Day 2.3 Warm-Up

1. Which atom would require more energy to remove an electron: Na or Cl? Explain your reasoning.

The e^-s removed from Na + Cl are both in the 3rd E level. Cl has more p^+, thus stronger effective nuclear charge (Z_{eff}) and stronger attraction bwtn nucleus + valence e^-. ∴ Cl requires more E to remove its e^-.

2. Which atom would require more energy to remove an electron: Li or Cs? Explain your reasoning.

The e^- removed from Li is in the 2nd E level whereas in Cs the e^- is in the 6th E level. The e^- in Li is closer to the nucleus, thus is more strongly attracted. ∴ Li requires more E to remove its e^-.

3. Element X has the following ionization equations and ionization energies.

Valence e^- (1st ionization E)

$X \rightarrow X^+ + e^-$ $IE_1 = 735$ kJ/mol

$X^+ \rightarrow X^{2+} + e^-$ $IE_2 = 1445$ kJ/mol

Core e^- (inner e^-)

$X^{2+} \rightarrow X^{3+} + e^-$ $IE_3 = 7730$ kJ/mol

$X^{3+} \rightarrow X^{4+} + e^-$ $IE_4 = 10540$ kJ/mol

Huge Jump!

a) How many valence electrons are in an atom of element X?

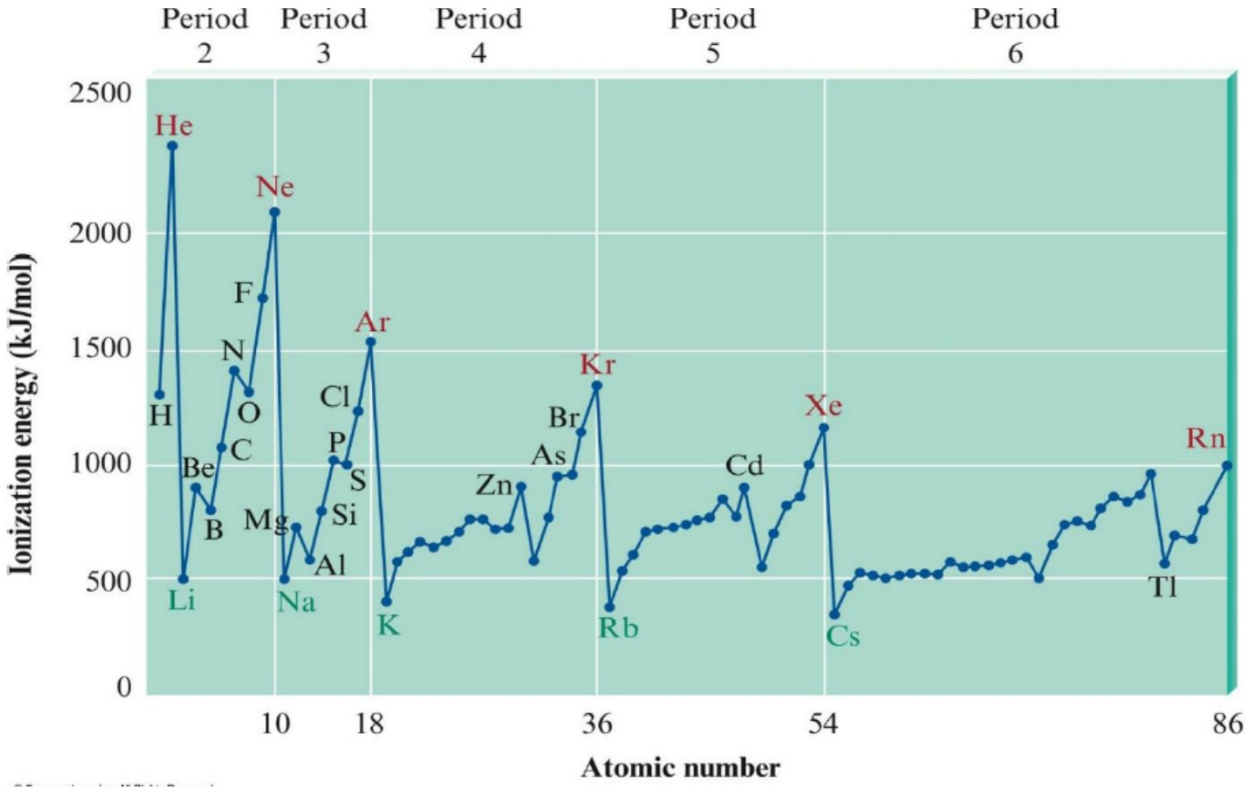
2

b) When element X bonds with nitrogen, what is the formula of the ionic compound that is formed?

X^{2+} N^{3-}

X_3N_2

4. Ionization energy values for the elements in the first six periods are shown below.



a) In general, what is the ionization energy trend across a single period?

I.E. increases across a period

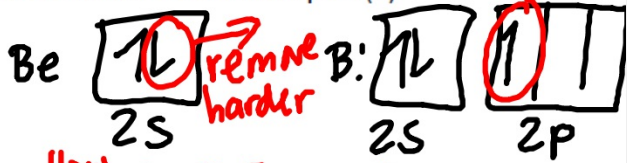
b) Examine the data for periods 2 and 3, identify exceptions to the trend described in part (a).

Be – B (lower than expected)

Grp 2 vs. Grp 13

Higher E state

easier remove



Higher I.E.

Lower I.E.

N – O – same P - S

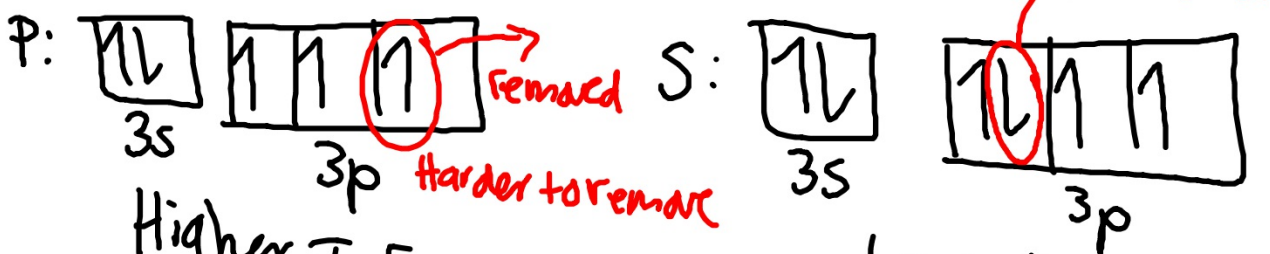
Grp. 15 vs Grp. 16

Mg – Al – same as Be - B

e⁻/e⁻ repulsion

Easier

P – S (lower I.E. than expected)

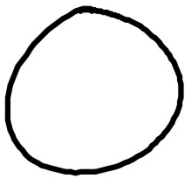


Harder to remove

Higher I.E.

Lower I.E.

S orbitals



p orbitals

d orbitals