AS 91390: Demonstrate understanding of thermochemical principles and the properties of particles and substances

Explaining why atomic radii decrease (get smaller) going across a period

Across a period, the effective nuclear charge increases.

Both have the

- same number of electron shells
- same energy levels
- same shielding of outer e's by inner e's
- same repulsion from inner shell electrons
- valence e's in same energy level

but ___ has a greater

- nuclear charge
- no of protons

so there is a stronger attraction for the valence electrons, bringing them in closer, resulting in a smaller radius.

Example: Cl < Na

Explaining why cations are smaller than the parent atoms they were formed from

_____ is smaller than ______ because it has lost an electron(s) from an entire valence shell so the electrons are

- only in ____ shells /energy levels instead of ___ shells / energy levels
- in less shells / energy levels

Example: Na^+ < Na

Explaining why anions are larger than the parent atoms they were formed from

_____ is larger than ______ because it has gained electron(s) leading to increased electron-electron repulsion increasing the size of the electron cloud so __ > __
Example: Cl^- > Cl

Explaining why atomic radii increase (get bigger) going down a group

_____ is larger than ______ because the added electron(s) go into a whole new valence shell & shielding is greater / repulsion from inner shells has increased (so bonding electrons will be further from the positive nucleus) so there is weaker (electrostatic) attraction between the nucleus and the valence electrons.
Example: K > Na

Explaining why molecules and ions have a particular shape

There are	2 3 4 5 6	• regions of electron density • regions of negative charge*	around the central atom	which **repel** to take a	• linear • trigonal planar • tetrahedral • trigonal bipyramidal • octahedral	arrangement	• to minimise repulsion • to get as far apart as possible

* single / double / triple bond / lone pair = one region of negative charge

There are	___ bonding electron pairs	**and**	___ lone pairs	which results in a	• linear • v-shaped • trigonal planar • trigonal pyramidal • tetrahedral • trigonal bipyramidal • see-saw / distorted tetrahedron • t- • octahedral • square pyramidal • square planar	shape	• molecule • ion

Explaining why a covalent molecule is polar or non-polar

The	_ - _ bond(s) is/are	• polar • non polar	because of EN difference**	& molecule is	• symmetrical • asymmetrical	so	• the bond dipoles cancel out / don't cancel out • centre of +ve and -ve charge coincide / don't coincide	& so the molecule is	• polar • non-polar

**(state __ is more electronegative than __ OR draw the δ+ and δ- above a bond OR use ⟶ (crossed arrow) to indicate, if you can)

Explaining why first ionisation energy increases across a period but decreases down a group

__ and __ have the same number of shells but __ has

- greater nuclear charge
- greater number of protons

so greater electrostatic attraction between nucleus and valence electrons

__ has the greatest number of electron shells, so its electrons are further from the nucleus, so less energy is required to remove a valence electron. It also has greater shielding effect of an additional shell between the valence shell and the nucleus / repulsion from inner shell electrons increases and so less energy is required to remove the outermost electron.

E.g. Ca < Mg < Cl

Explaining why electronegativity increases across a period but decreases down a group

Valence electrons are

- added to same shell
- the same distance from nucleus

but in ___ there is a greater

- number of protons
- nuclear attraction

so val. electron(s) is/are more strongly attracted

But going down a group nuclear charge increases but so does shielding too, so the atomic radii increase causing less attraction of electrons to the nucleus.

E.g. why F > O > N and why Cl < F

Extension: **No longer examined @ L3**

Explaining why TM can form compounds with variable oxidation states / can form a range of oxides and a group 1 or 2 metal like Ca cannot

__ only has __ valence electron(s) which it loses to form a __ + ion but ___ has valence electrons in 3d & 4s which it can lose to form stable ions or share covalently

E.g. Ca and Mn