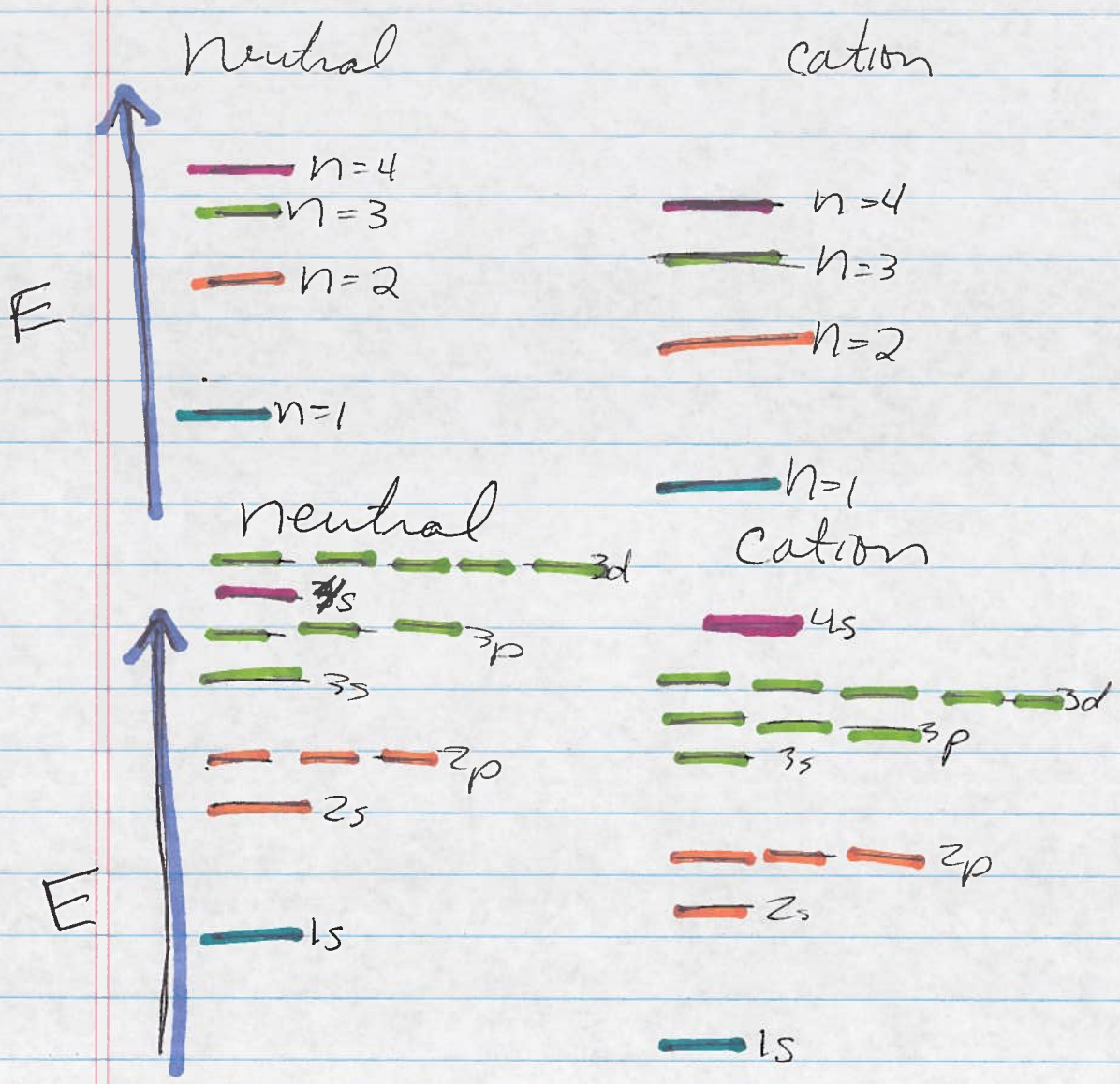
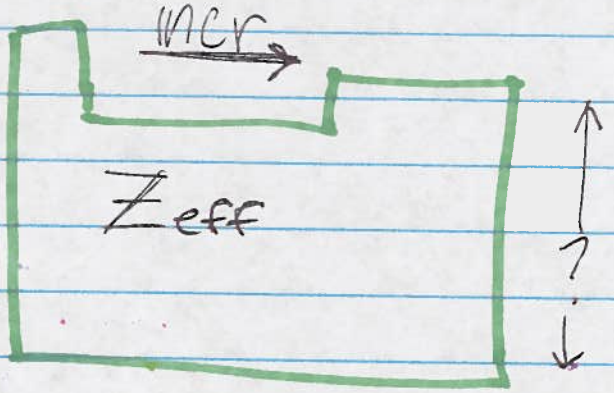
Gen Chem with Dr. M!

Wednesday 10/28/15



In cations, take away 4S first, then 3d.



Z_{eff}	
Li	1.30
Na	2.20
K	2.20
Rb	2.20

Electron affinity

$E + e^- \rightarrow E^-$

Energy is released

$Na + e^- \rightarrow Na^-$ $\quad \Delta E = -50$ kJ/mol

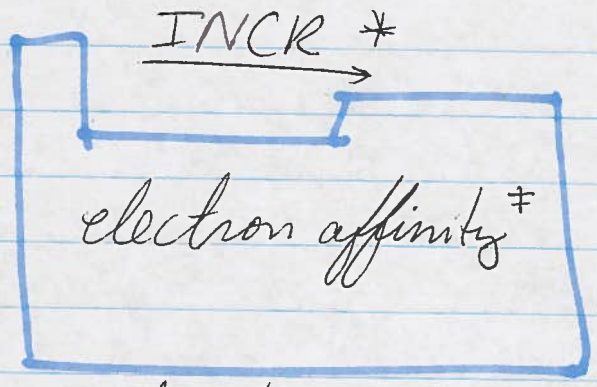
$[Ar]3s^1$ $\quad [Ar]3s^2$ → filled subshell is happy subshell

Ionization energy

$E \rightarrow E^+ + e^-$ always takes energy

$Na \rightarrow Na^+ + e^-$ $\quad E_{i1} = +496$ kJ/mol

↑ takes energy



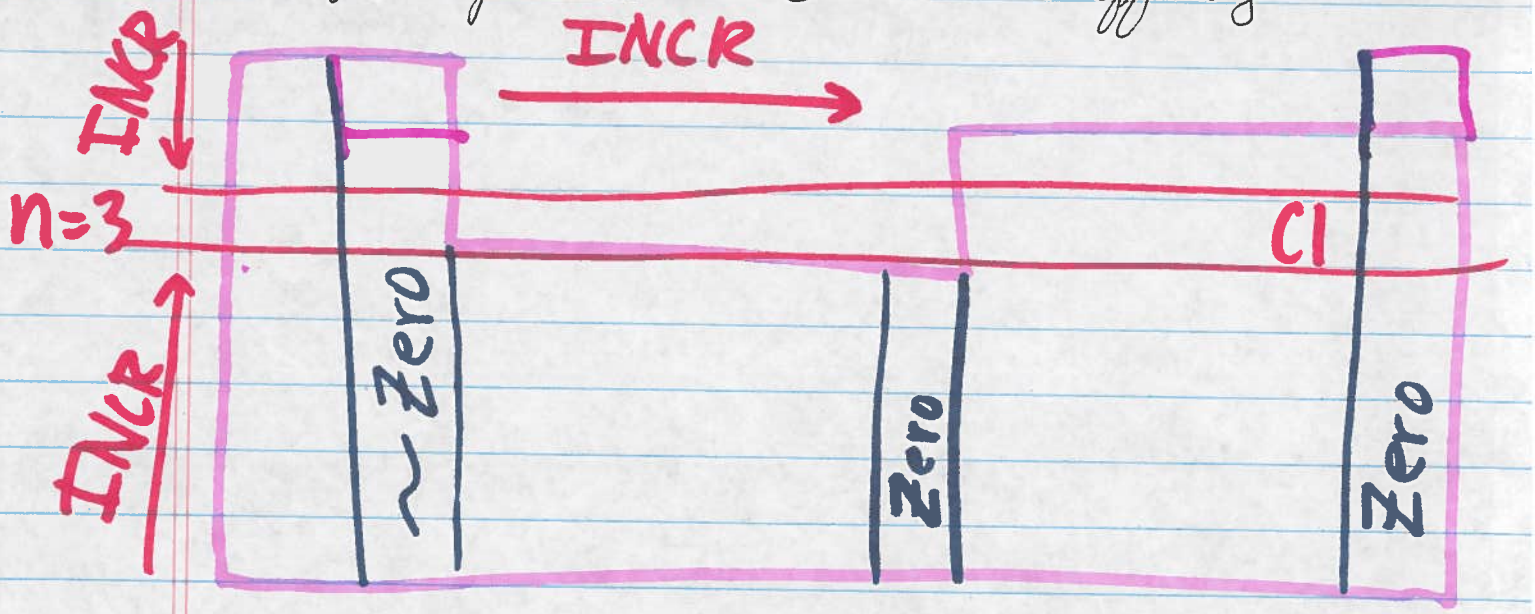
* due to Zeff

‡ $E + e^- \rightarrow E^-$

becomes more negative (releases more energy)

$F + e^- \rightarrow F^- \quad \Delta E = -330\ kJ/mol$

Noble Gases have 0 electron affinity



N 1s 2s 2p

Lattice Energy: $Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ energy released

$E = -787\ kJ/mol$ (exo)

Lattice energy $\propto (Z_{cation} * Z_{anion})$

charge on cation ↑ ↑ charge on anion

$Na_{(s)} + 1/2\ Cl_{2(g)} \rightarrow NaCl_{(s)}$ $E = -411$ kJ/mol

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$Na_{(s)} \rightarrow Na_{(g)}$ $E = +107$ kJ/mol

$Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ $E = +496$ kJ/mol

$\frac{1}{2}\ Cl_{2(g)} \rightarrow \frac{1}{2}\ 2\ Cl_{(g)}$ $E = \frac{244}{2}$ kJ/mol $= +122$ kJ/mol

$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$ $E = -349$ kJ/mol (exothermic)

$Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ $E = -787$ kJ/mol

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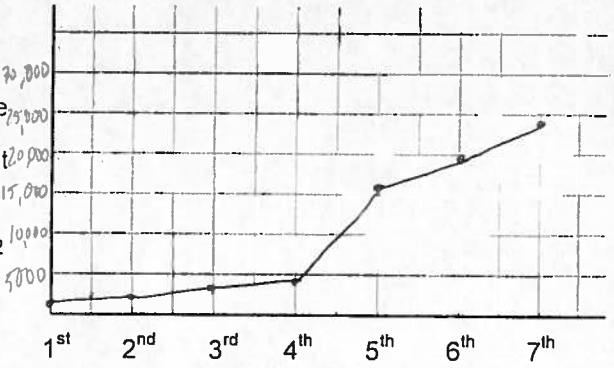
NIE qn $Na + 1/2\ Cl_2 \rightarrow NaCl$ $E = -411$ kJ/mol

Folder Activity Chapter 6 Day 2 28 October 2015

Printed Name: Monika Satkauskas Chm 203 Student number: TA

1 H																2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110	111	112		114		116		118

1. The sequential ionization energies for silicon are (all in kJ/mol): E_{i1} = 787; E_{i2} = 1577; E_{i3} = 3231; E_{i4} = 4356; E_{i5} = 16091; E_{i6} = 19784; and E_{i7} = 23783. Plot these data on the graph paper below. (Make each horizontal line an increment of 5000 kJ) Write the electron configuration of the resulting ion near each data point – so for 1st, you would write $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$, and so on.



2. What is the solubility rule involving Group 1 cations? all group 1 cations are soluble

What is the solubility rule involving halides? the are soluble except Ag^+, Pb^{2+}, $(Hg_2)^{2+}$

What is the range of lattice energy values for Group 1 halides? 649 – 1,036 kJ/mol

3. The lattice energies of $CaSO_4$, $SrSO_4$, and $BaSO_4$ are 2653, 2603 and 2423 kJ/mol, respectively. Why do you think these lattice energies are larger than for Group 1 halides? The charges on the ions are larger.

How does lattice energy seem to relate to solubility? The larger the charge, the larger the lattice energy and the less soluble it is.

4. The charge on the cation is called Z^+ and the charge on the anion is Z^-. Lattice energies are $\propto Z^+ \times Z^-$. Complete this table of $Z^+ \times Z^-$ and give an example of each combination. Circle those that you know or suspect are insoluble from a solubility rule.

$\lvert Z^+ \times Z^- \rvert$	$Z^+ = 1$	$Z^+ = 2$	$Z^+ = 3$
$Z^- = -1$	1, NaCl	2, $CaCl_2$	3, $AlCl_3$
$Z^- = -2$	2, Na_2CO_3	4, $CaCO_3$	6, $Al_2(CO_3)_3$
$Z^- = -3$	3, Na_3PO_4	6, $Ca_3(PO_4)_2$	9, $AlPO_4$

Can you make a generalization about the product of charges and lattice energies? The larger the product the larger the lattice energy.

There are other factors besides lattice energies that affect solubility, so there are exceptions (examples, AgCl (1 x -1) is insoluble, while $CuSO_4$ (2 x -2) is soluble.