

## Week 2

Periodic Trends: What are the periodic trends for the following?

Effective nucleus charge: the net positive charge experienced by valence electrons. (i.e. number of valence electrons)

$Z_{\text{eff}} = Z$  ( the number of protons) -  $S$  (the number of shielding electrons, i.e. valence electrons)

Eg. Ne: 10 electrons, valence shell contains 8 electrons,  $Z_{\text{eff}} = 10 - 2 = 8$

$\text{F}^- : 9 - 2 = 7$

$\text{Na}^+ : 11 - 2 = 9$

Very important as it can explain lots of things, such as the unsymmetrical force in HF, F has more effective nucleus, charge, thus more ER.

- a) Atomic radii *Decreases from left to right of period. As we move from left to right of period, protons are added, more attraction between electron and proton. Greater effective nuclear charge, greater attraction, lesser distance. Hence the decrease in atomic radii*  
*Increases from the top to the bottom of the group. The bottom atoms have more shell, they are further and further away from the nucleus.*
- b) Ionisation energy *Increases from left to right of period. Decreases down group. As we move from left to right of the period, atomic radii decreases due to the greater attraction between protons in the nucleus and the surrounding electrons. Due to this attraction, it is harder to remove an electron from the atom. Hence, the increase in ionization energy.*  
*Going down the group however, it decreases as the distance of the valence electron shell from the nucleus increases.*
- A large increase in ionization energy is observed to remove the first core electron.
- A large jump in ionization energy indicates that *all the valence electrons have been removed.*

Element	$I_1$	$I_2$	$I_3$	$I_4$	$I_5$	$I_6$	$I_7$
Na	495.8	4562.4 <sup>b</sup>	—	—	—	—	—
Mg	737.7	1450.7	7732.7	—	—	—	—
Al	577.5	1816.7	2744.8	11,577.5	—	—	—
Si	786.5	1577.1	3231.6	4355.5	16,090.6	—	—
P	1011.8	1907.5	2914.1	4963.6	6274.0	21,267.4	—
S	999.6	2251.8	3357	4556.2	7004.3	8495.8	27,107.4
Cl	1251.2	2297.7	3822	5158.6	6540	9362	11,018.2
Ar	1520.6	2665.9	3931	5771	7238	8781.0	11,995.3

Electron affinity:

- The energy change accompanying the **addition of 1 mol of electrons to 1 mol of gaseous atoms or ions**. EA1 usually negative, EA2 always positive
- TRENDS:
  1. **Reactive non-metals:** *Groups 16 and 17*; in their ionic compounds they form negative ions (have **high IEs** and **very (-ve) EAs**)
  2. **Reactive metals:** *Group 1*; in their ionic compounds, they form positive ions (have **low IEs** and **slightly (-ve) EAs**) IE & EA
  3. **Noble gases:** *Group 18*; they do not lose or gain electrons (have **very high IEs** and **slightly (+ve) EAs**)