

Stability and reactivity

Target level

This is a probe which may be used in post-16 courses, or in the later stage of courses for 14–16 year olds.

Topics

This probe is designed to elicit students' ideas about chemical stability and reactivity.

Rationale

This probe is inspired by research which suggests that students often believe that atoms will spontaneously form species with octet structures regardless of the chemical context. It is also considered that students do not logically relate the reactivity of a substance to the stability of the chemical species it is comprised of. This may be, in part, because of the difficulty students have in relating the molar phenomena of chemical reactions with the theoretical model of particle interactions. The items on this probe are intended to act as a starting point for discussing these ideas in the classroom.

Difficulties in applying molecular level models, and learners' ideas about reactions and stability are discussed in Chapter 6 of the Teachers' notes.

Question 2 originally suggested that 'the sodium atom will emit an electron...', but the term 'emit' was considered unfamiliar to many students. The term 'eject' is considered more familiar (eg from operating stereo equipment). (Another alternative - that 'the atom would 'lose' an electron' does not necessarily imply a spontaneous process.)

During piloting, teachers noted that the probe 'gave the pupils more opportunity to air their ideas'. One teacher described it as 'good, short, sharp - did not disrupt lesson, yet caused pupils to question their understanding.' One teacher noted that all the students in a post-16 class answered 'in terms of obtaining a full electron shell by losing one electron to obtain a stable octet'. Another noted 'a constant contradiction throughout [the answers from a class of 15–16 year olds] - the atom being most stable yet most willing to donate an electron', and concluded that it was 'possible that students misunderstand the concept of stability'.

Instructions

It is worth emphasising that the questions relate to the comparison shown in the diagram.

Resources

- Student worksheet
 - Stability and reactivity

Feedback for students

Answers and some suggested discussion points are provided for teachers.

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Stability and reactivity – answers

In discussing the responses it is suggested that the teacher should focus on the figure on the sheet, and begin by considering question 2. The electron is negatively charged and the ion positive, so they will be spontaneously attracted to form an atom. The atom will not emit an electron without an input of energy. In the context of the diagram, then, the atom is more stable (question 1), and the ion is more 'reactive' (question 3).

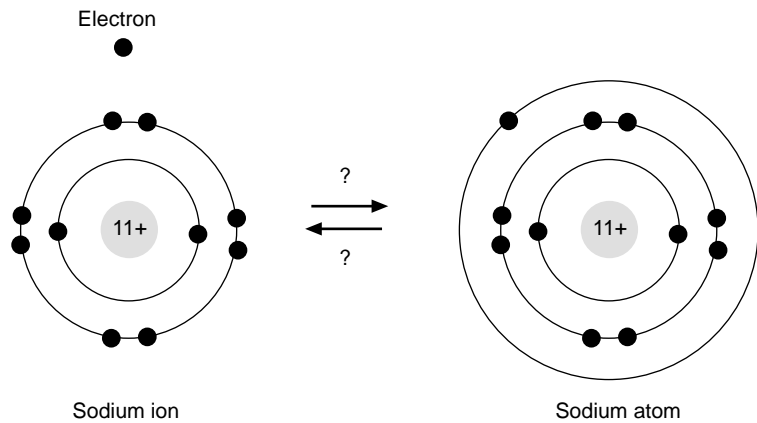
It should be borne in mind, however, that this exercise is intended as a probe, and not a test. Some students are likely to think in terms of more familiar chemical contexts, eg comparing a sodium ion in sodium chloride with elemental sodium (which students may consider to contain atoms), where the metal is part of a more reactive system in the presence of water, or air etc. An important teaching point is that students need to consider the overall chemical context when judging 'stability' or 'reactivity'.

1. The sodium atom is more stable than the sodium ion.
2. The sodium ion and electron will combine to become an atom.
3. The sodium ion is more reactive than the sodium atom.

Stability and reactivity

The three questions all refer to the diagram on the right.

Please tick one box for each of the three questions, and explain your reasons.



Question 1



Reason

- The sodium atom is more stable than the sodium ion.
- The sodium ion is more stable than the sodium atom.
- The sodium ion and sodium atom are equally stable.
- I do not know which statement is correct.

Question 2



Reason

- The sodium atom will eject (give out) an electron to become an ion.
- The sodium ion and electron will combine to become an atom.
- Neither of the changes suggested above will occur.
- I do not know which statement is correct.

Question 3



Reason

- The sodium atom is more reactive than the sodium ion.
- The sodium ion is more reactive than the sodium atom.
- The sodium ion and sodium atom are equally reactive.
- I do not know which statement is correct.

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