equivalent resistance (in ohms) = 9

DONE! BACK

1 2 3 –

Level Eleven

The green resistance is of 10 ohms and the yellow ones are of 5 ohms each. Connect all of them in parallel and find the current through the circuit.



Answer (in amperes) = 3

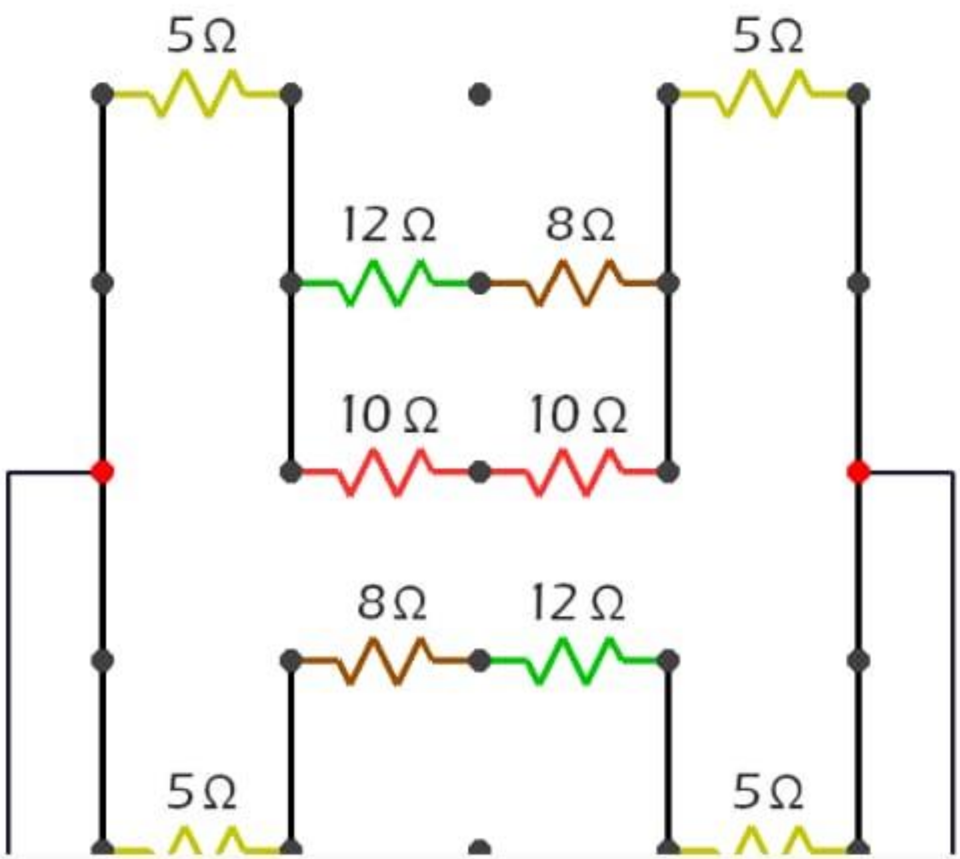
DONE!

BACK

1 2 3 –

Level Twelve

The resistances (in ohms) are as mentioned.
Find the equivalent resistance of the circuit.



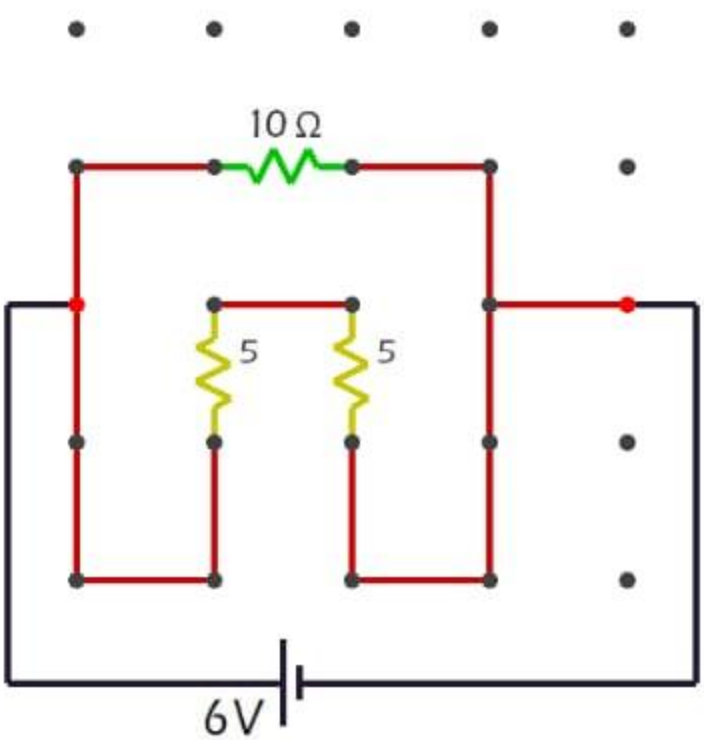
Equivalent resistance (in ohms) = 12

DONE! BACK

1 2 3 –

Level Thirteen

Connect the two 5 ohm resistances in series and the 10 ohm resistance in parallel with them. Now find the current through each 5 ohm resistance.



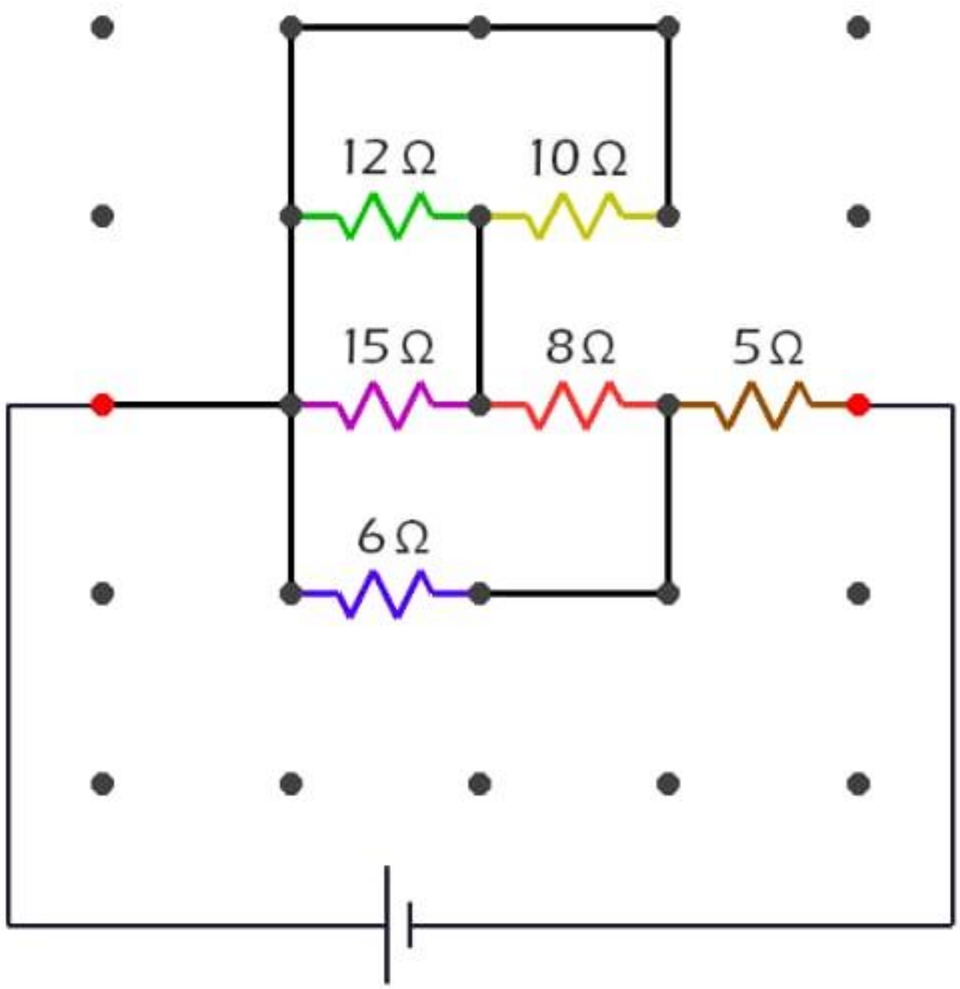
Answer (in amperes) = 0.6

DONE! BACK

1 2 3 -

Level Fifteen

The resistances (in ohms) are as mentioned. Find the equivalent resistance of the circuit.



Sir I forgot to take some of the ss so here are the taken ones.