

(5) Today

2.2.4 Shielding

2.3 Periodic Properties

Next Class (6)

2.3 Periodic Properties

3.1.1 Resonance and 3.1.3 Formal Charge

3.1.2 Expanded Octets

3.1.4 Failure of Lewis Structures to Predict
Unusual Cases

(7) Second Class from Today

3.2 VSEPR

Third Class from Today (8)

3.2 VSEPR

Slater's Rules for Approximating Effective Nuclear Charge

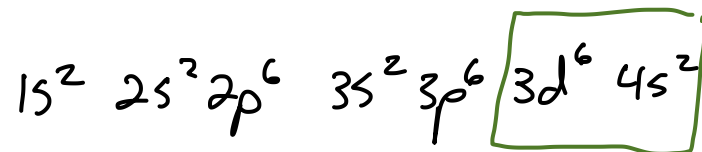
$$Z_{\text{eff}} = Z - S$$

Where Z_{eff} = effective nuclear charge, Z = nuclear charge, and S = shielding constant

- group orbitals by n and l
(1s) (2s,2p) (3s,3p) (3d) (4s, 4p) (4d) (4f) (5s, 5p) (5d) (etc)
- electrons in groups to the right do not shield electrons to their left
- S can be determined for ns and np electrons
 - each electron in the same group contributes 0.35 to the value of S for other electrons in the same group exception, 1s electron contributes 0.30
 - each electron in $n - 1$ groups contribute 0.85 to S
 - each electron in $n - 2$ groups contribute 1.00 to S
- for nd and nf
 - each electron in the same group contributes 0.35 to the value of S (same as 3a)
 - each electron in a group to the left contributes 1.00 to S

H	He	F
$1s^1$ the 1s e^- experiences a $Z_{\text{eff}} = 1$ e^- 's don't shield themselves	$1s^2$ $S = 1 \cdot 0.3 = 0.3$ $Z_{\text{eff}} = 2 - 0.3 = 1.7$ $1e^-$ shields the other e^-	$1s^2 2s^2 2p^5$ 1s e^- 's experience... $S = 1 \cdot 0.3 = 0.3$ $Z_{\text{eff}} = 9 - 0.3 = 8.7$ $2s+2p$ $S = 6 \cdot 0.35 + 2 \cdot 0.85 = 3.8$ $Z_{\text{eff}} = 9 - 3.8 = 5.2$

Shielding: Fe



Section 2.2.4

Slater's Rules for Determining Effective Nuclear Charge

$$Z_{\text{eff}} = Z - S$$

Where Z_{eff} = effective nuclear charge, Z = nuclear charge, and S = shielding constant

1. group orbitals by n and l

(1s) (2s,2p) (3s,3p) (3d) (4s, 4p) (4d) (4f) (5s, 5p) (5d) (etc)

2. electrons in groups to the right do not shield electrons to their left

3. S can be determined for ns and np electrons

a. each electron in the same group contributes 0.35 to the value of S for other electrons in the same group
exception, 1s electron contributes 0.30

b. each electron in $n - 1$ groups contribute 0.85 to S

c. each electron in $n - 2$ groups contribute 1.00 to S

4. for nd and nf

a. each electron in the same group contributes 0.35 to the value of S (same as 3a)

b. each electron in a group to the left contributes 1.00 to S

Z_{eff} for Fe's $4s$ e^- 's contribution $4s$ e^- 's, $3d$, $3s3p$, $2s2p$, $1s$

$$S = 1 \cdot 0.35 + 6 \cdot 0.85 + 8 \cdot 0.85 + 8 \cdot 1 + 2 \cdot 1 = 22.25$$

$$Z_{\text{eff}} = 26 - 22.25 = 3.75$$

Z_{eff} for Fe's $3d$ e^- 's contribute $3d$, $3s3p$, $2s2p$, $1s$

$$S = 5 \cdot 0.35 + 8 \cdot 1 + 8 \cdot 1 + 2 \cdot 1 = 18 + 1.75 = 19.75$$



From left to right ionization E
increases Z_{eff} increases...
more E needed to remove e^-

From top to bottom
as distance from the
nucleus increases it
becomes easier to remove
 e^- 's

