**Assessment: current electricity**

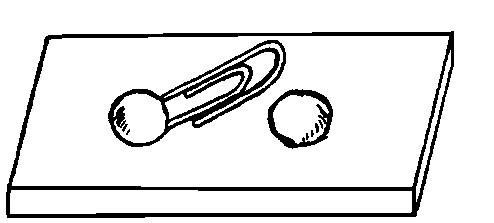
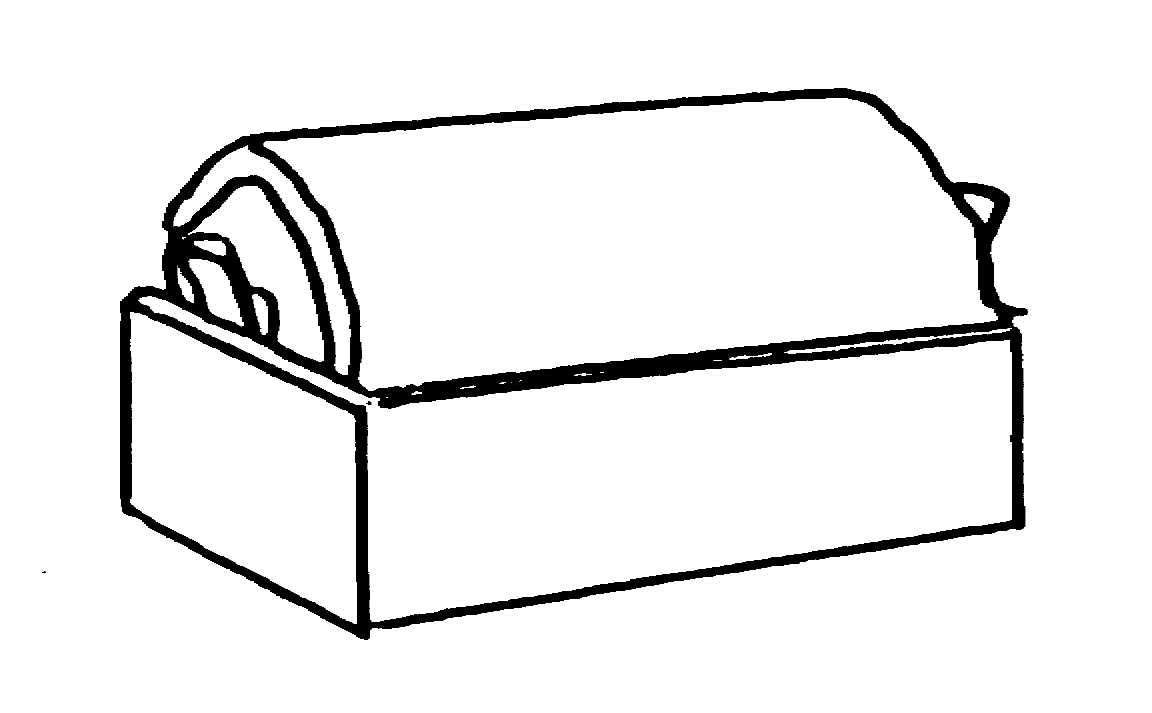
NAME:

**—**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | Will the bulb light? |  | 6    A B | Which bulb / bulbs will light? |
| 2 | Will the bulb light? |  | 7    A B | Which bulb / bulbs will light? |
| 3 | Will the bulb light? |  | 8 | Will the bulb light? |
| 4 | Will the bulb light? |  | 9 | Will the bulb light? |
| 5 | Will the bulb light? |  | 10 | Will the bulb light? |

|  |  |
| --- | --- |
| 11  Metal nail  (a conductor) A B | Which bulb / bulbs will light? |
| 12  Plastic spoon  (an insulator) A B | Which bulb / bulbs will light? |

1. Look at this circuit.



Circuit diagrams show us how to connect a circuit:

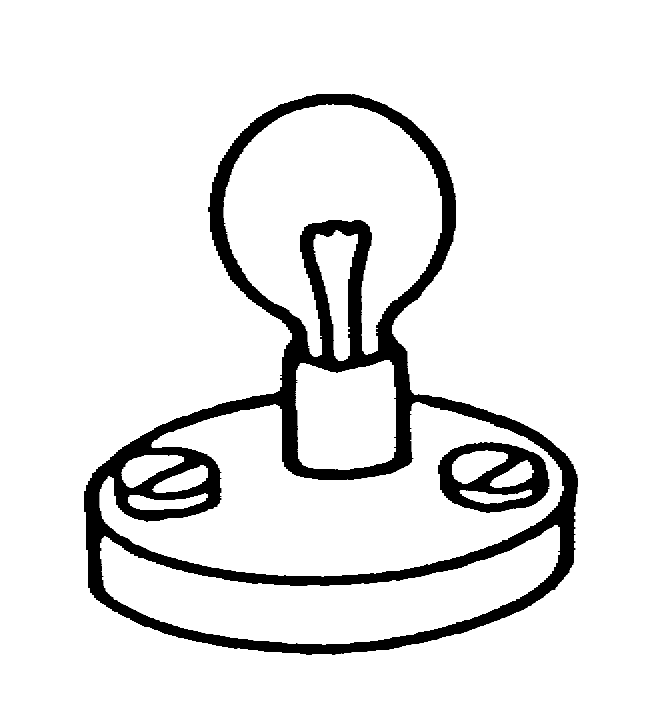
|  |  |  |
| --- | --- | --- |
| **1** | **2** | **3** |
| **4** | **5** | **6** |

Which of the circuit diagrams show how to connect the circuit?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |
| --- | --- | --- |
| **A** | Just circuit diagram 1 |  |
|  |  |  |
| **B** | Just circuit diagram 5 |  |
|  |  |  |
| **C** | Circuit diagrams 1 and 3 |  |
|  |  |  |
| **D** | Circuit diagrams 1, 2 and 3 |  |
|  |  |  |
| **E** | Circuit diagrams 1, 3, 4 and 5 |  |

1. A bulb is connected to a battery. The bulb is lit



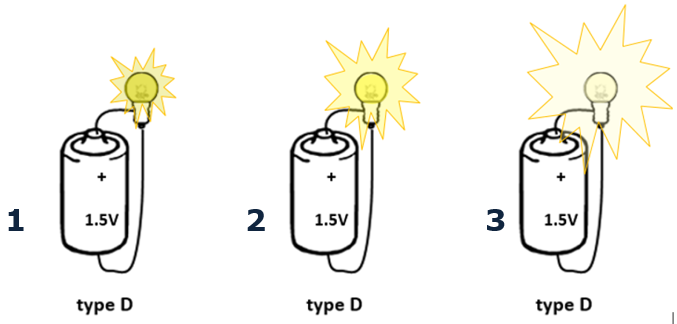
**Battery**

Which of the following best describes the electric current in this circuit?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | An electric current passes from the battery through the wire to the bulb. It is **all** used up in the bulb. So there is **no current** in the other wire. | **Battery**  **Battery** |  |
|  |  |  |  |
| **B** | An electric current passes from the battery through the wire to the bulb. **Some** of it is used up in the bulb. So there is a **smaller current** in the other wire. | **Battery** |  |
|  |  |  |  |
| **C** | An electric current passes from the battery through the wire to the bulb. It passes through the bulb and back to the battery. The current in the other wire is **the same size.** | **Battery** |  |
|  | |  |  |  |
| **D** | | There are two electric currents from the battery to the bulb. They meet at the bulb and this is what makes it light. | **Battery** |  |

1. Three different bulbs are lit with a battery.

The batteries are all exactly the same type. Bulb 1 is dim, bulb 2 is bright and bulb 3 is very bright.

1. Which battery will last the longest?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |
| --- | --- | --- |
| **A** | Battery 1. |  |
|  |  |  |
| **B** | Battery 2. |  |
|  |  |  |
| **C** | Battery 3. |  |
|  |  |  |
| **D** | They all last the same time. |  |

1. Why will this battery last the longest?

Put a tick (✓) in the box next to the correct answer.

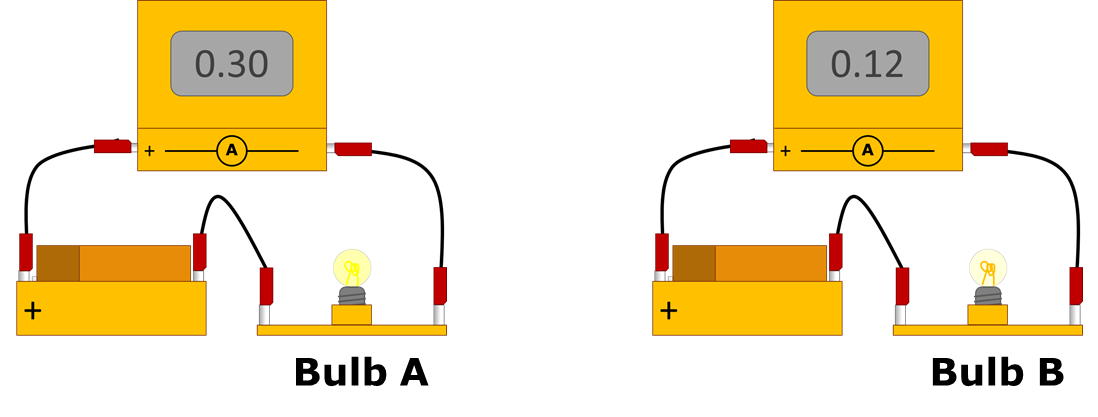
|  |  |  |
| --- | --- | --- |
| **A** | The bulb is transferring energy from the battery the fastest. |  |
|  |  |  |
| **B** | All the batteries are the same. |  |
|  |  |  |
| **C** | The bulb is transferring energy from the battery the most slowly. |  |

1. Sienna measures the current through different components.

She uses an ammeter.

She wants to find out which component has the biggest resistance.

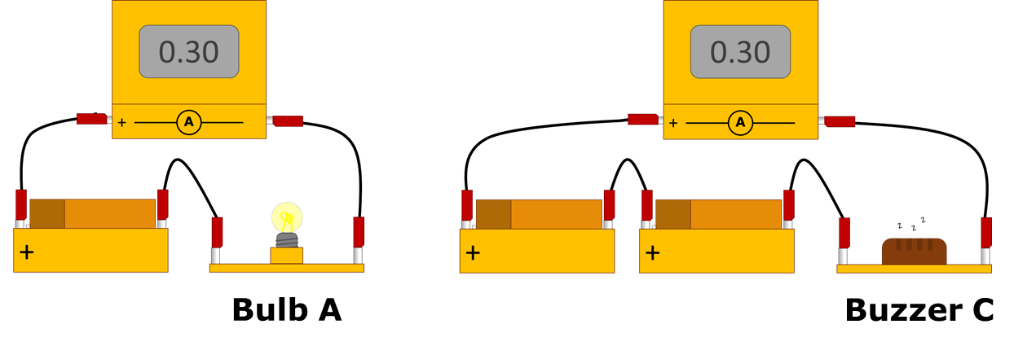
1. Which bulb has the biggest resistance?



*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | **Bulb A** has a bigger resistance. |  |
|  |  |  |
| **B** | **Bulb B** has a bigger resistance. |  |

1. Which component has the biggest resistance?

****

*Put a tick (✓) in the box next to the best answer.*

|  |  |  |
| --- | --- | --- |
| **A** | **Bulb A** has a bigger resistance. |  |
|  |  |  |
| **B** | The bulb and the buzzer each have the same resistance. |  |
|  |  |  |
| **C** | **Buzzer C** has a bigger resistance. |  |

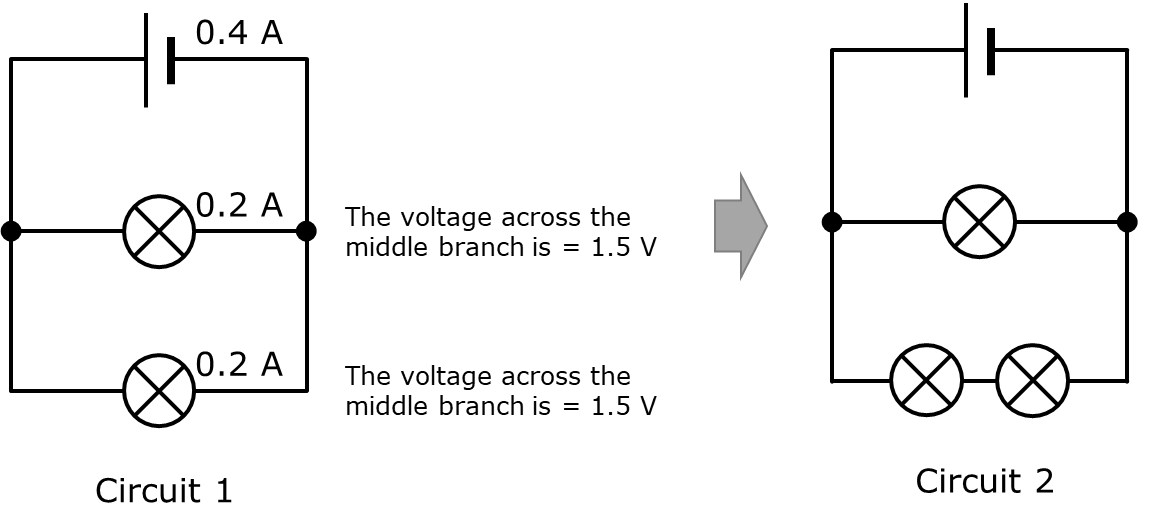
1. Matilda sets up circuit 1.

She measures the current through the battery and through each branch.

She measures the potential difference across each branch.

Matilda adds a bulb to the bottom branch.

The bulb is identical to the other two.



Potential difference across bottom branch = 1.5V

Potential difference across middle branch = 1.5V

What do you think about circuit 2?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | Potential difference across the bottom branch is 1.5 V. |  |  |  |  |
| **B** | Current through the battery is 0.4 A. |  |  |  |  |
| **C** | Current through the middle branch is 0.2 A. |  |  |  |  |
| **D** | Resistance of the bottom branch is bigger than the resistance of the middle branch. |  |  |  |  |
| **E** | Current in the bottom branch is 0.2 A. |  |  |  |  |

**FEEDBACK**

**Question 1**

**Expected answers**

1 yes, 2 no, 3 no, 4 no

5 no, 6 A lit and B off, 7 A lit and B off

8 no, 9 A and B both off, 10 A and B both off

11 A and B both on, 12 A and B both off

**How to respond - what next?**

Circuit 5 does not contain a battery. Circuits 1, 4, 6, 8, 9 and 10 are simple loop circuits, in which wires are connected correctly to components (to the correct terminals), and which are or are not complete.

Circuits 2, 3 and 7 all contain a component with both wires connecting to the same terminal on a component. On some of these examples students will be seeing a loop, but not one that goes *through* the components.

Circuits 11 and 12 test the idea that ‘electricity’ can flow through a conductor, but not an insulator, and a complete conducting loop is necessary for a circuit to work. An investigation to identify insulators and conductors in a simple test circuit is usually completed below age 11.

If students have misunderstandings about tracing a circuit to find out if it is complete it is helpful to show them how to trace the circuit *through* different circuits whilst explicitly tracing the circuit through each component.

If students have misunderstandings about how conductors and insulators affect a complete circuit it would be useful to complete a practical investigation to find out which types of materials are electrical conductors and which are insulators.

**Question 2**

**Expected answers**

Answer D

**How to respond - what next?**

Answer A is one of three possible correct answers. This answer shows students are viewing the circuit diagram as a direct copy of the circuit, but using symbols and circuit diagram conventions to make it neat. Answer B is the same thing except that they have got the battery back to front which shows they do not know which the positive end is on the circuit symbol. (They may not know this for choice A either).

Answer E shows that the student is tracing round the circuit and identifying each component in turn. They may not realise that the battery symbol shows which way round the battery should be, or they may think that it just does not matter.

Answer C shows that the student is tracing round the circuit and identifying each component in turn, and they have recognised the direction of the battery shown on the circuit symbol. They have failed to recognise that they can trace around the circuit in both directions and that circuit 2 is simply circuit 1 flipped around. This leads onto the correct answer D.

If students have misunderstandings about identifying circuit diagrams that represent a series circuit, it will help to set up the circuit, with long connecting wires, and show them how it can/cannot be arranged into the different representations. Alternatively you can set up circuits 1, 2 and 3 together, so they look exactly like the circuits in the diagrams, and then, without disconnecting wires, rearrange them to show they are the same.

**Question 3**

**Expected answers**

C There is an electric current through one wire to the bulb. It passes through the bulb and back to the battery. The current in the other wire is **the same size.**

**How to respond - what next?**

The false answers in this question describe clearly what the students are thinking.

If students have misunderstandings about how electric current flows around a circuit without being ‘used up’, then it will help to give them more experience in measuring current at different points around series circuits to show that it is the same at all points. In particular it is useful to do this with more than three or more bulbs, because with one or two bulbs answer D (clashing currents model) is logically correct.

**Question 4**

**Expected answers**

1. A, b) C

**How to respond - what next?**

Answer A, C shows students have understood the idea that the less bright the bulb is, the slower it is transferring energy from the chemical store of the battery.

Answer C to part a: ‘all the batteries lasting the same time’ shows students thinking that the external circuit does not affect how the battery works – the ‘constant current’ misconception. This is likely to be followed with answer B which confirms this thinking.

An answer of C, A probably shows the student has understood the question wrongly and this may be a language problem. Other combinations of answers suggest guess-work.

**Question 5**

**Expected answers**

1 bulb B

2 buzzer C

**How to respond - what next?**

In question 1 the bulb with the bigger resistance has the smaller current. Because the same potential difference is used in each circuit, this question requires a straight forward application of the idea that resistance is as a measure of how hard it is for charge to flow.

Question 2 requires students to recognise that a battery with a bigger potential difference ‘pushes’ harder. If more potential difference is needed to ‘push’ electric charges through the buzzer, to get the same sized current as that which flows through the bulb, this must be because the buzzer has a bigger resistance than the bulb.

If students have misunderstandings about resistance as a measure of how hard it is for electric charge to flow, it can help to use the rope-loop model to elicit students’ explanations of what happens to current when a component with a bigger resistance is swapped into a circuit; and why a different potential difference is needed to push charge through the new component so that current is the same size as it was through the first component.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Ordered resistance (find this here [https://www.stem.org.uk/best/physics/big-idea-electricity-and-magnetism](https://www.stem.org.uk/best/physics/big-idea-electricity-and-magnetism%20under%20Topic%202) under Topic 2 More electric circuits, Key concept 1, Resistance)

**Question 6**

**Expected answers**

A, C and D are correct; B and E are wrong.

**How to respond - what next?**

The idea that the potential difference across each branch is the same as the potential difference across the battery is central to understanding parallel circuits, and in circuit 2 the potential difference across the bottom branch is 1.5V (statement A).

Adding a bulb to the bottom branch increases the resistance of that branch (statement D) and therefore reduces the current through it, so it is now less than 0.2A (~~statement E~~). Because the potential difference across the middle branch and its resistance are unchanged, then the current through the middle branch is still 0.2A (statement C).

The current through each branch adds up to the current through the battery, and as the current through the bottom branch is now smaller, the current through the battery is also smaller (~~statement B~~).

It is common for students to consider that the current from a battery is the same, no matter what circuit it is connected to, so it is likely that several students think that statement B is correct. If these students apply the rule for current in a parallel circuit they could incorrectly identify statement E as correct. This contradicts the logic of having increased the resistance in this branch, but when in doubt it is tempting to apply rules blindly!

If students have misunderstandings about what determines current in a parallel circuit, it is likely that they have not understood some of the earlier steps in the progression toolkits for parallel circuits. This is especially true if understanding of potential difference in parallel circuits is not secure. It may be appropriate to use some of the other resources in this key concept to consolidate each step of the thinking about the circuits in this question.

The following BEST ‘response activity’ could be used engage students in small group discussions about these same ideas, in follow-up to this diagnostic question:

* Response activity: Adding a bulb (find this here [https://www.stem.org.uk/best/physics/big-idea-electricity-and-magnetism](https://www.stem.org.uk/best/physics/big-idea-electricity-and-magnetism%20under%20Topic%202) under Topic 2 More electric circuits, Key concept 2, Parallel circuits)