

Trends in atomic and ionic radius

- 1) State and explain the trend in atomic radius down a group.
- 2) State and explain the trend in atomic radius across a period.
- 3) State and explain which is smaller, the lithium atom or the lithium ion (Li^+).
- 4) State and explain which is bigger, the fluorine atom or the fluoride ion (F^-).
- 5) Arrange the following in order of increasing atomic radius (smallest first): Cl, Si, Na.
Explain your reasoning.
- 6) Arrange the following in order of increasing radius: Ar, Cl^- , K^+ . Explain your reasoning.

Answers:

- 1) Atomic radius increases down a group as the number of occupied energy levels increases.
- 2) Atomic radius decreases across a period as the nuclear charge increases and the electron shielding remains constant.
- 3) The lithium ion is smaller than the lithium atom. The lithium ion has 1 occupied energy level, compared to 2 occupied energy levels for the lithium atom. The ion has more protons than electrons which increases the electrostatic attraction between the nucleus and valence electrons, making the ion smaller.
- 4) The fluoride ion is bigger than the fluorine atom. The ion has more electrons than protons which decreases the electrostatic attraction between the nucleus and valence electrons, meaning the electrons are held less tightly, making the ion bigger than the atom.
- 5) $\text{Cl} < \text{Si} < \text{Na}$
 - Na, Si and Cl are all period 3 elements – atomic radius decreases from left to right across a period because of increasing nuclear charge and the electron shielding remains constant.
- 6) $\text{K}^+ < \text{Ar} < \text{Cl}^-$
 - They all have the same number of electrons (isoelectronic) and number of occupied energy levels (3), but different numbers of protons.
 - K^+ has more protons than electrons (making it smaller for the reasons discussed in question 3)
 - Ar has the same number of protons and electrons.
 - Cl^- has more electrons than protons (making it bigger for the reasons discussed in question 4).