

Chemguide – questions

FIRST IONISATION ENERGIES

This topic is potentially a very rich source of exam questions. It is important that you can get questions like these right. Don't even think about doing them if you can't reliably write electronic structures for the elements.

You may need a copy of the Periodic Table for some of these questions.

1. The first ionisation energy of sodium is 494 kJ mol^{-1} . Write the equation which represents the reaction occurring during the first ionisation energy of sodium.
2. Hydrogen has an electronic structure of $1s^1$; helium is $1s^2$. Explain why helium's first ionisation energy (2370 kJ mol^{-1}) is much higher than hydrogen's (1310 kJ mol^{-1}).
3. One of the factors which affects first ionisation energy is the nuclear charge. Lithium has 1 more proton than helium (and so a greater nuclear charge), and yet its first ionisation energy is much lower (519 kJ mol^{-1}). Explain why.
4. In both Periods 2 and 3, although there are some fluctuations, the main trend is for first ionisation energy to increase across both periods. Explain why that is.
5. The first ionisation energy of each element in Period 3 is less than that for the corresponding element in Period 2. For example, magnesium in Group 2 has a first ionisation energy of 736 kJ mol^{-1} , whereas beryllium, above it in the same group, has a first ionisation energy of 900 kJ mol^{-1} . Using magnesium and beryllium as an example, explain why first ionisation energies in Period 3 are smaller than the corresponding ones in Period 2.
6. Explain why aluminium's first ionisation energy (577 kJ mol^{-1}) is less than magnesium's (736 kJ mol^{-1}).
7. Explain why sulphur's first ionisation energy (1000 kJ mol^{-1}) is less than that of phosphorus (1060 kJ mol^{-1}).
8. In the first row of the d-block elements from scandium to zinc, apart from zinc, all the elements have fairly similar first ionisation energies despite the number of protons increasing across the series. Explain why the elements from scandium to copper have similar first ionisation energies.
9. Explain why the first ionisation energy of zinc (908 kJ mol^{-1}) is significantly higher than that of copper (745 kJ mol^{-1}).