**Shocking!**

Mains electricity in the UK is 230 V.

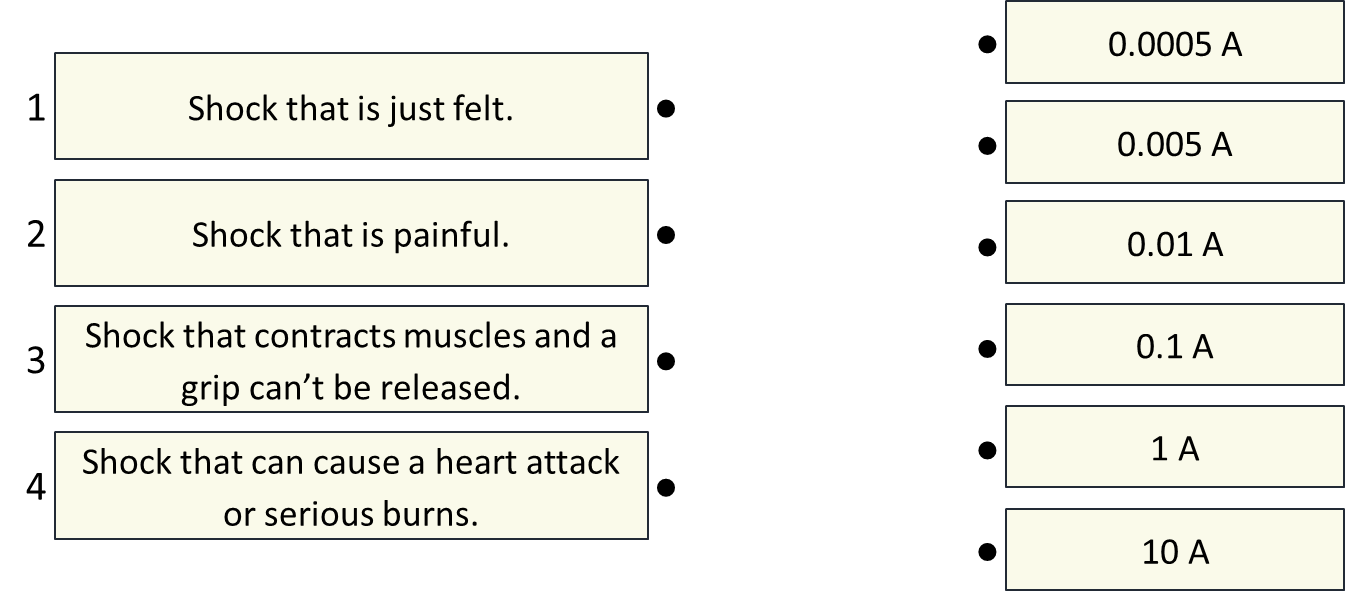
This is high enough to cause an electric shock.

The bigger the current, the more harmful an electric shock could be.



Read the descriptions of electric shocks.

Match each description to the current that can cause it.



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

|  |
| --- |
| **Diagnostic question** |
| **Shocking!** |

**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: | Describe the effects of an electric shock on a person. |
| Question type: | Linking ideas |
| Key words: | Mains electricity, current, electric shock, contracting muscles |

**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**

This task is intended for discussion in pairs or small groups. It is best done as a pencil and paper exercise.

Students should read the statements and follow the instructions on the worksheet. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

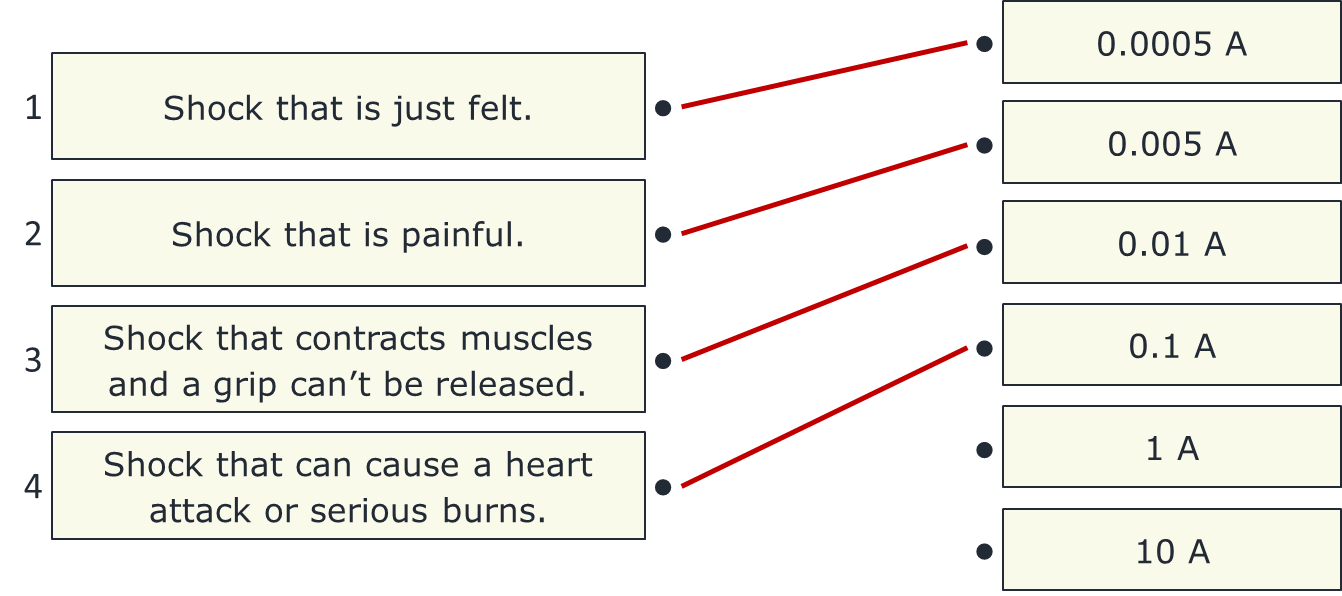
Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as the scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**



**How to respond - what next?**

Very small currents flowing through a person’s body can cause electric shock.

It is common for students to associate the sort of currents flowing through a mains appliance with the size of current needed to cause a serious electric shock. The high resistance (see \* in What does the research say) of human skin means that it is unlikely, in most situations, for such a large current to be pushed through a person’s body by mains electricity that has a potential difference of 230 V.

If students have misunderstandings about the size of current needed to produce an electric shock, it can help to discuss the tiny electrical signals with which nerves in the body communicate with one another, which include the transmission of signals controlling the contraction of muscles.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Image of warning sign by Openicons 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.