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Lesson 16

Worksheet (WS)

Unit 2020 : Electrical science

Worksheet 10: Series/parallel resistive circuits

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Work sheet (WS)

Generic information:

In a series circuit we add all of the resistance/resistors.

Whereas, in a Parallel circuit we use the formula.

$$R_T = \frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}$$

WS Question one

Resolve the following problems relating to series and parallel resistive circuits.

1. Complete the following table for resistors that are all connected in series.

	R1	R2	R3	R4	R _T
a	7 Ω	10 Ω	8 Ω	15 Ω	
b	7 Ω	16 Ω	8 Ω	19 Ω	
c	1.5 Ω	5.6 Ω	8.2 Ω	7.3 Ω	
d	0.03 Ω	0.105 Ω	1.06 Ω	2.007 Ω	
e	15 MΩ	21.3 MΩ	1.4 MΩ	5.3 MΩ	
f	15 mΩ	83 mΩ	26 mΩ	9 mΩ	
g	200 KΩ	500 KΩ	10 kΩ	1.2 MΩ	

Handwritten calculations below the table:

- For row g: $200\text{ K}\Omega + 500\text{ K}\Omega = 700\text{ K}\Omega$ (labeled as 710 KΩ)
- For row g: $700\text{ K}\Omega + 10\text{ k}\Omega = 710\text{ K}\Omega$
- For row g: $710\text{ K}\Omega + 1.2\text{ M}\Omega = 1,910\text{ K}\Omega = 1.91\text{ M}\Omega$ (labeled as 1,200,000)

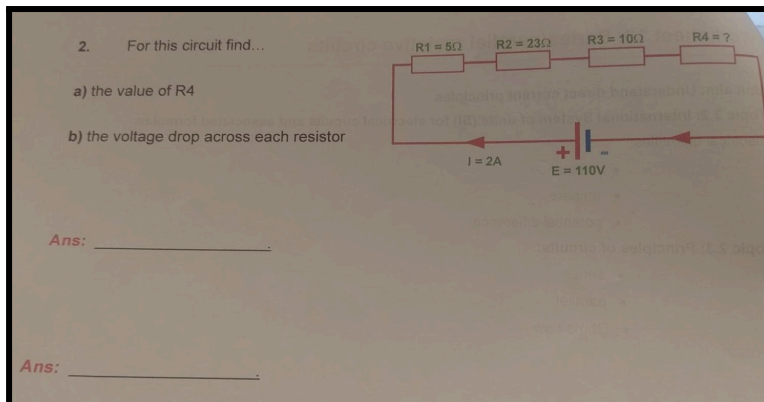
	R1	R2	R3	R4	Rt
a	7 Ω	10 Ω	8 Ω	15 Ω	40 Ω
b	7 Ω	16 Ω	8 Ω	19 Ω	50 Ω
c	1.5 Ω	5.6 Ω	8.2 Ω	7.3 Ω	22.6Ω
d	0.03 Ω	0.105 Ω	1.06 Ω	2.007 Ω	3.202Ω
e	15 MΩ	21.3 MΩ	1.4 MΩ	5.3 MΩ	43MΩ
f	15 mΩ	83 mΩ	26 mΩ	9 mΩ	133MΩ
g	200 KΩ	500 KΩ	10 kΩ	1.2 MΩ	1.91MΩ

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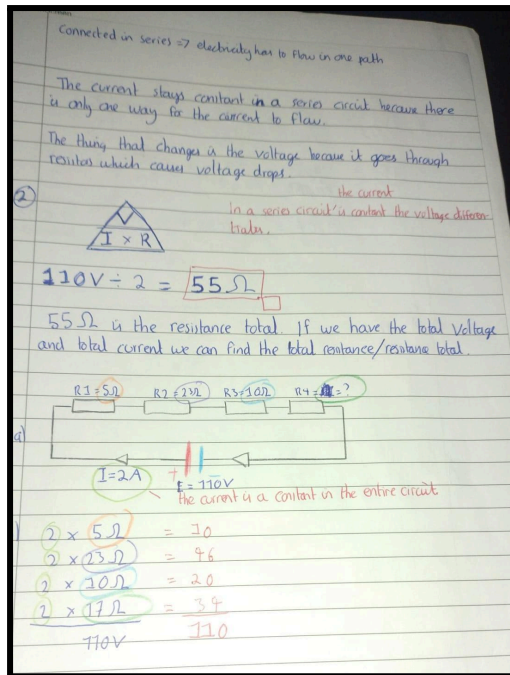
Question one working out

$$\begin{aligned}200\text{ k}\Omega &= 200,000\Omega \\500\text{ k}\Omega &= 500,000\Omega \\10\text{ k}\Omega &= 10,000\Omega \\1.2\text{ M}\Omega &= 1,200,000\Omega \\ \text{Total} \\1.91\text{ M}\Omega &= 1,910,000\end{aligned}$$

WS Question two



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2 a) working out

In a series circuit the **current** is constant. Whereas, in the series circuit the **voltage** changes. We have to deduce the value of **R4**. For the resistances we have:

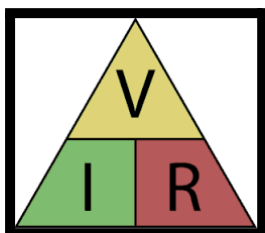
R1 = 5 ohms,

R2 = 23 ohms,

R3 = 10 ohms,

R4 = ?

The Ohms law triangle.



$$110 \text{ V} / 2 \text{ A} = 55 \text{ ohms}$$

55 Ohms is the **total resistance** for the entire circuit.

$$\text{R1 (5 ohms)} + \text{R2 (23 ohms)} + \text{R3 (10 ohms)} = 38 \text{ ohms}$$

Hence, **R4** = 17 ohms.

Because, $38 + 17 = 55$ ohms.

2 b) working out

Voltage drop in a resistor = **Current** x **resistance of resistor**

Resistor	Current	Resistance per resistor	Voltage drop per resistor
R1	2	5Ω	10
R2	2	23Ω	46
R3	2	10Ω	20
R4	2	17Ω	34
		Voltage drop total	110V

The way to figure out if you have calculated voltage drop properly. Is that the total voltage drop should equal the voltage of the entire circuit.

WS Question three

3. Three resistors with values of 0.012Ω , 0.015Ω & 0.008Ω are connected in parallel across a 2.4 V d.c. supply. Calculate:

a) the current flowing in each resistor

I in $0.012\Omega =$ _____

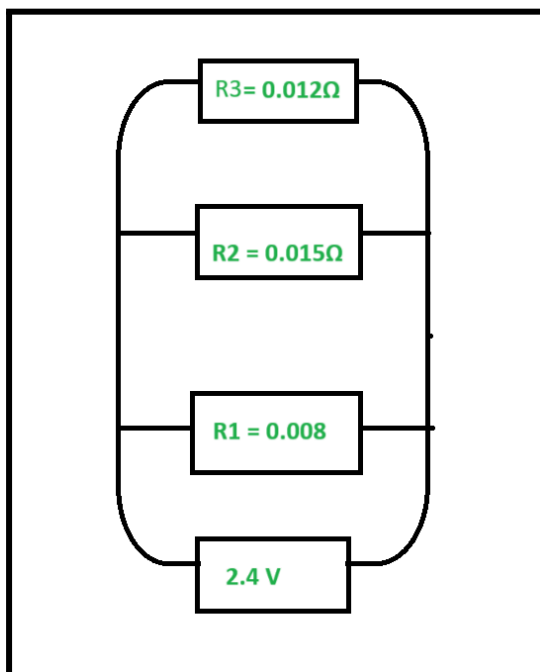
I in $0.015\Omega =$ _____

I in $0.008\Omega =$ _____

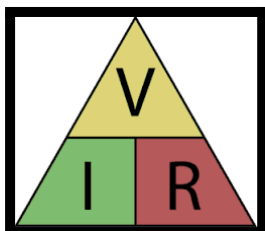
b) the total current drawn from the supply.

Ans: _____

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Calculate the current flowing through each resistor



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A) The current flowing in the resistor

$$R3 \Rightarrow 2.4 \text{ V} / 0.012 \text{ ohms} = 200 \text{ amps}$$

$$R2 \Rightarrow 2.4 \text{ V} / 0.015 \text{ ohms} = 160 \text{ amps}$$

$$R1 \Rightarrow 2.4 \text{ V} / 0.008 \text{ ohms} = 300 \text{ amps}$$

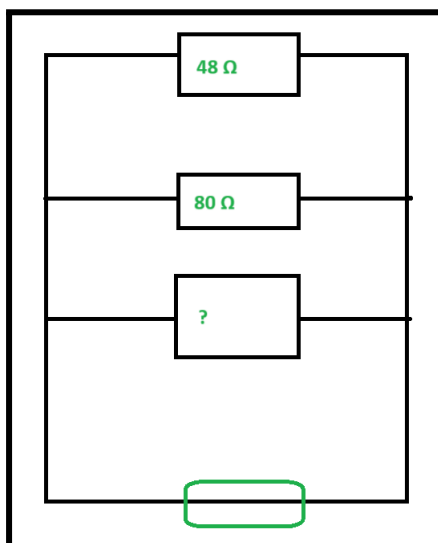
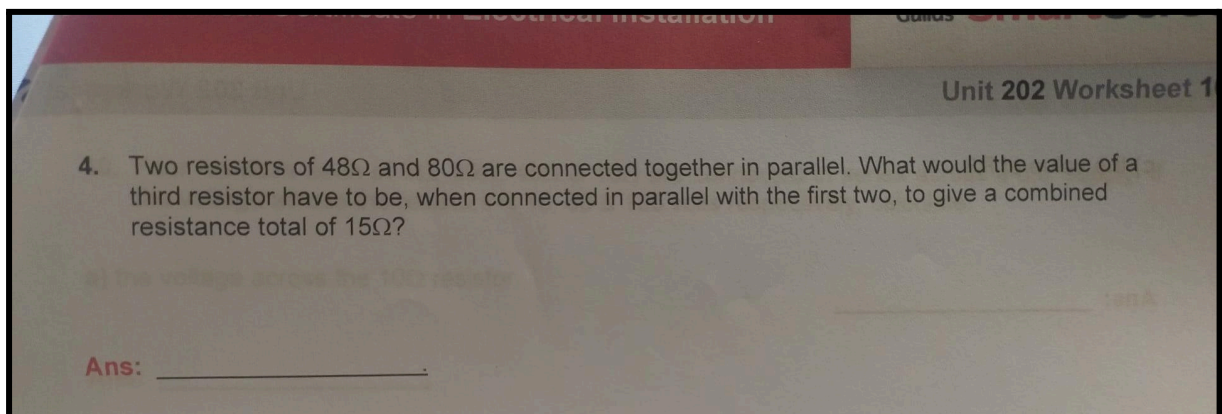
B) The total current drawn from the supply

$$\text{Total Current} = \text{Total Voltage} / \text{Total Resistance}$$

$$2.4 / (200 + 160 + 300 = 660)$$

$$= 0.035 \text{ amps}$$

WS Question four



Question four working out

Question four

Step one $\frac{1}{15} = \frac{1}{48} + \frac{1}{80} + \frac{1}{x}$

Step two Find the LCM (15, 48, 80)

$\frac{1}{15}$	$\frac{1}{48}$	$\frac{1}{80}$
$15 \div 3 = 5$	$48 \div 2 = 24$	$80 \div 2 = 40$
	$24 \div 2 = 12$	$40 \div 2 = 20$
	$12 \div 2 = 6$	$20 \div 2 = 10$
	$6 \div 2 = 3$	$10 \div 2 = 5$
(3)	$(2^4 \times 3)$	$(2^4 \times 5)$

$[2^4 \times 3 \times 5] = 240$

Step three

$\frac{1}{15}$	$\xrightarrow{\times 16}$ becomes $\frac{16}{240}$	$\frac{1}{48}$	$\xrightarrow{\times 5}$ becomes $\frac{5}{240}$	$\frac{1}{80}$	$\xrightarrow{\times 3}$ becomes $\frac{3}{240}$
	$\xrightarrow{\times 16}$	$\xrightarrow{\times 5}$		$\xrightarrow{\times 5}$	

$\frac{16}{240} = \frac{5}{240} + \frac{3}{240} + \frac{1}{x}$

$\frac{16}{240} - \frac{8}{240} = \frac{1}{x}$

$\frac{8}{240} = \frac{1}{x}$

$240 \times 1 = 8 \times x$

$(\div 8) 240 = 8x (\div 8)$

$\boxed{30} = x$

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WS Question five

5. Complete the following table assuming that the resistors are connected in parallel:

	R_1	R_2	R_3	R_T
a.	120Ω		---	48Ω
b.		48Ω	---	12Ω
c.		50Ω	---	40Ω
d.	40Ω		20Ω	10Ω
e.	60Ω		20Ω	10Ω

Question five working out

Row A) $R_2 = 80\Omega$

Handwritten working out for Row A:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{48} = \frac{1}{120} + \frac{1}{x}$$

Factorization and LCM:

$$48 \div 2 = 24, 120 \div 2 = 60$$
$$24 \div 2 = 12, 60 \div 2 = 30$$
$$12 \div 2 = 6, 30 \div 2 = 15$$
$$6 \div 2 = 3, 15 \div 3 = 5$$

LCM of 120 and 48 is 240.

$$\frac{5}{240} = \frac{2}{240} + \frac{1}{x}$$
$$5 - 2 = \frac{3}{240} = \frac{1}{x}$$
$$x = 80$$

Row B) $R_1 = 16\Omega$

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Row B

Step one $\frac{1}{12} = \frac{2}{48} + x$

Find the LCM of (12, 48)

$12 \div 2 = 6$ $48 \div 2 = 24$
 $6 \div 2 = 3$ $24 \div 2 = 12$
~~6~~ $12 \div 2 = 6$
 $3 \div 2 = 3$

Step two $(2 \times 2 \times 3)$ $(2 \times 2 \times 2 \times 2 \times 3)$
 $(2^2 \times 3)$ $(2^4 \times 3)$
 $[2^4 \times 3] = 48$

Step three $\frac{1}{12}$ becomes $\frac{4}{48}$, $\frac{1}{48}$ stays the same, because it is in LCM

Step four $\frac{4}{48} = \frac{1}{12} + x$

$4 - 1 = x$

$48 \quad 48$

$\frac{3}{48} = \frac{1}{16}$ $(3 \cdot x = 48 \cdot 1)$
 $3 \cdot x = 48$
 $x = 48 \div 3$
 $x = 16$

$\frac{1}{16}$

Row C) $R_1 = 200 \Omega$

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row c

Step one $\frac{1}{40} = \frac{1}{50} + \frac{1}{x}$

Step two
LCM LCM for (40, 50)

$\frac{1}{40}$ $\frac{1}{50}$

$40 \div 2 = 20$ $50 \div 2 = 25$
 $20 \div 2 = 10$ $25 \div 5 = 5$
 $10 \div 2 = 5$
 $(2^3 \times 5)$ $(2 \times 5 \times 5)$
 $[2^3 \times 5^2] = 200$

Step three

$\frac{1}{40} \xrightarrow{\times 5} \frac{5}{200}$, $\frac{1}{50} \xrightarrow{\times 4} \frac{4}{200}$
 $\xrightarrow{\times 5}$ $\xrightarrow{\times 4}$

Step four

$\frac{5}{200} = \frac{4}{200} + \frac{1}{x}$

$\frac{5}{200} - \frac{4}{200} = \frac{1}{x}$

$\frac{1}{200} = \frac{1}{x}$ } $1 \cdot x = 200$
 $x = 200$

Row D) $R_2 = 40\Omega$

row d.

Step one $\frac{1}{10} = \frac{1}{20} + \frac{1}{40} + \frac{1}{x}$

Step two Find the LCM

$$\frac{1}{10}$$

$$\frac{1}{20}$$

$$\frac{1}{40}$$

$$10 \div 2 = 5$$

$$20 \div 2 = 10$$

$$40 \div 2 = 20$$

$$10 \div 2 = 5$$

$$20 \div 2 = 10$$

$$10 \div 2 = 5$$

$$(2^1 \times 5)$$

$$(2^2 \times 5)$$

$$(2^3 \times 5)$$

$$[2^3 \times 5] = 40$$

Step 3 $\frac{1}{10} \xrightarrow{\times 4} \frac{4}{40}$, $\frac{1}{20} \xrightarrow{\times 2} \frac{2}{40}$, $\frac{1}{40} \xrightarrow{\times 1} \frac{1}{40}$

$$\frac{4}{40} = \frac{2}{40} + \frac{1}{40} + \frac{1}{x}$$

$$\frac{4}{40} = \frac{3}{40} + \frac{1}{x}$$

$$\frac{4}{40} - \frac{3}{40} = \frac{1}{x}$$

$$\frac{1}{40} = \frac{1}{x}$$

$$40 \times 1 = 1 \times x$$

$$40 = x$$

$$\boxed{40} \square$$

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Row E) $R_2 = 30\Omega$

row e $R_2 =$

Step one $\frac{1}{10} = \frac{1}{60} + \frac{1}{20} + \frac{1}{x}$

Step two Find the LCM (10, 60, 20)

$\frac{1}{10}$	$\frac{1}{60}$	$\frac{1}{20}$
----------------	----------------	----------------

$10 \div 2 = 5$ $60 \div 2 = 30$ $20 \div 2 = 10$
 $30 \div 2 = 15$ $10 \div 2 = 5$
 $15 \div 3 = 5$
 (2×5) $(2^2 \times 3 \times 5)$ $(2^2 \times 5)$
 $[2^2 \times 3 \times 5] = 60$
60 is the LCM

Step three

$\frac{1}{10} \xrightarrow{\times 6} \frac{6}{60}$	$\frac{1}{60} \xrightarrow{\times 1} \frac{1}{60}$	$\frac{1}{20} \xrightarrow{\times 3} \frac{3}{60}$
--	--	--

Step four $\frac{6}{60} = \frac{1}{60} + \frac{3}{60} + \frac{1}{x}$

$\frac{6}{60} = \frac{4}{60} + \frac{1}{x}$

$\frac{6}{60} - \frac{4}{60} = \frac{1}{x}$

$\frac{2}{60} = \frac{1}{x}$ $60 \times 2 \times x = 60 \times 1$
 $2x = 60$
 $x = 30$

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WS Question six

6. For the circuit opposite find...

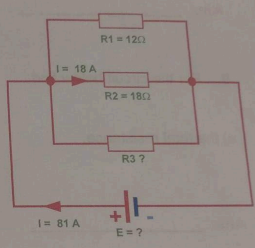
a) the supply voltage E

Ans: _____

b) the current flowing in R1 and R3

I in R1: _____

I in R3: _____



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c) the value of R3

Ans: _____

WS Question seven

7. Calculate the value of resistor to be connected in series with two resistors each of 1.8Ω and 5.6Ω to give a total resistance of 10Ω .

Ans: _____

Question seven working out

Calculate the value of resistor to be connected in series with two resistors each of 1.8Ω and 5.6Ω to give a total resistance of 10Ω .

$$10\Omega = 5.6 + 1.8 + x$$

$$x = 2.6 \quad \square$$

WS Question eight

8. Six resistors of equal value are connected in series. Calculate the value of the individual resistors if the total resistance is 14.4Ω .

Ans: _____

Question eight working out

In a series circuit we add the resistor values together to get the Resistance Total (R_t).
In this case we divide 14.4 ohms by 6 to get the individual resistor values. The answer is 2.4 .

Question 8. Six resistors of equal value are connected in series. Calculate the value of the individual resistors if the total resistance is 14.4Ω .

Working out: $14.4 \div 6 = 2.4 \quad \square$

WS Question nine

9. For the circuit below find...

a) the total resistance.

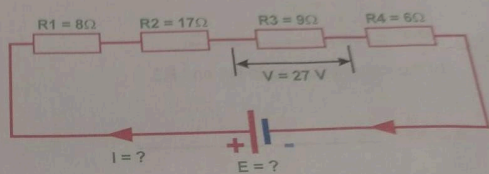
Ans: _____

b) the total current.

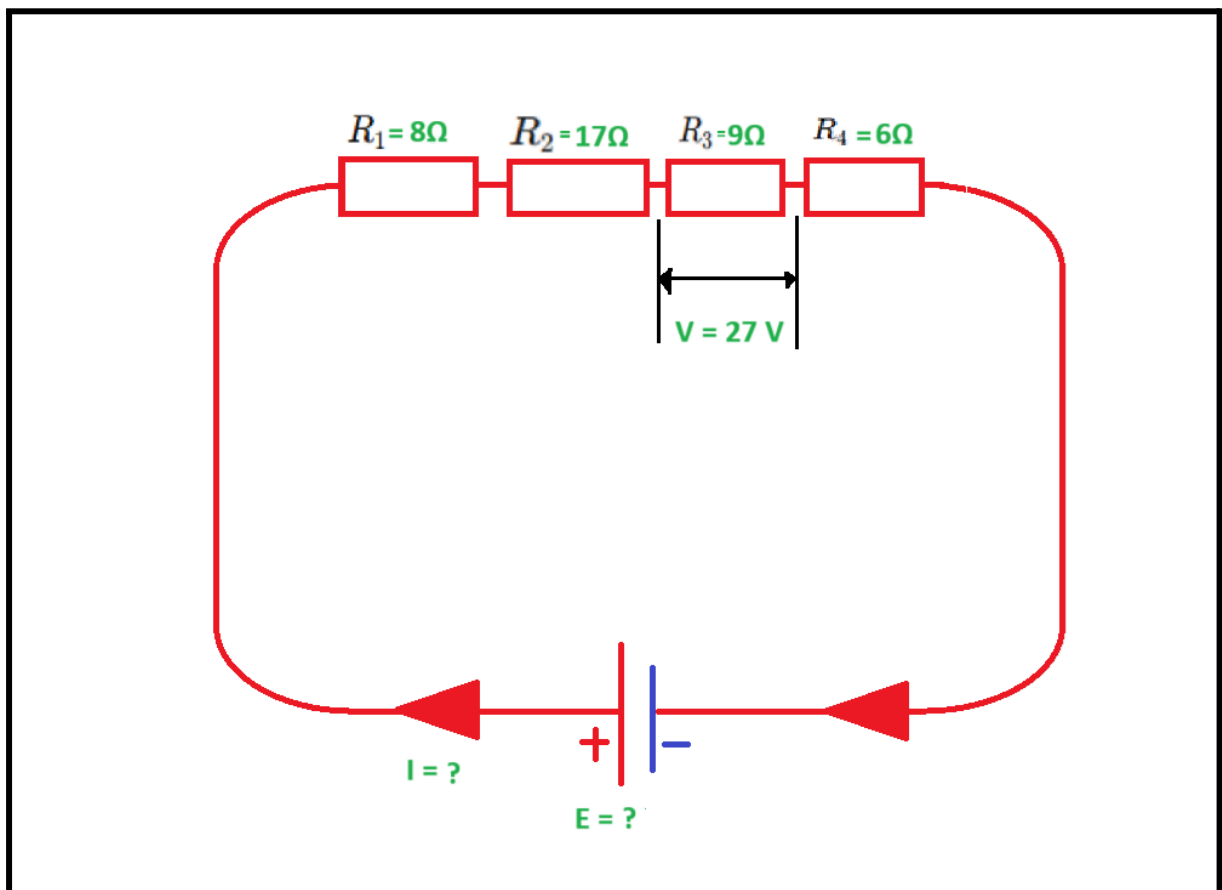
Ans: _____

c) the supply voltage E.

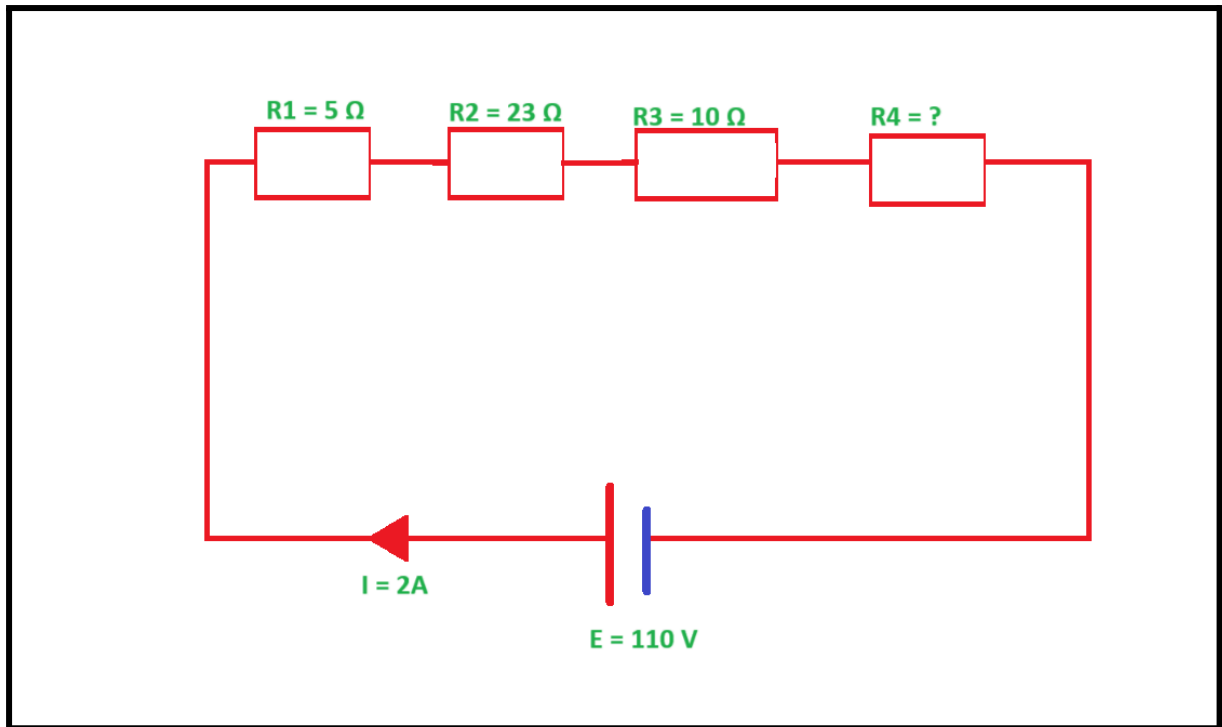
Ans: _____



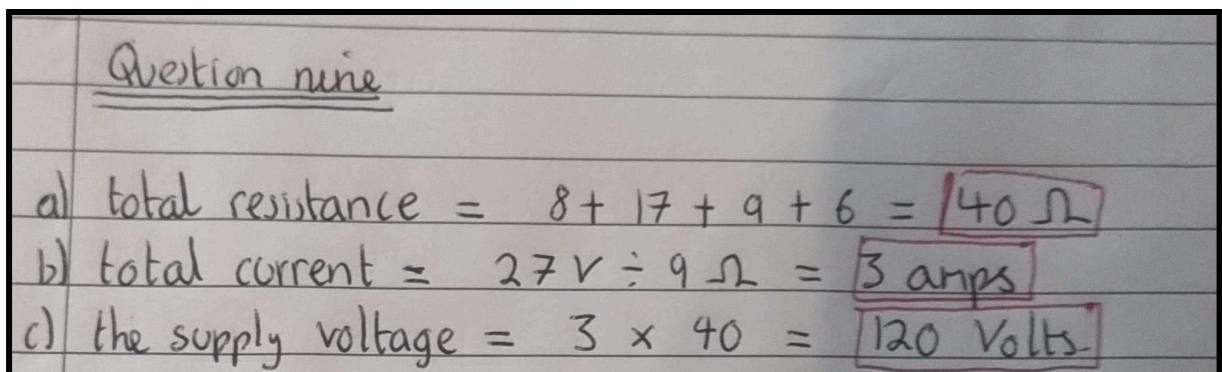
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Question nine working out



Question ten

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Unit 202 Worksheet 10

10. Four resistors each of 5Ω , 20Ω , 45Ω & 10Ω are connected in series across a d.c. supply. If the voltage across the resistors is 15, 60 & 135 volts respectively, calculate:

a) the voltage across the 10Ω resistor.

Ans: _____.

b) the supply voltage.

Ans: _____.

Question ten working out

