**Resisting a shock**

Standard mains sockets should not be found in a bathroom.

A shaver socket contains an extra safety device that makes it safe.



Wet skin has a much lower resistance than dry skin.

Why are standard mains sockets dangerous in a bathroom?

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

|  |  |  |
| --- | --- | --- |
| **A** | Wet skin increases the voltage of a shock. |  |
|  |  |  |
| **B** | Wet skin increases the current from a shock. |  |
|  |  |  |
| **C** | Wet skin increases the voltage of a shock and current from it. |  |

*Physics > Big idea PEM: Electricity and magnetism > Topic PEM8: Mains electricity > Key concept PEM8.1: Electrical safety*

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| --- |
| **Diagnostic question** |
| **Resisting a shock** |

**Overview**

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| --- | --- |
| Learning focus: | Fuses, circuit breakers and earth connections, used correctly, can prevent excess mains current and electric shocks. |
| Observable learning outcome: | Explain why there are no standard mains sockets in a bathroom. |
| Question type: | Simple multiple choice |
| Key words: | Mains socket, shaver socket, electric shock |

**What does the research say?**

In order to develop a good understanding of mains electrical safety, students need first to understand that the severity of an electric shock is largely due to the size of current passing through a person’s body and the route it takes. The size of current passing through a person is determined by the potential difference (p.d.) across the person, perhaps between an exposed live wire and the ground, and the resistance\* of their skin (Goodenough, 2007), which can decrease by a factor of several hundred when the skin is wet (Brown, 1986). A high p.d. can cause a dangerously large current to flow through a person, but in a steamy bathroom the same p.d. can cause a current to flow that is several hundred times bigger.

Goodenough (2007) describes in detail the effects of current on the human body. A current of 0.5 mA through a person’s body can be felt and a current of 0.5 – 10 mA would be painful. At some point, between 10 mA and 50 mA, a person’s nervous response would be affected so they are unable to release a grip and if the current is maintained it can cause involuntary muscle contractions, difficulty breathing and disturb heart function. Higher currents than 50 mA can stop the heart, stop breathing and cause burns and other tissue damage. The main cause of death from an electric shock is ventricular fibrillation, which is when the heart stops beating rhythmically and becomes unable to pump blood. Alternating current is more likely to affect the rhythm of the heart than direct current.

*\*Strictly speaking, the resistance to alternating currents is called impedance and includes the resistive effects of capacitance and inductance. This understanding is usually covered in undergraduate courses at university.*

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

B Wet skin increases the current from a shock.

**How to respond - what next?**

The voltage of mains electricity is not altered by adding a new circuit (even if it includes a human). The current does increase because the resistance of wet skin is lower than dry skin, and current flows according to the relationship: current = voltage divided by resistance. With a fixed voltage, the smaller the resistance, the bigger the current.

It is common for students to have the misunderstanding that a bigger voltage *is needed* to give a bigger electric shock.

If students have misunderstandings about why wet skin greatly increases the risk of a serious electric shock, it can help to provide the opportunity for them to work out the current that can pass through a person’s body in different situations and compare the current to the severity of shock described in the BEST diagnostic question: Shocking! The following BEST ‘response activity’ could be used to do this, in follow-up to this diagnostic question:

* Response activity: Shocking calculations

**Acknowledgments**

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Images: Shaver socket from Shutterstock and wet arm by Myriams-Fotos from Pixabay.

**References**

Brown, C. (1986). Electric shock and the human body - or 'Is it amps or volts that kill you, sir?'. *Physics Education,* 21(6)**,** 350.

Goodenough, H. (2007). Electrical safety. *Catalyst.* Oxfordshire: Philip Allan Updates.