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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.

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

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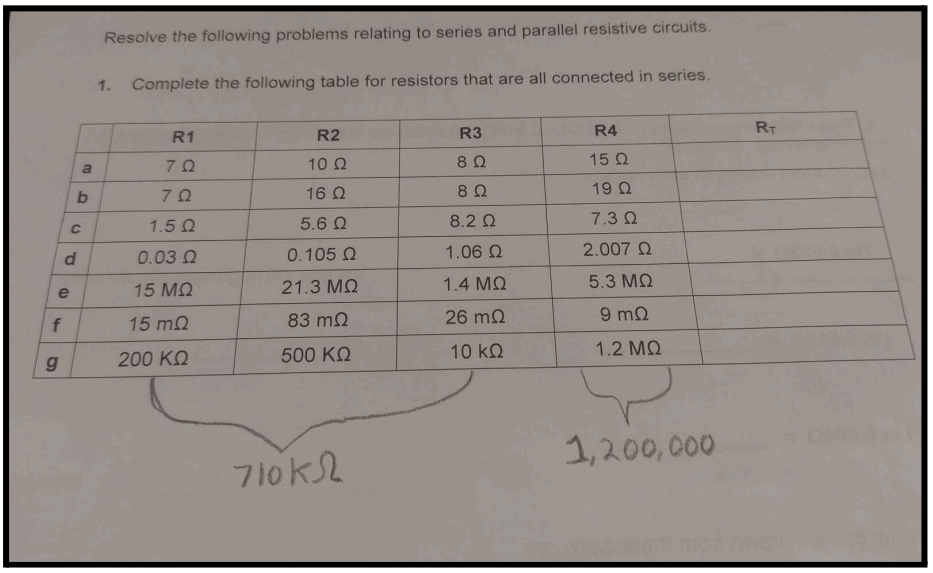
# WS Question one



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 | |

710KΩ

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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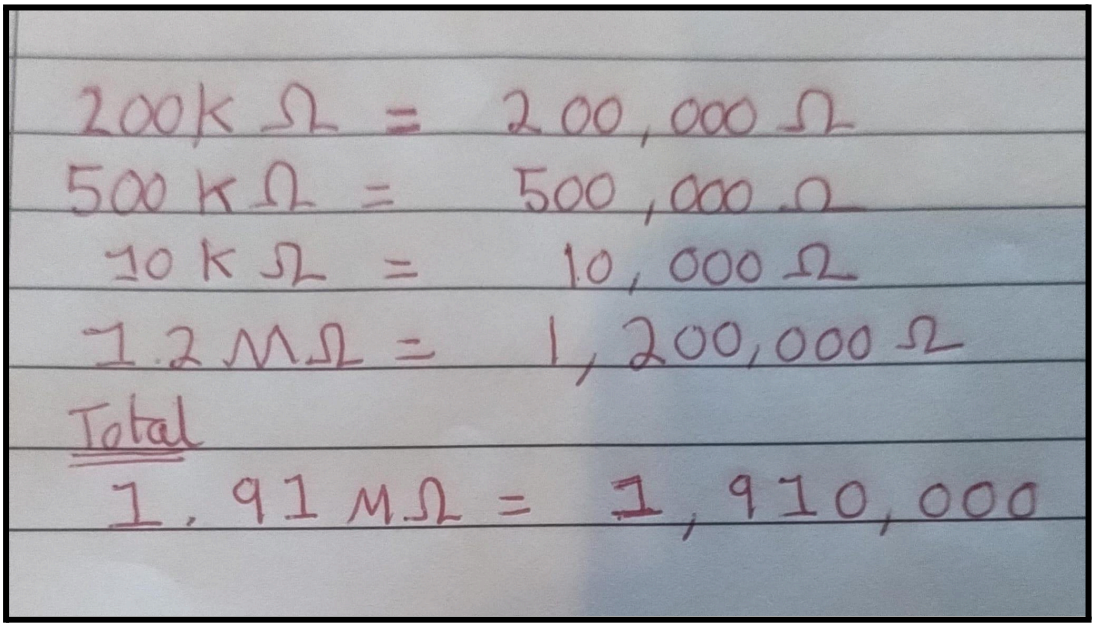
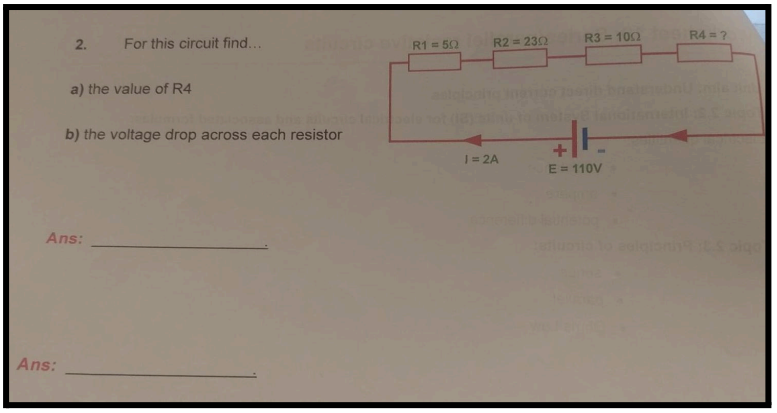
**Question one working out**




# WS Question two



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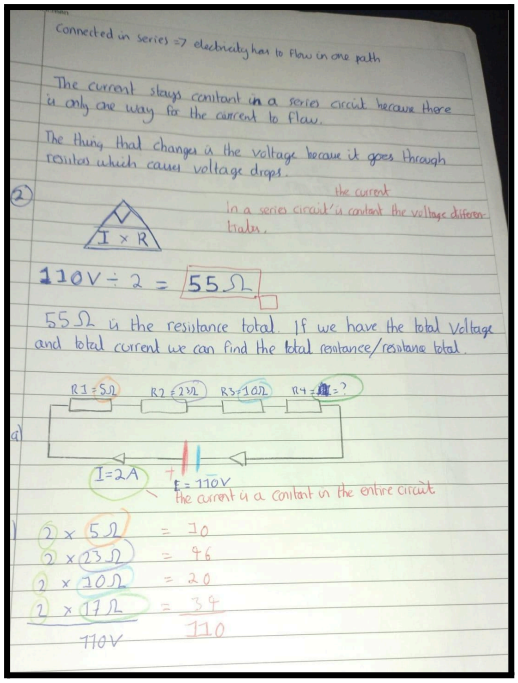
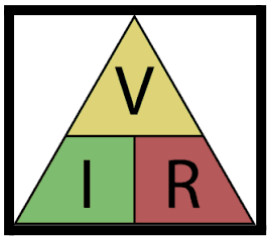



**2 a) working out**

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 V** / **2A** = **55 ohms**
**55 Ohms** is the **total resistance** for the entire circuit.

**R1 (**5 ohms) + **R2** (23 ohms) + **R3** (10 ohms) = 38 ohms

Hence, **R4** = 17 ohms.

Because, 38 + 17 = 55 ohms.

**2 b) working out**

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**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.

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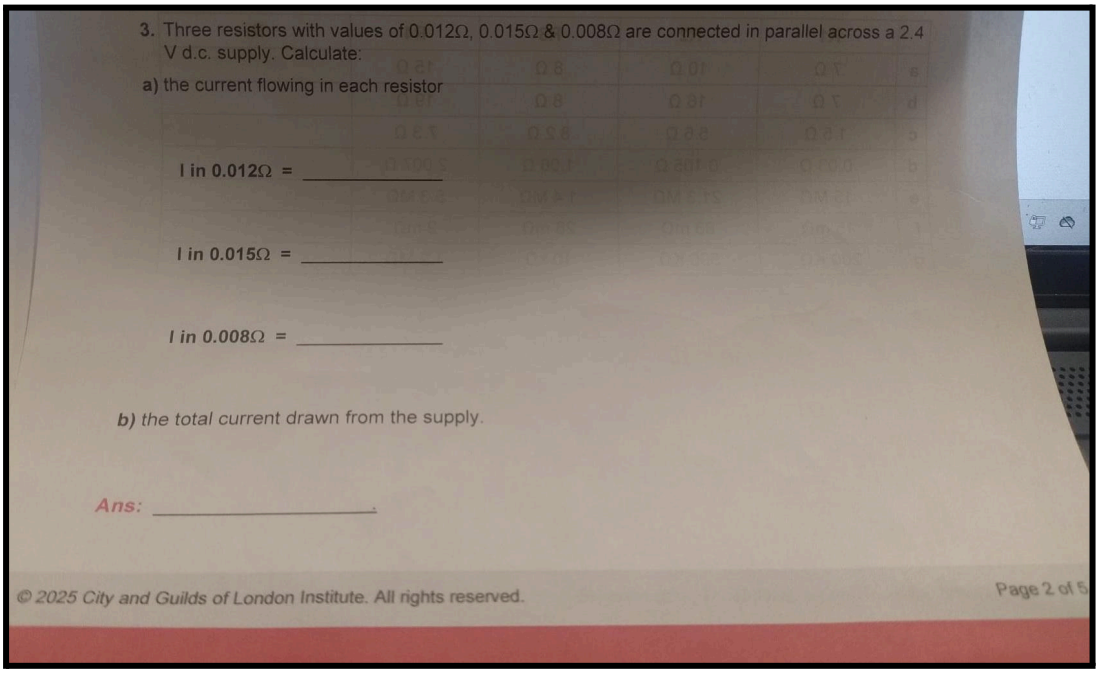
# WS Question three



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 0.012Ω = _____

I in 0.015Ω = _____

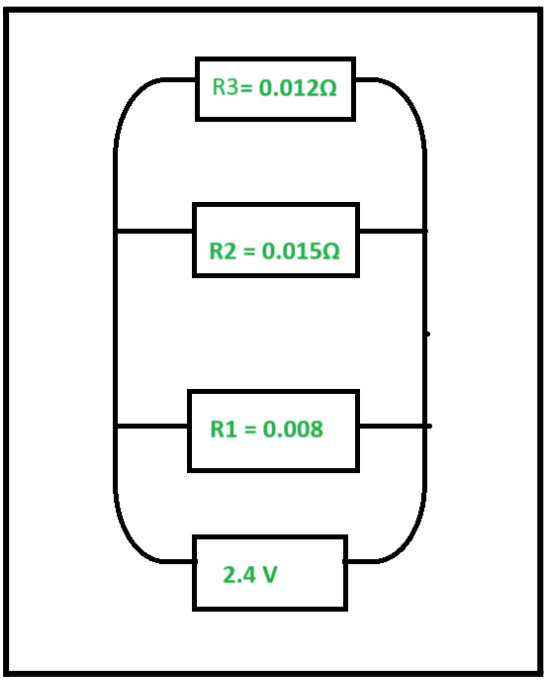
I in 0.008Ω = _____

b) the total current drawn from the supply.

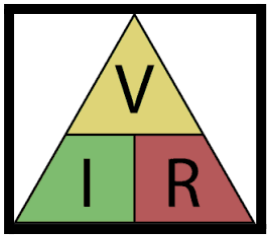
Ans: _____.








Calculate the current following through each resistor



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A)  The current flowing in the resistor

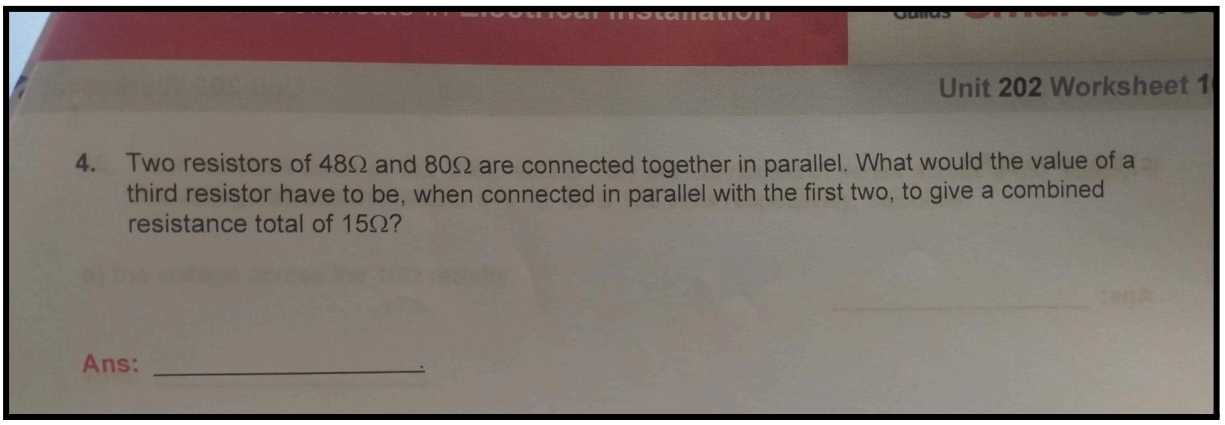
**R3** => 2.4 V /0.012 ohms = 200 amps
**R2** => 2.4 V /0.015 ohms  = 160 amps
**R1** => 2.4 V /0.008 ohms = 300 amps

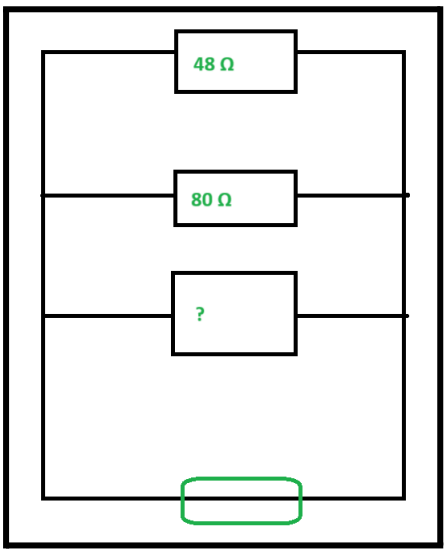
B) The total current drawn from the supply

**Total Current** = **Total Voltage** / **Total Resistance**

**2.4** / (**200** + **160** + **300** = **660**)
= **0.035 amps**

# WS Question four



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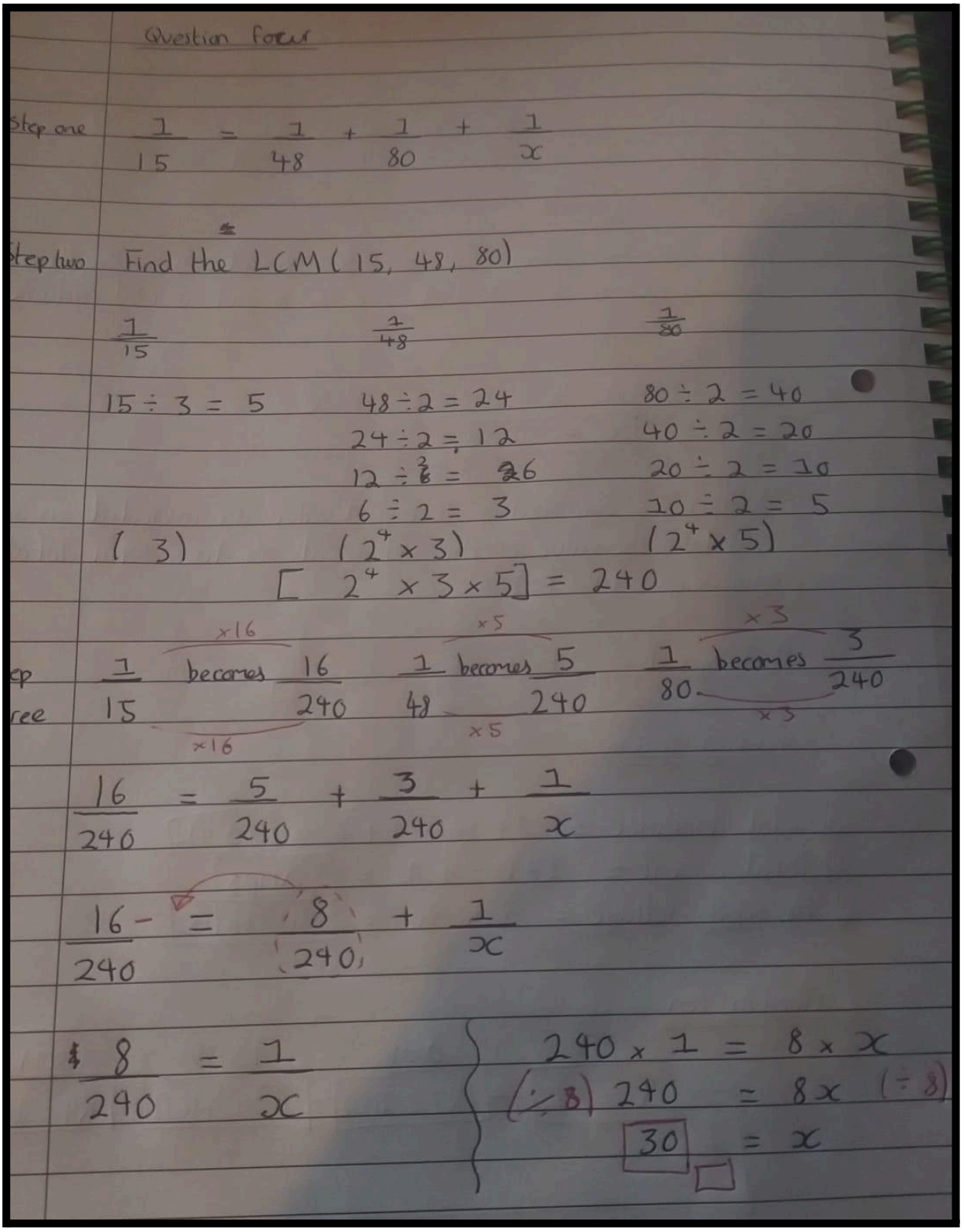
**Question four working out**



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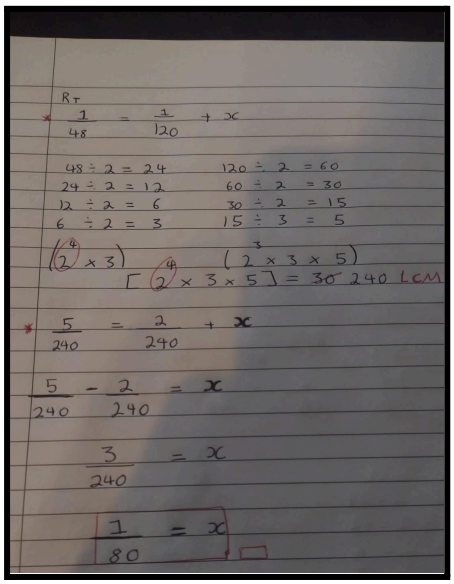
# WS Question five

**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 Ω**




**Row B) $R_1$ = 16 Ω**

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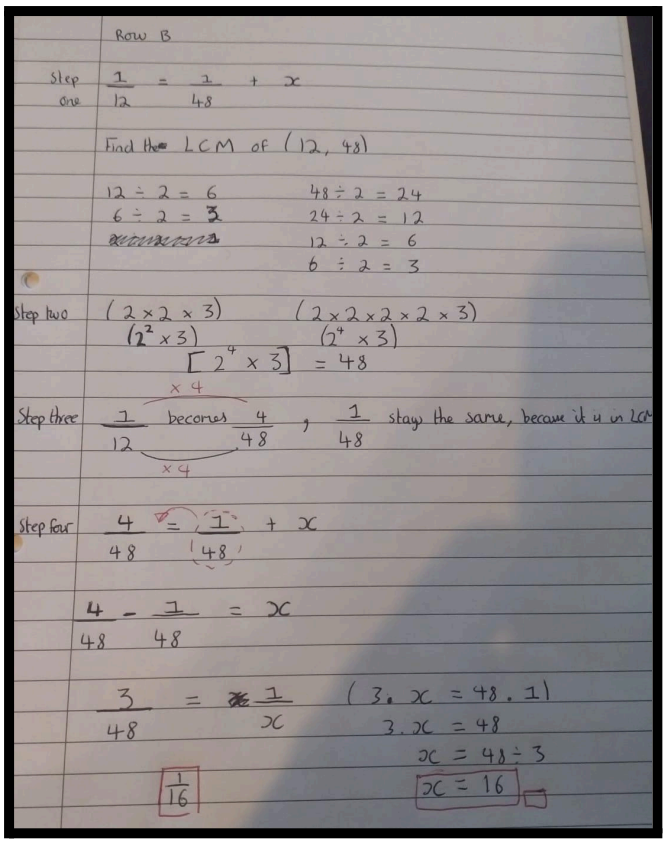
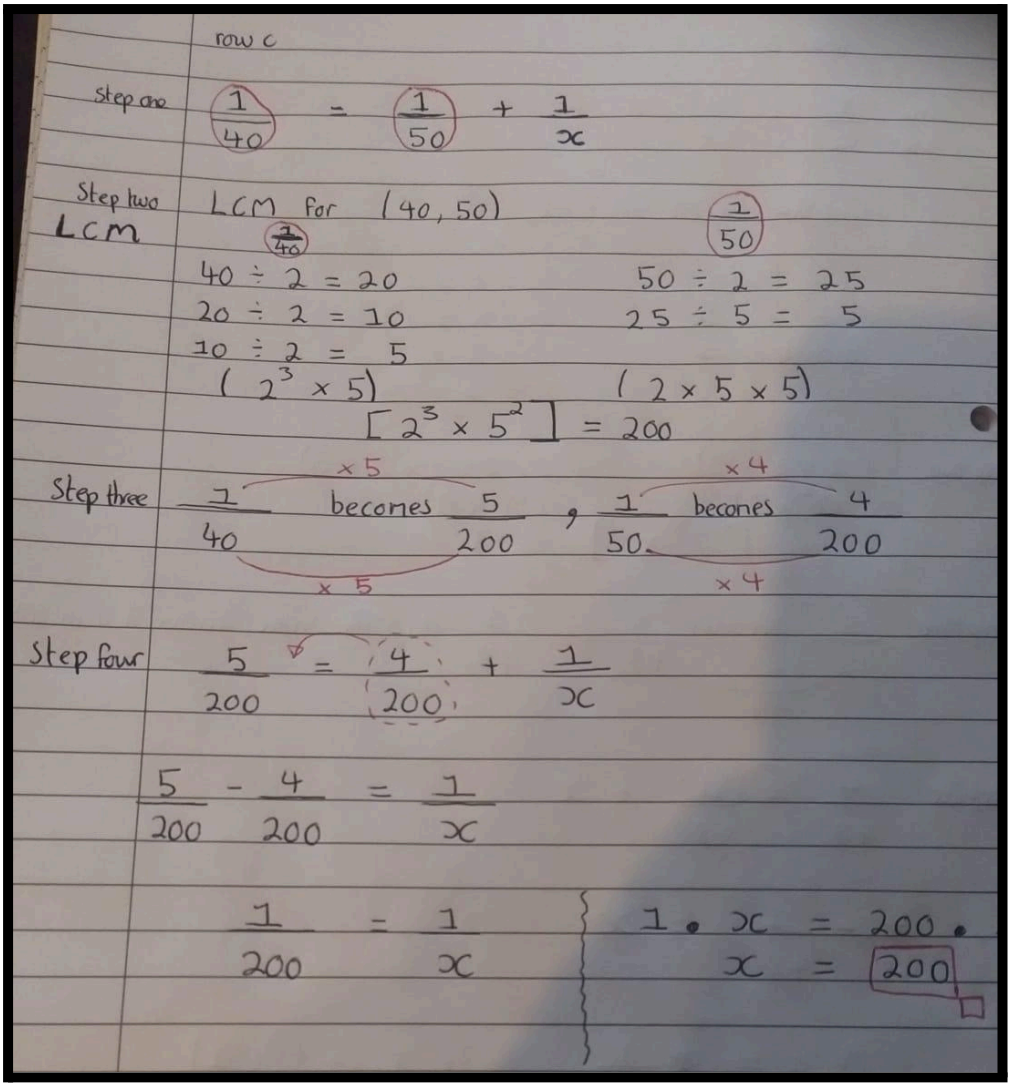



**Row C) $R_1$ = 200 Ω**


row c
step one
1/40 = 1/50 + 1/x
Step two
LCM
LCM for (40, 50)
40 ÷ 2 = 20
20 ÷ 2 = 10
10 ÷ 2 = 5
(2³ x 5)
50 ÷ 2 = 25
25 ÷ 5 = 5
(2 x 5 x 5)
[2³ x 5²] = 200
Step three
1/40 becomes 5/200, x 5
1/50 becomes 4/200, x 4
Step four
5/200 = 4/200 + 1/x
5/200 - 4/200 = 1/x
1/200 = 1/x
1 . x = 200 .
x = 200

**Row D) $R_2$ = 40Ω**

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row d.

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

Step two Find the LCM

$\frac{1}{10}$ $\frac{1}{20}$ $\frac{1}{40}$

$10 \div 2 = 5$ $20 \div 2 = 10$, $10 \div 2 = 5$ $40 \div 2 = 20$, $20 \div 2 = 10$, $10 \div 2 = 5$

$(2^1 \times 5)$ $(2^2 \times 5)$ $(2^3 \times 5)$

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

Step 3 $\frac{1}{10}$ becomes $\frac{4}{40}$ (×4), $\frac{1}{20}$ becomes $\frac{2}{40}$ (×2), $\frac{1}{40}$ becomes $\frac{1}{40}$ (×1)

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

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

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

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

$40 \times 1 = 1 \times x$

$40 = x$

$\boxed{40}$

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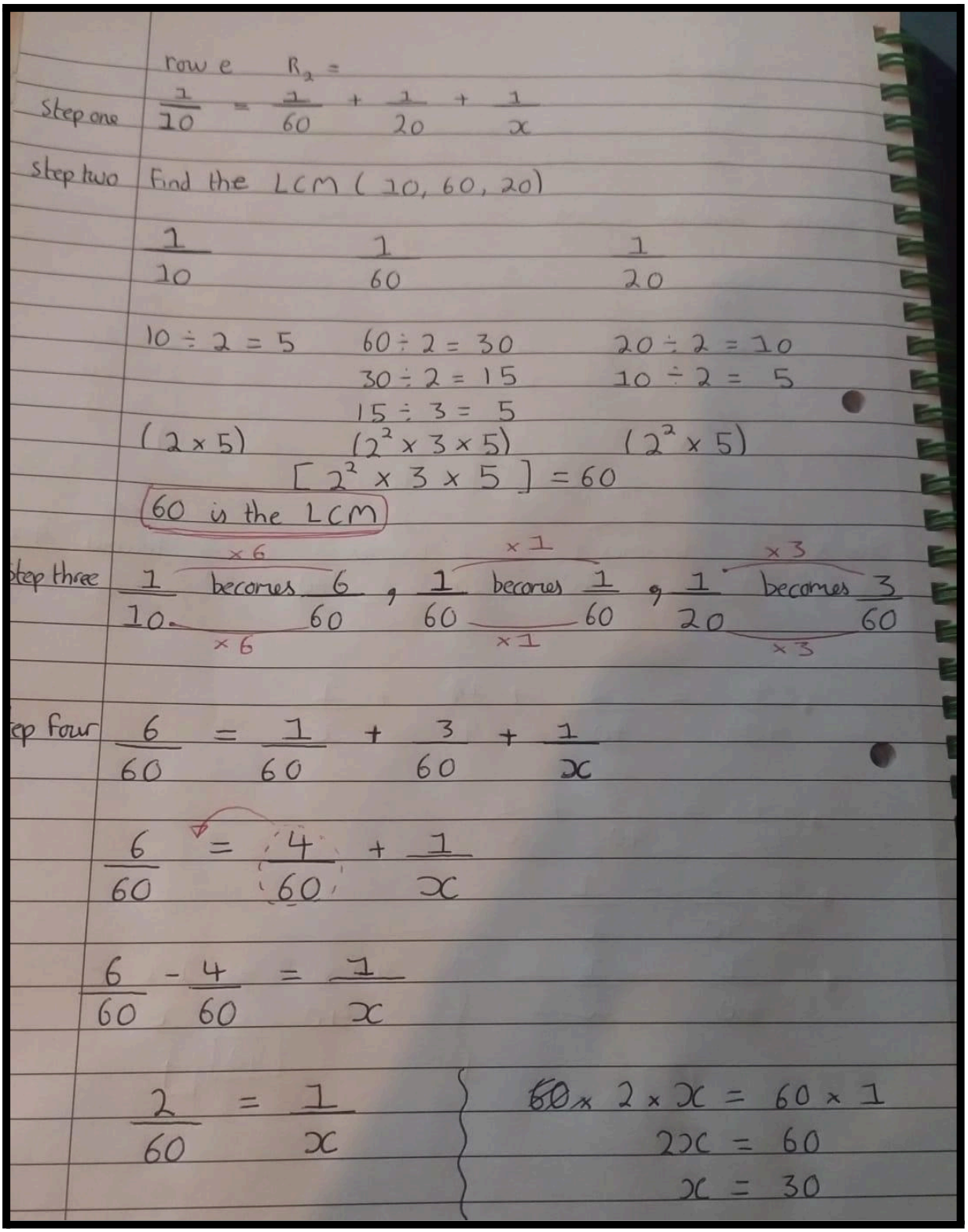
**Row E) $R_2 = 30\Omega$**



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)

| $\frac{1}{10}$ | $\frac{1}{60}$ | $\frac{1}{20}$ |
|---|---|---|
| $10 \div 2 = 5$ | $60 \div 2 = 30$ | $20 \div 2 = 10$ |
| | $30 \div 2 = 15$ | $10 \div 2 = 5$ |
| | $15 \div 3 = 5$ | |
| $(2 \times 5)$ | $(2^2 \times 3 \times 5)$ | $(2^2 \times 5)$ |

$[2^2 \times 3 \times 5] = 60$

60 is the LCM

step three $\frac{1}{10}$ (×6) becomes $\frac{6}{60}$, $\frac{1}{60}$ (×1) becomes $\frac{1}{60}$, $\frac{1}{20}$ (×3) becomes $\frac{3}{60}$

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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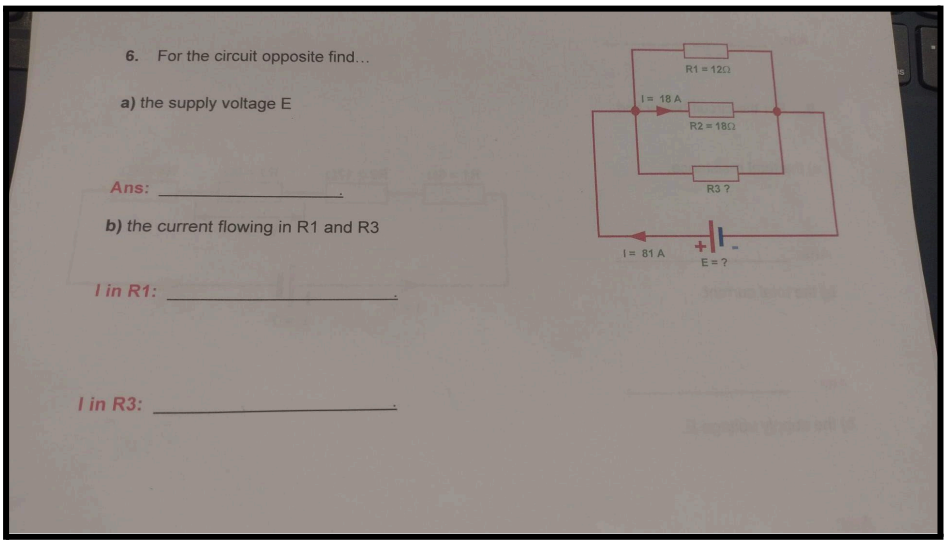
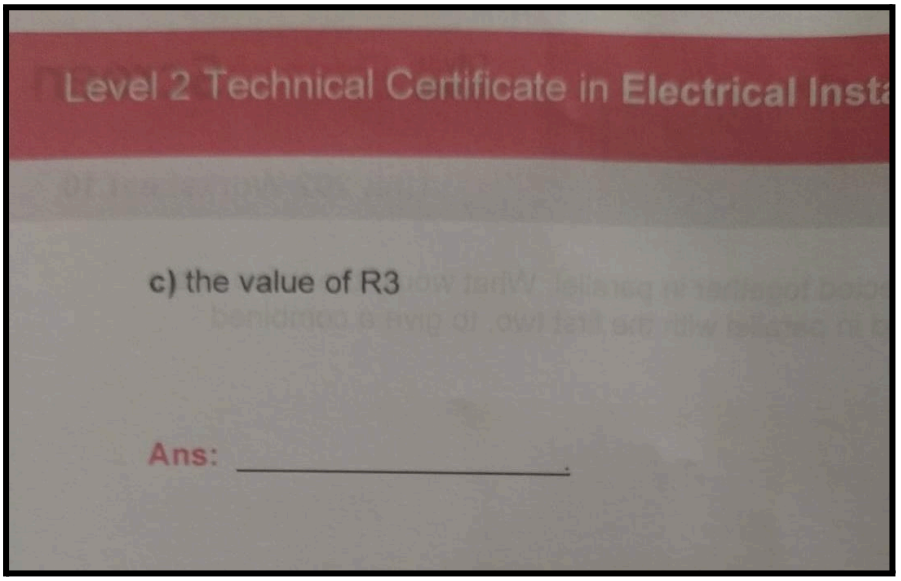
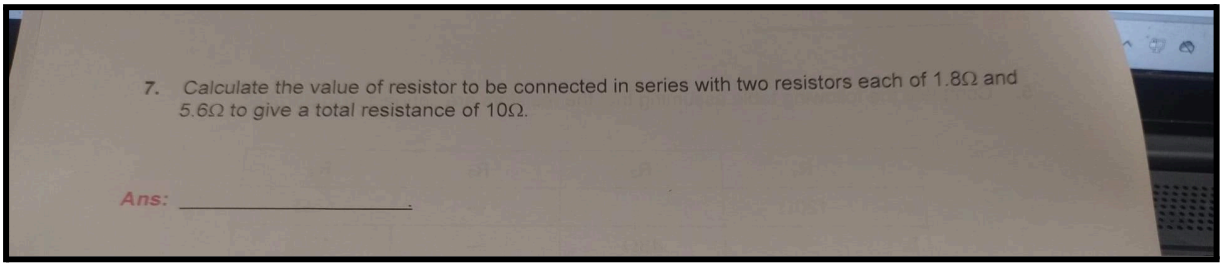
# WS Question six

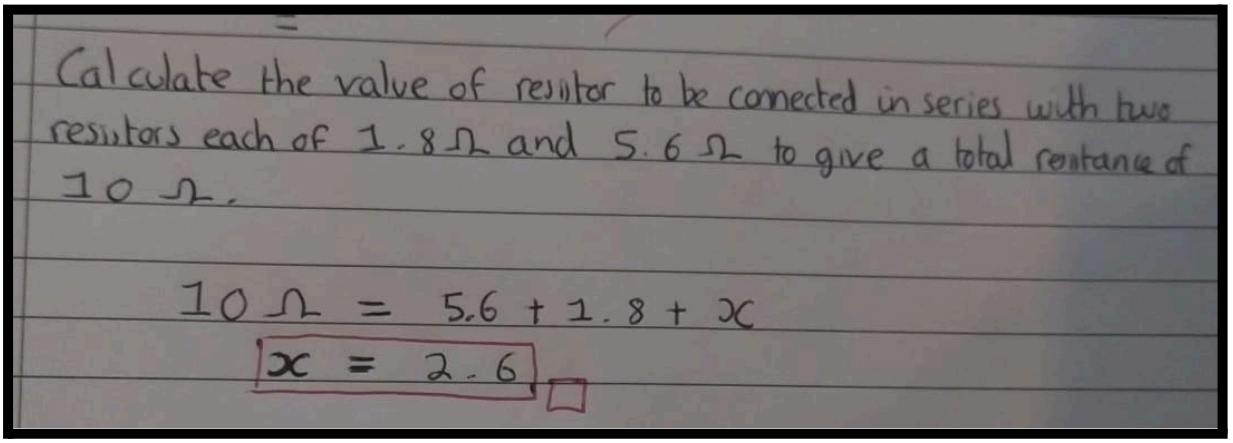


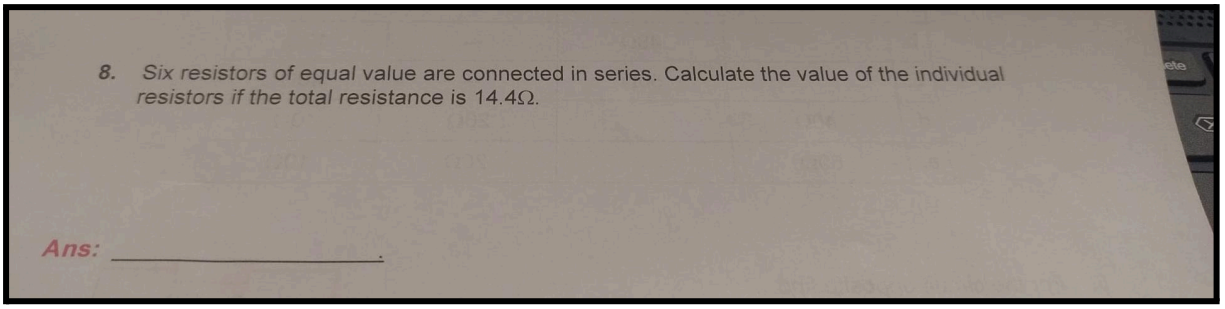

# WS Question seven



**Question seven working out**

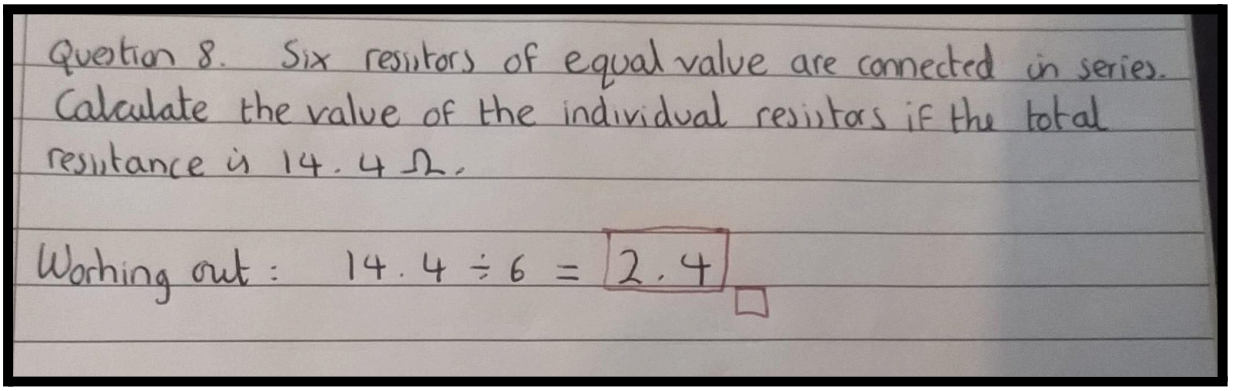



# WS Question eight

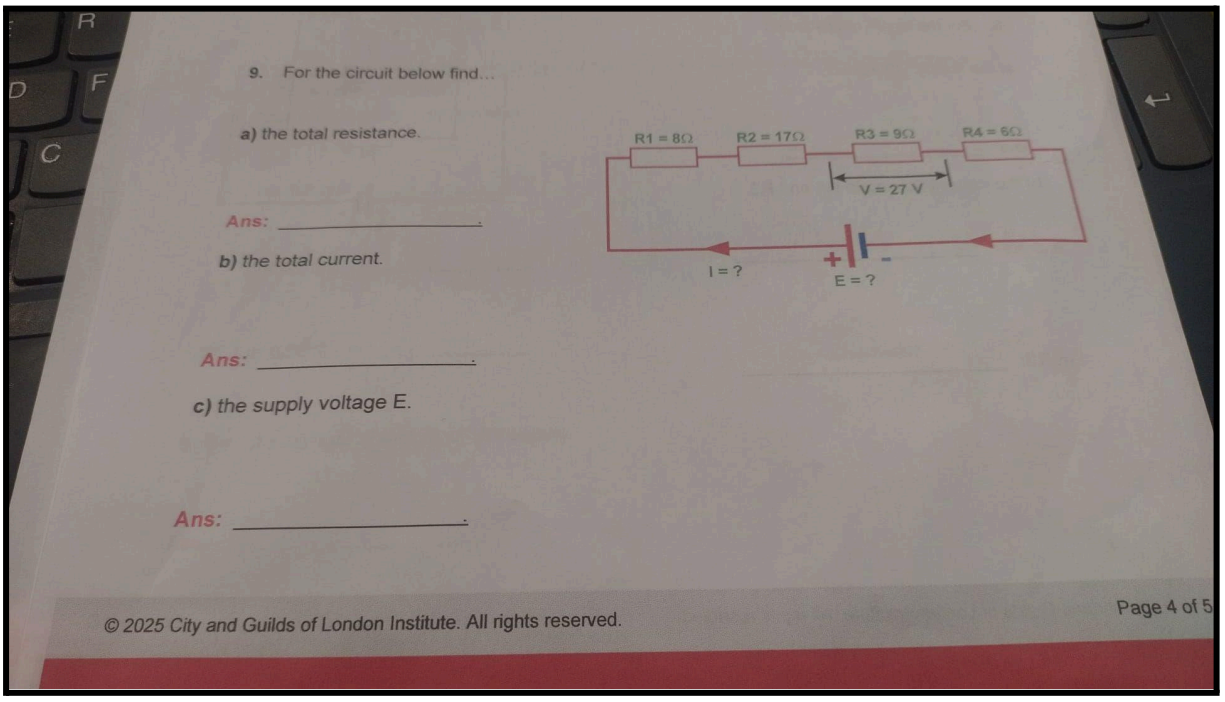



**Question eight working out**

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.



# 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: _____.

R1 = 8Ω R2 = 17Ω R3 = 9Ω R4 = 6Ω

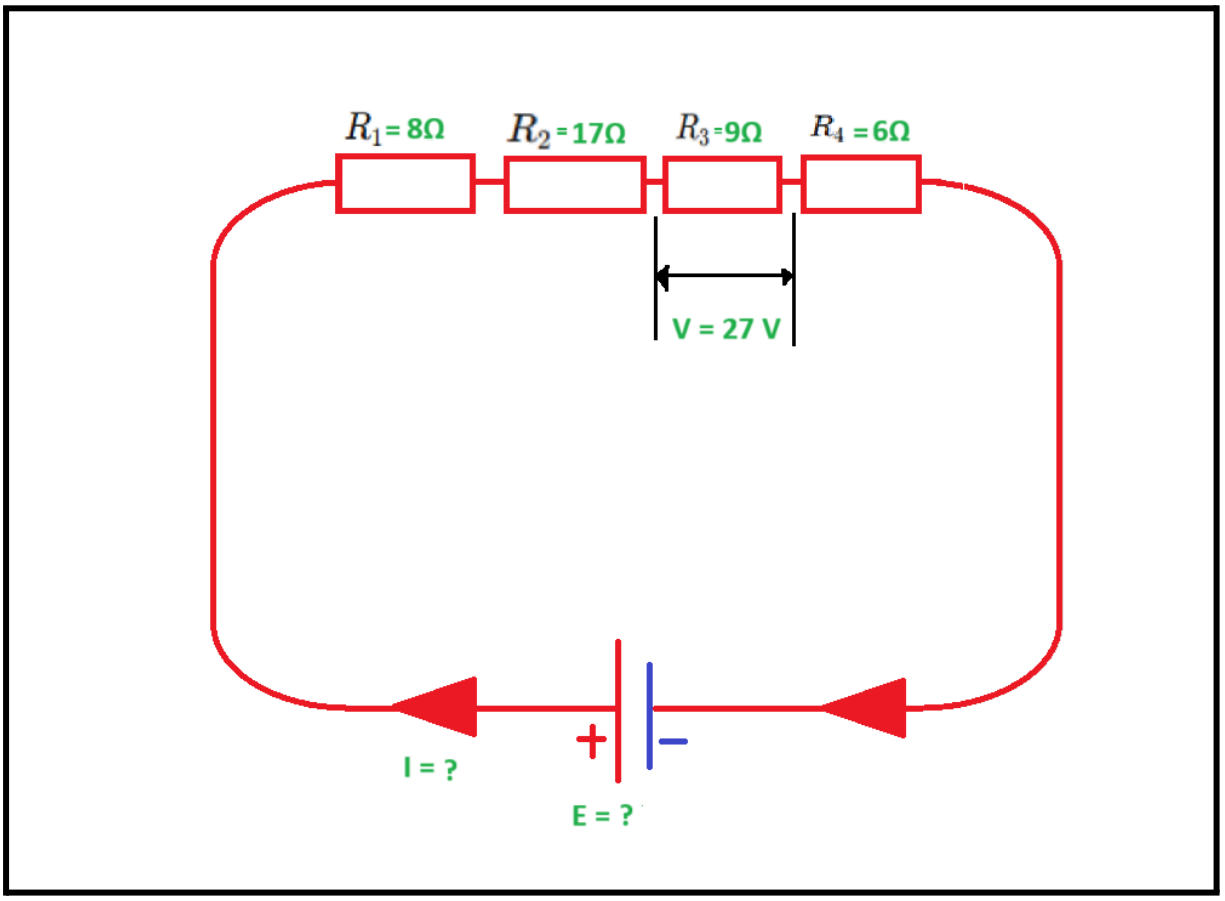
V = 27 V

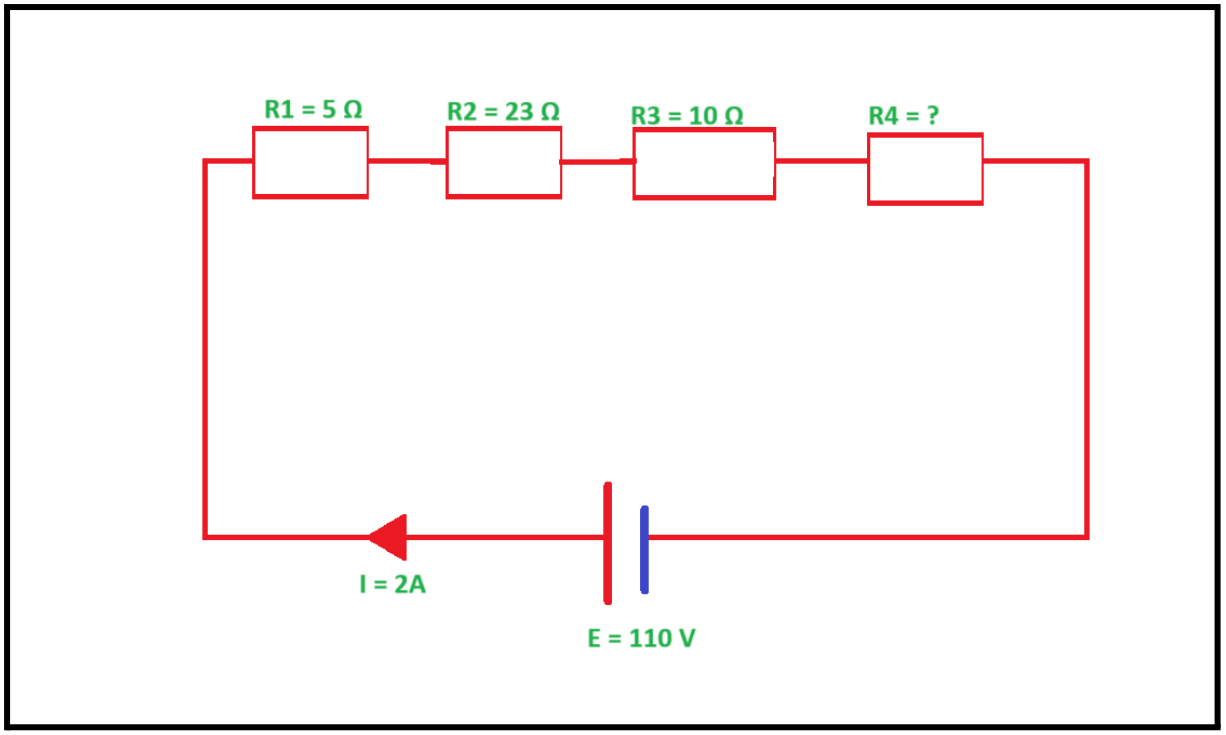
I = ?

E = ?

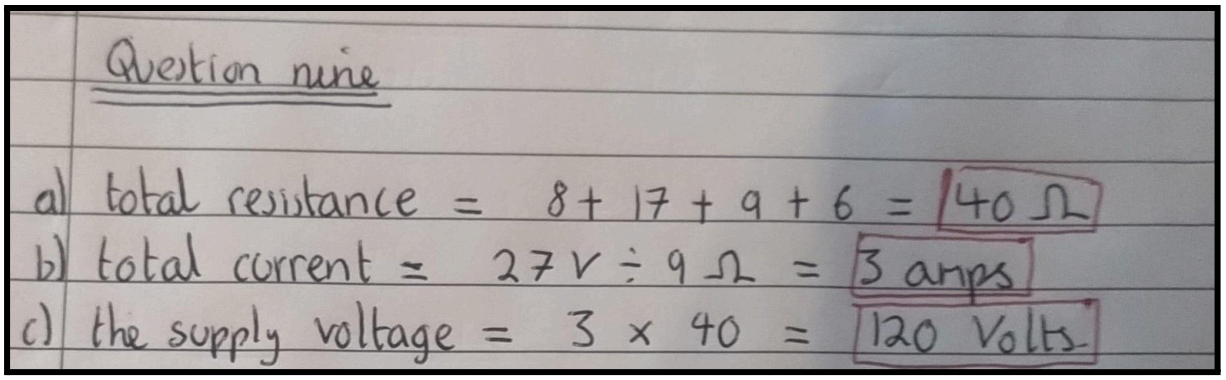









**Question nine working out**




# Question ten

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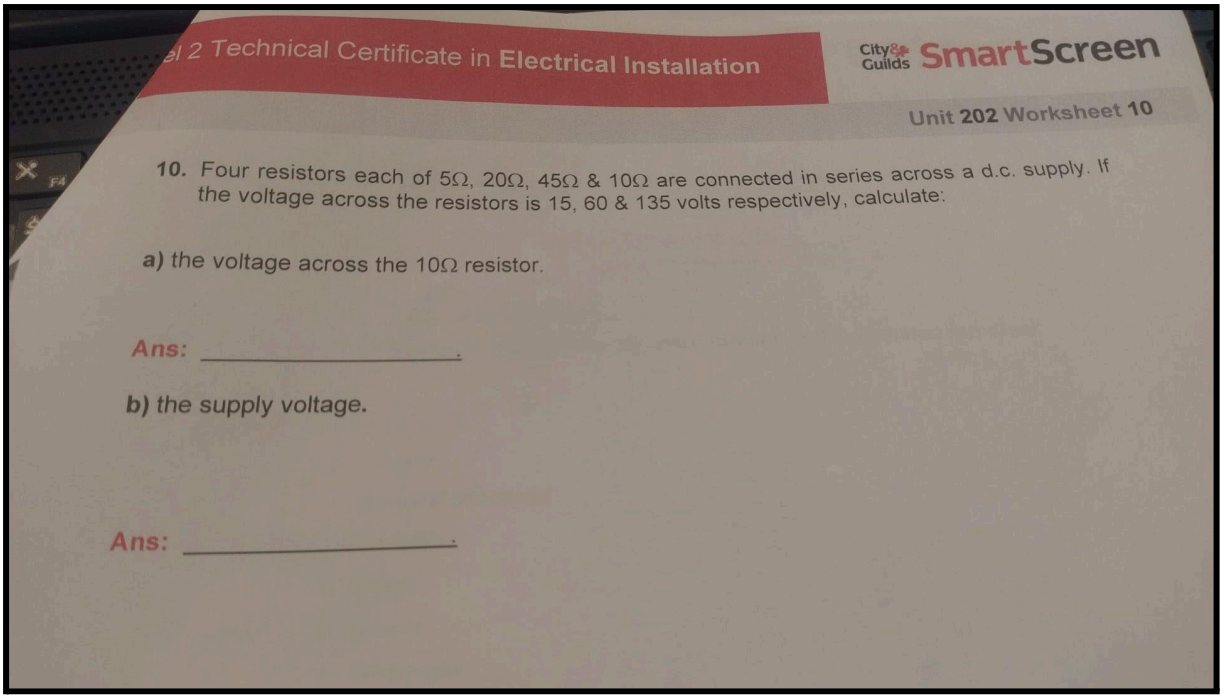

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Unit 202 Worksheet 10

**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**