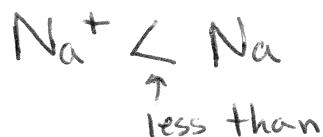
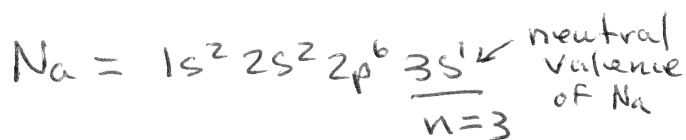
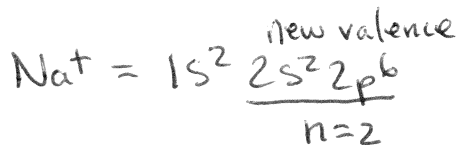


P. Trends Ions

- ① cations versus the neutral atom, The cation is smaller than the neutral element.



Reason: The cation has lost its valence. The new valence is in a lower energy level.

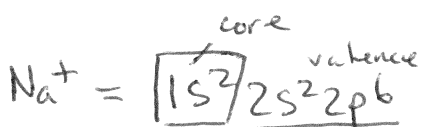


①

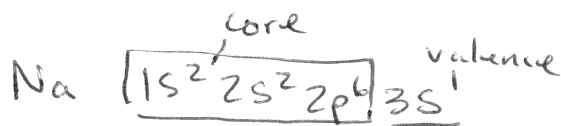
In Na^+ the valence e^- are in $n=2$ which is closer to the protons than the valence in Na.

So the force of attraction is higher for Na^+ valence.

- ② The Z_{eff} in Na^+ is greater than the Z_{eff} for Na:

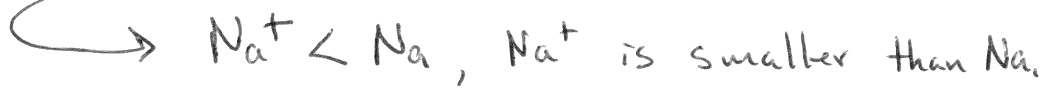


$$Z_{\text{eff}} = 11 - 2 = +9$$

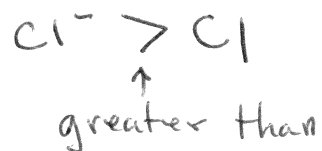


$$Z_{\text{eff}} = 11 - 10 = +1$$

- ② you can see that the Z_{eff} for Na^+ valence is 9 times higher than Z_{eff} for Na. Therefore, the force of attraction on the valence of Na^+ is greater than for Na and



(B) Anions versus the neutral atom. The anion of an element is bigger than the neutral atom. This has NOTHING to do with energy level or Z_{eff} !



Reason: yes, the valence is full. BUT the reason that the anion is bigger is because of e^-/e^- repulsion between the paired e^- 's in the full valence. There is no change in energy level or the Z_{eff} in the case of the anion.

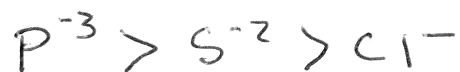
Periodic Trends

Cations



↑
greater
than

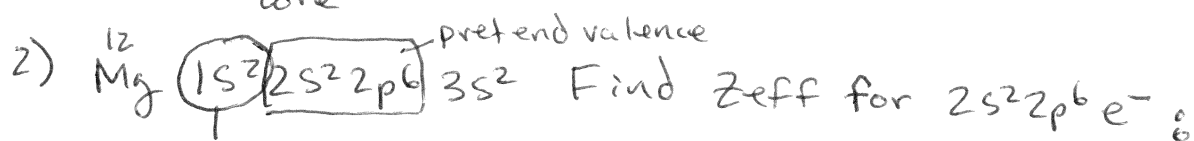
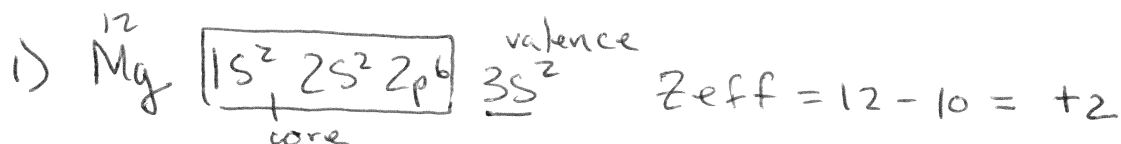
Anions



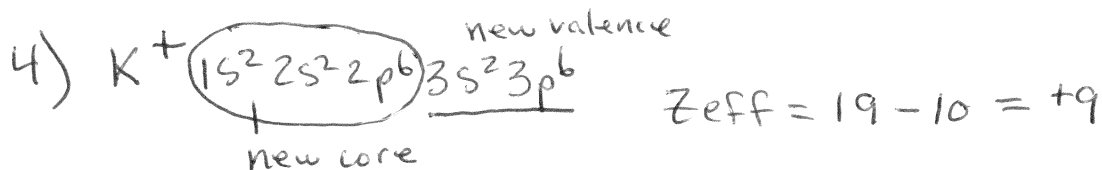
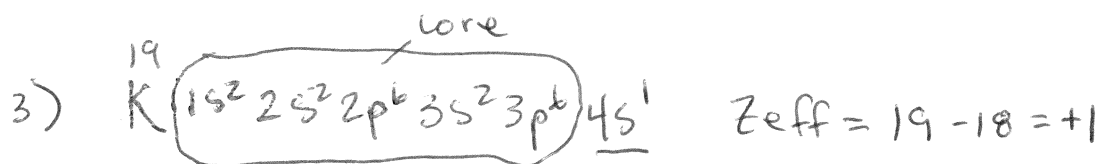
↑
greater
than

Calculation of Z_{eff} on electrons other than valence of neutral atoms

(A) To calculate the Z_{eff} on e^- other than valence follow the following examples:



$Z_{\text{eff}} = 12 - 2 = +10$; so the $n=2$ e^- are being held by $+10$ charge by comparison to the neutral atom valence which is $+2$.

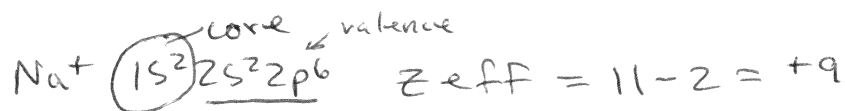
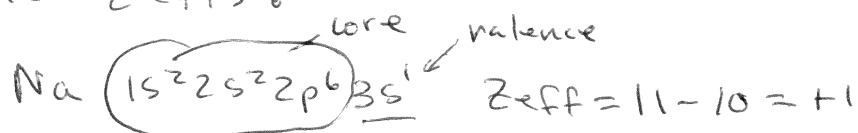


The new valence ($3s^2 3p^6$) is being pulled on by $+9$ versus $+1$ for the neutral element.

Answering Questions using Z_{eff}

1) why is the ionization energy of Na^+ greater than Na ?

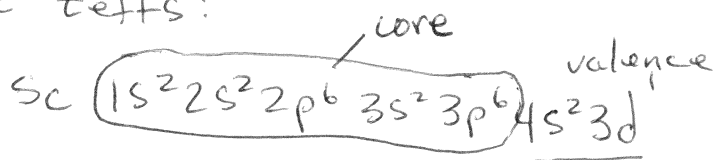
1st calc Z_{eff} s:



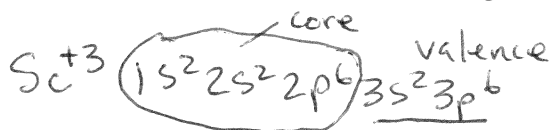
2nd answer: Z_{eff} Na^+ is $+9$ and Z_{eff} Na is $+1$,
 e^- in Na^+ held 9 times tighter than Na .

3. why is it harder to remove an e^- from Sc^{+3} than Sc ?

1st calc Z_{eff} s:



$$Z_{eff} = 21 - 18 = +3$$



answer

$$Z_{eff} = 21 - 10 = +11$$

The valence of Sc^{+3} has a Z_{eff} of $+11$ and the Z_{eff} of Sc is $+3$ so the valence of Sc^{+3} is being held much more tightly than Sc .