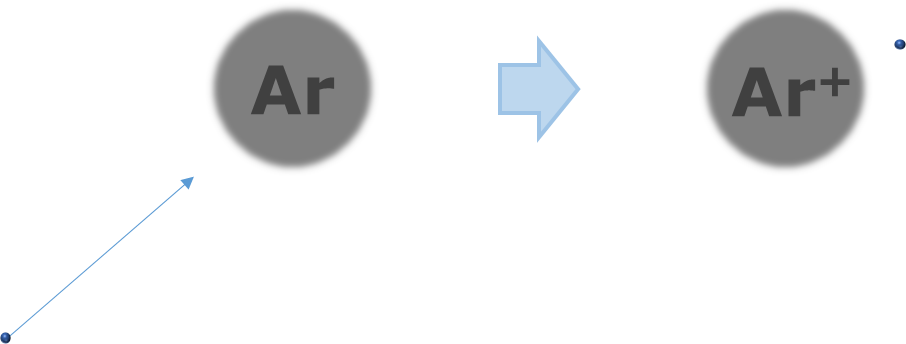
**Beta ionisation**

Beta particles are emitted by some radioactive isotopes.

They move at high speed and can ionise atoms or groups of atoms.

**

Some of these statements about beta ionisation are correct and some are wrong.

Use the correct statements to explain how beta particles can cause ionisation.

**Start with:** An argon atom has no overall charge.

The argon is now an ion because it has an electric charge.

If it bashes into an outer electron.

It can push an electron off an argon atom.

A direct hit is not needed.

A beta particle is a very, very fast electron with a negative charge.

The argon is now an ion because it is radioactive.

Because it has the same number of electrons as protons.

Because it has the same number of electrons as neutrons.

A beta particle is radioactive.

Its electric field repels electrons from a distance.

Explaining Beta ionisation cards

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*Physics > Big idea PMA: Matter > Topic PMA5: Nuclear physics > Key concept PMA5.3: Ionising radiation*

|  |
| --- |
| **Response activity** |
| **Beta ionisation** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Some forms of radiation can ionise atoms or groups of atoms. Several properties of each form of ionising radiation are determined by its ionising power. |
| Observable learning outcome: | Describe what happens when radiation causes ionisation. |
| Activity type: | Explanation story |
| Key words: | Ionisation, radiation, beta particle |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Alpha ionisation

**What does the research say?**

Radioactive materials contain radioactive particles that are unstable and may undergo radioactive decay, and emit radiation. Alpha and beta particles are types of radiation, but it is common for students to describe them as ‘radioactive particles’ (Millar and Gill, 1996). This is wrong because they are both stable particles and do not undergo radioactive decay. Similarly, gamma radiation, which comprises of high energy photons, (which, at this stage, can be thought of as short bursts of electromagnetic wave) does not undergo radioactive decay.

Radiation can be harmful if it causes ionisation. Ionising radiation can cause outer electrons to be forced out of atoms, in turn affecting bonds and interactions between atoms. Often, discussion about ionising radiation is limited to a description of the relative likelihood of alpha, beta or gamma radiation to cause ionisation and to be ‘absorbed’. Alpha particles are typically described as the most likely to ‘collide’ with and ‘knock out’ an atom’s outer electrons, because they are the biggest radiation particle with the most electrical charge. This description is also used to explain that alpha particles are the most easily absorbed, because they are slowed down or stopped by each collision. However, this description can lead to a misunderstanding that direct collisions with electrons are necessary to dislodge them. In fact, it is the attraction or repulsion between the electric field of an electron and that of alpha, beta or gamma radiation that is responsible.

**Ways to use this activity**

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.

**Suggested answer**

An argon atom has no overall charge.

* Because it has the same number of electrons as protons.
* A beta particle is a very, very fast electron with a negative charge.
* It can push an electron off an argon atom.
* A direct hit is not needed.
* Its electric field repels electrons from a distance.
* The argon is now an ion because it has an electric charge.

The four statements that are not used each show a common misunderstanding.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Millar, R. and Gill, J. S. (1996). School students' understanding of processes involving radioactive substances and ionizing radiation. *Physics Education,* 31**,** 27-33.