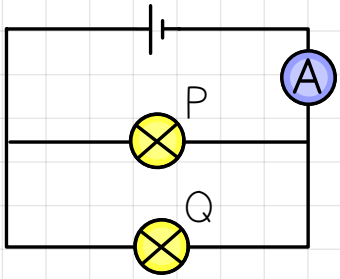
Circuit calculations (high demand)

1. In the circuit shown, lamps P and Q are identical. The cell has a potential difference of 6V and the ammeter shows a reading of 3A.

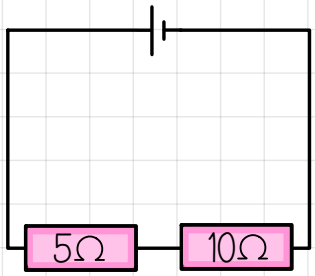


a) Calculate the current that passes through lamp P.

b) What is the voltage across lamp P?

c) Calculate the resistance of lamp P.

2. Resistors of 5 ohms and 10 ohms are connected in series with a cell providing 3 volts



a) What is the total resistance?

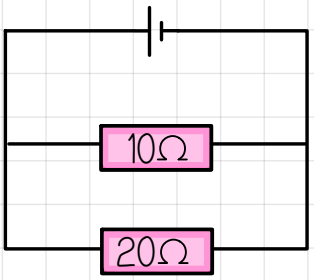
b) Calculate the current flowing through the circuit.

3. Resistors of 2 ohms and 4 ohms are connected in parallel across the cell. The cell has a potential difference of 6V. Another resistor of 5 ohms is connected in series with the cell.

a) Draw the circuit.

b) Calculate the total resistance in the circuit

4. In the circuit shown, 0.6A flows through the 10 ohm resistor.



a) Calculate the current flowing through the 20 ohm resistor.

b) Calculate the current flowing through the battery.

c) Calculate the potential difference across the cell.

5. Calculate the total resistance of the resistors 2 ohms, 5 ohms and 10 ohms when connected:

a) In series with each other

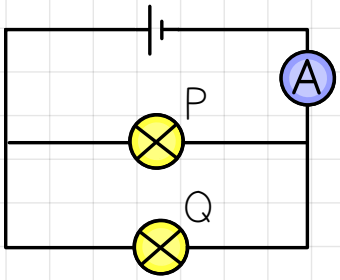
b) In parallel with each other

c) In which arrangement will the current in the circuit be larger? Explain your answer.

Circuit calculations (high demand)

Step by step calculations

1. In the circuit shown, lamps P and Q are identical. The cell has a potential difference of 6V and the ammeter shows a reading of 3A.



a) Calculate the current that passes through lamp P.

We need to use the principle that "current is shared in a parallel circuit". So we divide the total current by the number of branches. The question says that lamps P and Q are identical so the current will be shared equally.
Current through P = Total current / number of branches
Current through P = 3A / 2 = **1.5A**

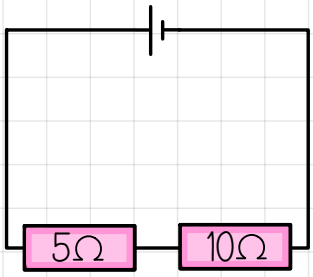
b) What is the voltage across lamp P?

It is worth noting that a question that does not say calculate is implying the answer can be deduced. We need to use the principle that "voltage is the same across components in a parallel circuit". As the voltage across the cell is 6V we can conclude that the voltage across P will be **6V** as well.

c) Calculate the resistance of lamp P.

Use the equation V = I x R
Substitute in the values from the question.
6V = 1.5A x R
It is worth noting even if you calculated a) and b) incorrectly you would still gain marks for putting those values into the equation.
Rearrange the equation to calculate R
R = 6V / 1.5A = **4Ω**

2. Resistors of 5 ohms and 10 ohms are connected in series with a cell providing 3 volts.



a) What is the total resistance?
We need to understand the principle that "total resistance in a series circuit is equal to the sum of all the resistors.
Total resistance = 5Ω + 10Ω = **15Ω**

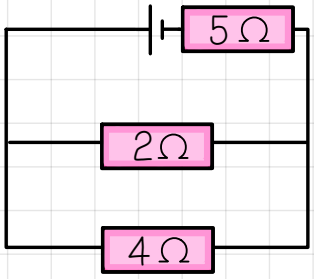
b) Calculate the current flowing through the circuit.

Use the equation V = I x R
Substitute the values into the equation: 3V = I x 15Ω
Rearrange the equation to calculate I.
I = 3V / 15Ω = **0.2A**

Circuit calculations (high demand)

3. Resistors of 2 ohms and 4 ohms are connected in parallel across the cell. The cell has a potential difference of 6V. Another resistor of 5 ohms is connected in series with the cell.

a) Draw the circuit.

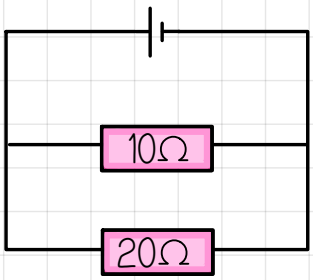


b) Calculate the total resistance in the circuit

When you have a question with resistors in series and parallel always calculate the resistance in the parallel section first. We need to use the principle that " the resistance in parallel is less than the smallest resistor". In this case the smallest resistor is 2Ω so the resistance in the parallel section is <2Ω. Next we need to work out the resistance of the whole circuit using the principle: the total resistance in a series circuit is equal to the sum of the resistors.

Total resistance = 5Ω + <2Ω = <u><7Ω</u>

4. In the circuit shown, 0.6A flows through the 10 ohm resistor.



a) Calculate the current flowing through the 20 ohm resistor.

It is not immediately obvious how to calculate this. You know the current through one branch but no indication is given for the overall current. However the current will be split proportionally between the resistors so we can use that to help us.

0.6A x 10 Ω / 20 Ω = <u>0.3A</u>

This fits in with our knowledge as less current would flow through the higher resistor. Another way would be to calculate the voltage through the 10 ohm resistor using the formula V = I x R.

V = 0.6A x 10 Ω = 6V

As components in parallel have the same voltage, the voltage across the 20 Ω resistor would also be 6V. We can then use V = I x R to calculate the current across the 20Ω resistor.

6V = I x 20 Ω

Rearrange the equation: I = 6V / 20 Ω = <u>0.3A</u>

b) Calculate the current flowing through the cell.

Using the principal "current is shared between branches of a parallel circuit", the current flowing through the cell will be equal to the sum of the current in the branches.

Total current = 0.6A + 0.3A = <u>0.9A</u>

Circuit calculations (high demand)

c) Calculate the potential difference across the cell.

Calculate the voltage through the 10 ohm resistor using the formula V = I x R
V = 0.6A x 10 Ω = 6V
Using the principal that "voltage across the components is the same across all components", then the voltage across the cell would be 6V.

5. Calculate the total resistance of the resistors 2 ohms, 5 ohms and 10 ohms when connected:

a) In series with each other

Using the principle "resistance in a series circuit is equal to the sum of the resistors", then the total resistance = 2 Ω + 5 Ω + 10 Ω = 17 Ω

b) In parallel with each other

Using the principal "resistance in a parallel circuit is less than the smallest resistor". The smallest resistor is 2 Ω , so the resistance = <2Ω.

c) In which arrangement will the current in the circuit be larger? Explain your answer.

The current will be larger in the parallel circuit. This is because current is inversely proportional to resistance. So small resistance will mean larger current.