**Comparing ions**

A picture containing indoor, sitting, table, full

Description automatically generated

Ionic compounds such as sodium chloride are formed from metal and non-metal ions.

**a.** Look at the following statements about the ions

*Put a tick (✓) in the box next to the statement that you think is correct.*

|  |  |  |
| --- | --- | --- |
| **A** | An Mg2+ ion always forms more ionic bonds than an Na+ ion. |  |
|  |  |  |
| **B** | An Mg2+ ion and an Na+ ion can form the same number of ionic bonds. |  |

**b.** Look at the following explanations.

*Put a tick (✓) in the box next every explanation that you think helps to explain your answer to part a.*

|  |  |  |
| --- | --- | --- |
| **A** | Ionic bonds only form where an electron is transferred. |  |
|  |  |  |
| **B** | The number of ionic bonds depends upon the arrangement of ions in the lattice. |  |
|  |  |  |
| **C** | The magnesium ion has a higher charge than the sodium ion. |  |
|  |  |  |
| **D** | More electrons are transferred to form an Mg2+ ion than an Na+ ion. |  |

*Chemistry > Big idea CPS: Particles and structure > Topic CPS8: Ionic bonding > Key concept CPS8.1: Ionic lattice*

|  |
| --- |
| **Diagnostic question** |
| **Comparing ions** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Ionic bonding occurs due to the electrostatic attraction between oppositely charged ions in an ionic lattice. |
| Observable learning outcome: | Recognise that the number of ionic bonds formed by an ion is determined by the arrangement of ions in the lattice. |
| Question type: | Two-tier multiple choice |
| Key words: | Ion, bond charge, lattice |

**What does the research say?**

In their chapter on bonding Taber and Coll (2002) cite research by John Oversby (1996) which found that even after university teaching some post-graduate trainee teachers considered some alternative conceptions about ionic bonding to be acceptable. As discussed in a paper by Taber, Tsaparlis and Nakiboğlu (2012) the key misunderstanding was that an ionic bond only exists where an electron has been transferred. This leads to the further alternative conception that where electron transfer has not occurred, ions were held together by “forces of attraction” and not bonds. The trainee teachers also incorrectly deduced that ions could only bond to the number of counter ions allowed by their valency.

**Ways to use this question**

Students should complete the questions 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 follow-on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

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**

1. B b. B

**How to respond - what next?**

A student who thinks that statement A is correct in part a may agree with A, C or D in part b. The combination of options selected may be used to provide more information students’ thinking. For example, if a student selects C only they may just have a misunderstanding about the link between charge and ionic bonding but if they also select A it will reveal a misconception about the nature of an ionic bond. Put together A C and D form an alternative explanation to justify the incorrect answering of part a.

If students have misunderstandings about what determines the number of ionic bonds formed by an ion it may help to show students diagrams of a range of ionic lattice structures. This could be of benefit to students intending to study chemistry further as these ideas will be met later when learning about unit cells and coordination numbers.

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

* Comparing lattices

**Acknowledgments**

Developed by Helen Harden (UYSEG)

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**References**

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Taber, K. S., Tsaparlis, G. and Nakibo ğlu, C. (2012). Student conceptions of ionic bonding: Patterns of thinking across three European contexts. *Internationl Journal of Science Education,* 34(18)**,** 2843-2873.