During Class Invention

Ionic Bonding

Name(s) with Lab section in Group

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1. Complete the following table

Element	Nuclear Charge	Complete Electron configuratio	Total # of electrons	# of inner core electrons	# of valence Electrons	Effective Nuclear Charge (VE)
Na	**11**	$1s^2 2s^2 2p^6 3s^1$	**11**	**10**	**1**	**+1**
Cl	**17**	$1s^2 2s^2 2p^6 3s^2 3p^5$	**17**	**10**	**7**	**+7**
Na^+	**11**	$1s^2 2s^2 2p^6$	**10**	**2**	**0**	**+9 (n=2 e^-)**
Cl^-	**17**	$1s^2 2s^2 2p^6 3s^2 3p^6$	**18**	**10**	**8**	**+7**
Mg	**12**	$1s^2 2s^2 2p^6 3s^2$	**12**	**10**	**2**	**+2**
Mg^+	**12**	$1s^2 2s^2 2p^6 3s^1$	**11**	**10**	**1**	**+2**
Mg^{2+}	**12**	$1s^2 2s^2 2p^6$	**10**	**2**	**0**	**+10 (n=2 e^-)**
S	**16**	$1s^2 2s^2 2p^6 3s^2 3p^4$	**16**	**10**	**6**	**+6**
S^{2-}	**16**	$1s^2 2s^2 2p^6 3s^2 3p^6$	**18**	**10**	**8**	**+6**

2. Why is the 2nd ionization energy in Na significantly greater than the first ionization energy for Na? Explain in terms of ENC.

The electron configuration for sodium is:

Na $1s^2 2s^2 2p^6 3s^1$

The first electron removed from sodium (the first ionization energy) comes from the 3s orbital. The ENC on this electron is a +1. The second electron removed from sodium must come from the second shell. The ENC on an electron in the second shell is +9 (since only the two 1*s* electrons are shielding the electrons in the second shell from the nuclear charge on sodium). An ENC of +9 means that it takes a very large amount of energy to remove the second electron from sodium. The first electron removed from sodium only experiences an ENC of +1 and is much easier to remove.

3. Why is the 2nd ionization energy in Mg a little larger compared to the first ionization energy for Mg? Explain in terms of ENC.

The electron configuration for magnesium is:

Mg $1s^2 2s^2 2p^6 3s^2$

The first two electrons removed from magnesium (the first and second ionization energy) come from the 3s orbital. The ENC on both of these electrons is a +2.

$$Mg(g) \rightarrow Mg^+(g) + 1e^- \quad \text{1st ionization energy}$$
$$Mg^+(g) \rightarrow Mg^{2+}(g) + 1e^- \quad \text{2nd ionization energy}$$

The first electron ionized comes from filled orbital where the repulsions are greater so as a result the first electron requires a smaller amount of energy to remove due to the electron-electron repulsions are greater when the orbital contains two electrons. When the second electron is removed there is not another electron present so it requires more energy to remove.

4. Which is larger, a sulfur atom or a sulfide ion? Explain in terms of ENC.

The electron configuration for each of these elements is,

S $1s^2 2s^2 2p^6 3s^2 3p^4$
S^{2-} $1s^2 2s^2 2p^6 3s^2 3p^6$

The ENC on the valence electrons is +6 for sulfur and a +6 for sulfide ion. So both sets valence electrons experience the same ENC. However, the sulfide ion has two additional electrons in its valence shell. The result is the electron-electron repulsions are greater for the sulfide valence electrons compared to the valence electrons in sulfur and the sulfide ion has a larger radius