Key Concepts

What makes a BOND?

1
H
1.008

The electronic structure of atoms explains atomic properties.

1s 2s 2p
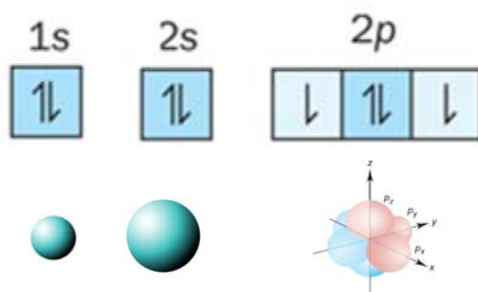
Atomic properties can be used to predict the type and organization of bonds in a molecule.

O=O
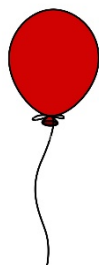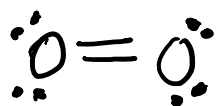
Chemical properties are determined by atomic and molecular structures.

The following pages are titled with respect to the learning objectives that their content relates to.

Learning Objectives

Recognize atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.

Write electron configurations (full and condensed) and orbital diagrams for *s* & *p*-block elements with $Z \leq 54$.

Identify paramagnetic and diamagnetic elements from their electron configurations.

Relate electron configurations to periodic trends in atomic/ionic radius, ionization energy, and electron affinity.

Use periodic trends and electronegativity to *predict* the nature of bonding in chemical species.

Draw Lewis structures for atoms, molecules and ions that minimize formal charges and/or follow the octet rule.

Explain how the type of bonding that characterizes a substance affects its physical and chemical properties.

Draw Lewis structures for atoms, molecules and ions that minimize formal charges and/or follow the octet rule.
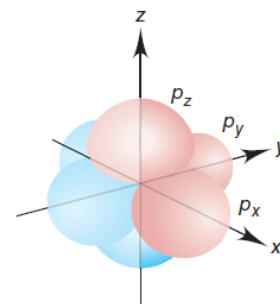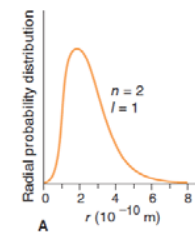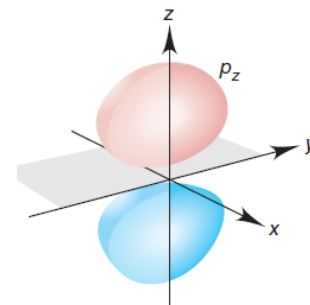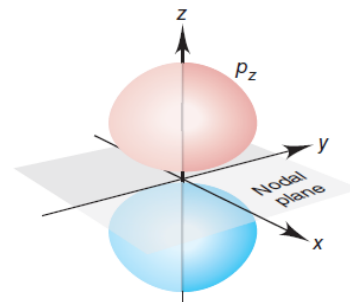
Identify trends in covalent bond strength.
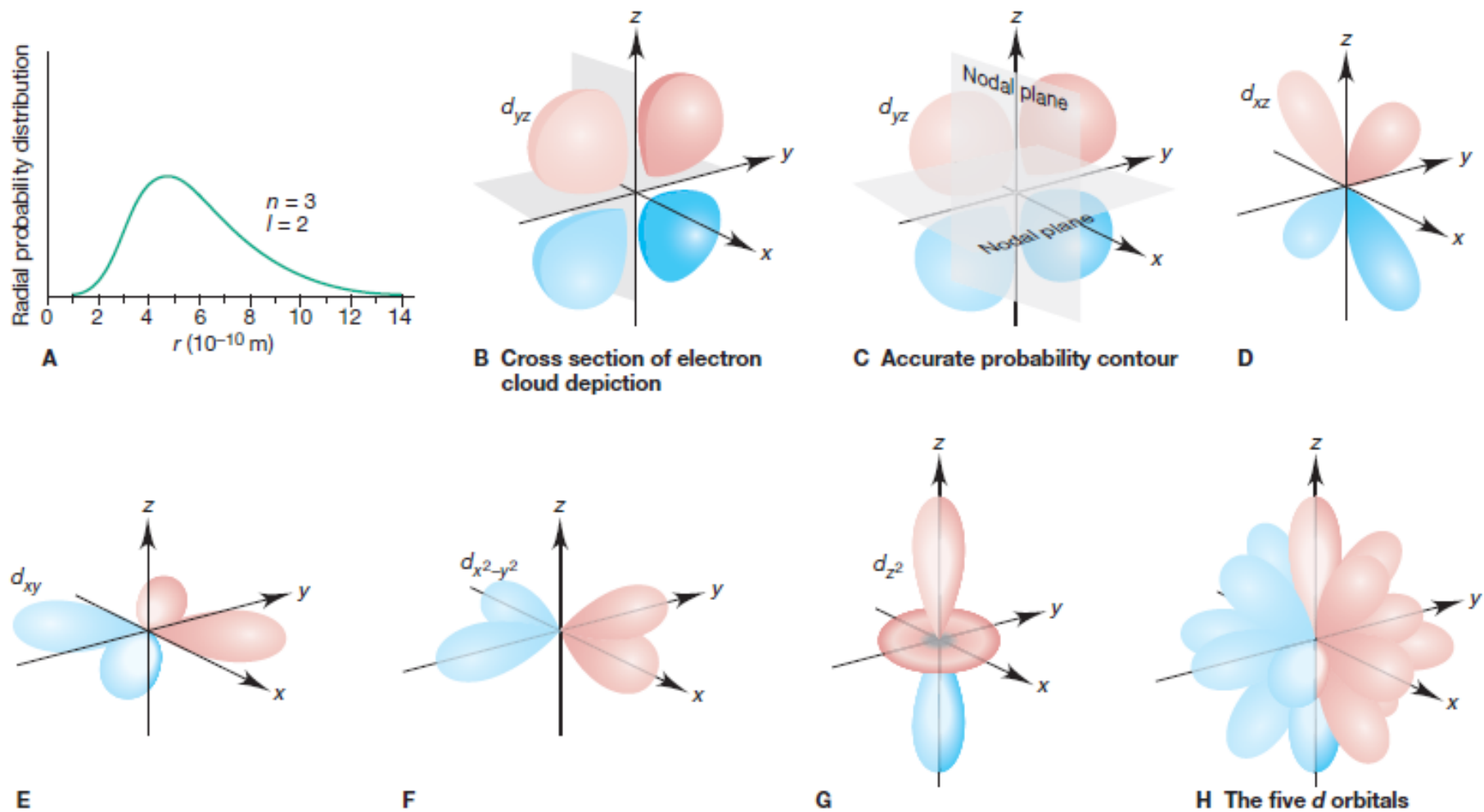
Recognize atomic orbital shapes (*s*)

A 1s orbital

B 2s orbital

C 3s orbital
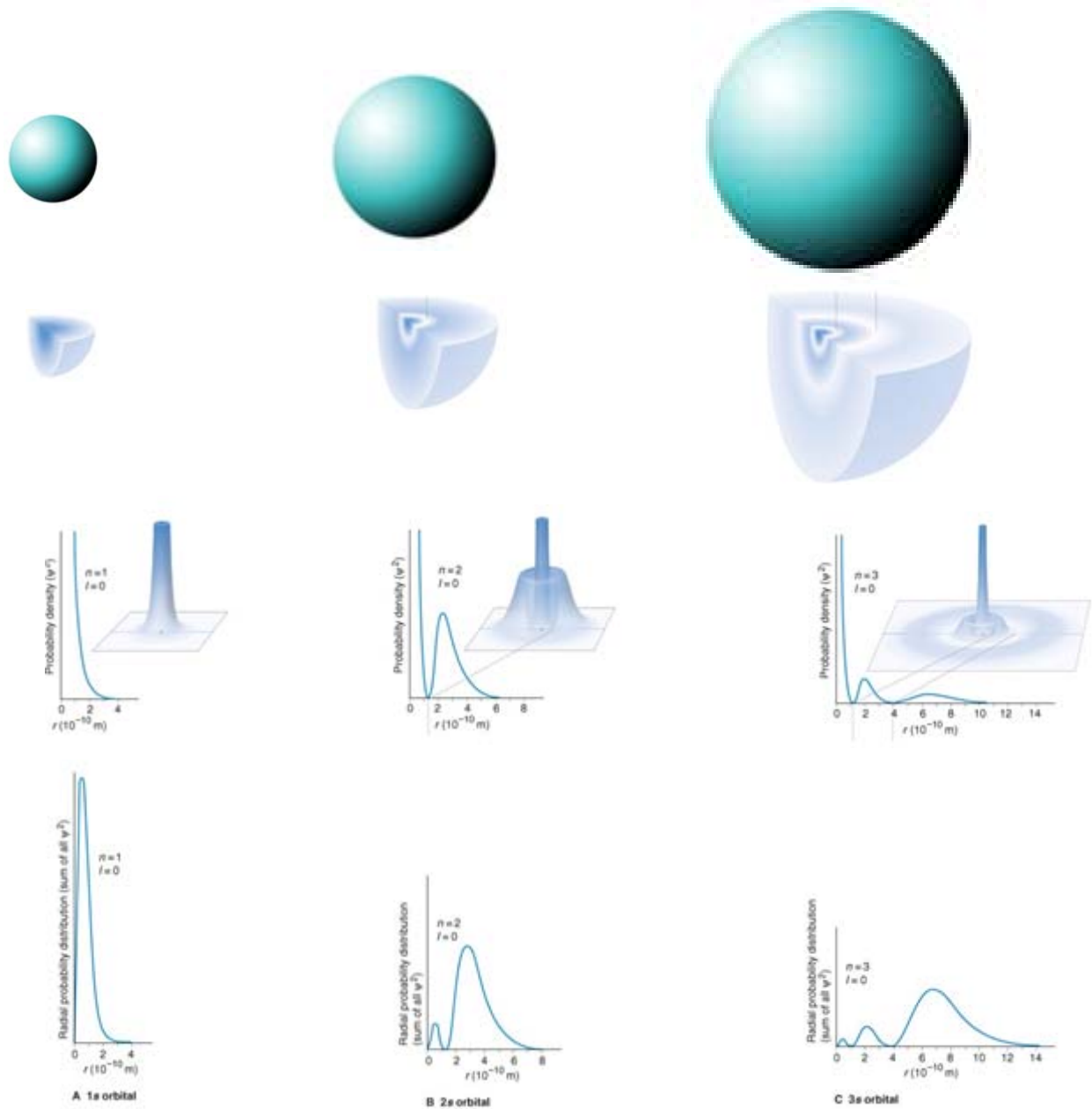
Modification of Fig 6.18

Recognize atomic orbital shapes (*p*)

Modification of Fig 6.19

Recognize atomic orbital shapes (*d*)

A

B Cross section of electron cloud depiction

C Accurate probability contour

D

E

F

G

H The five *d* orbitals

Modification of Fig 6.20

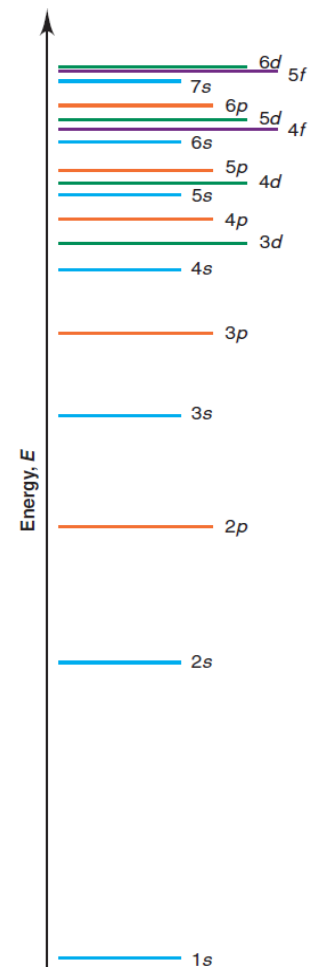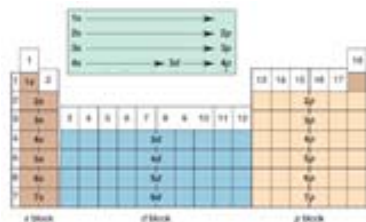*Recognize* atomic orbital shapes (*s, p* and *d*) and *predict* their relative energies.
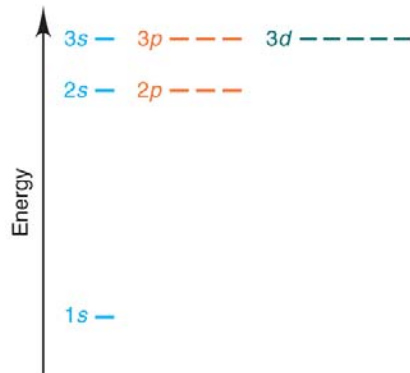
Fig 6.22

Fig 7.5

Write electron configurations (full and condensed) and orbital diagrams for *s* & *p*-block elements with Z ≤ 54.

Modification
Fig 7.11
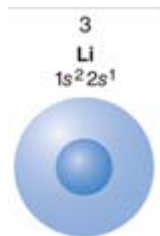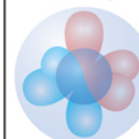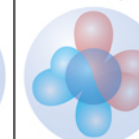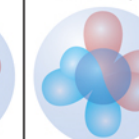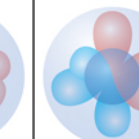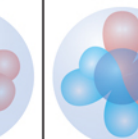
Fig 7.6   p. 276   Fig 7.7   Fig 8.5

Write electron configurations (full and condensed) and orbital diagrams for *s* & *p*-block elements with Z ≤ 54.

	1s	2s	2p
B	⇅	⇅	☐ ☐ ↓
C	⇅	⇅	↓ ☐ ↓
N	⇅	⇅	↓ ↓ ↓
O	⇅	⇅	↓ ⇅ ↓
F	⇅	⇅	↓ ⇅ ⇅
Ne	⇅	⇅	⇅ ⇅ ⇅

	helium 2 He 4.0026

boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
aluminium 13 Al 26.982	silicon 14 Si 28.085	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80
indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29

Group	13	14	15	16	17	18
Valence electrons	ns^2np^1	ns^2np^2	ns^2np^3	ns^2np^4	ns^2np^5	ns^2np^6
Period 2	· B ·	· C ·	· N ·	: O ·	: F :	: Ne :

5 B $1s^22s^22p^1$	6 C $1s^22s^22p^2$	7 N $1s^22s^22p^3$	8 O $1s^22s^22p^4$	9 F $1s^22s^22p^5$	10 Ne $1s^22s^22p^6$

Identify paramagnetic and diamagnetic elements from their electron configurations.

Relate electron configurations to periodic trends in atomic/ionic radius, ionization energy, and electron affinity.

Electronegativity

Electron Affinity

Ionization Energy

Size

Modification of Fig 7.13 and 7.19

Use periodic trends and electronegativity to *predict* the nature of bonding in chemical species.
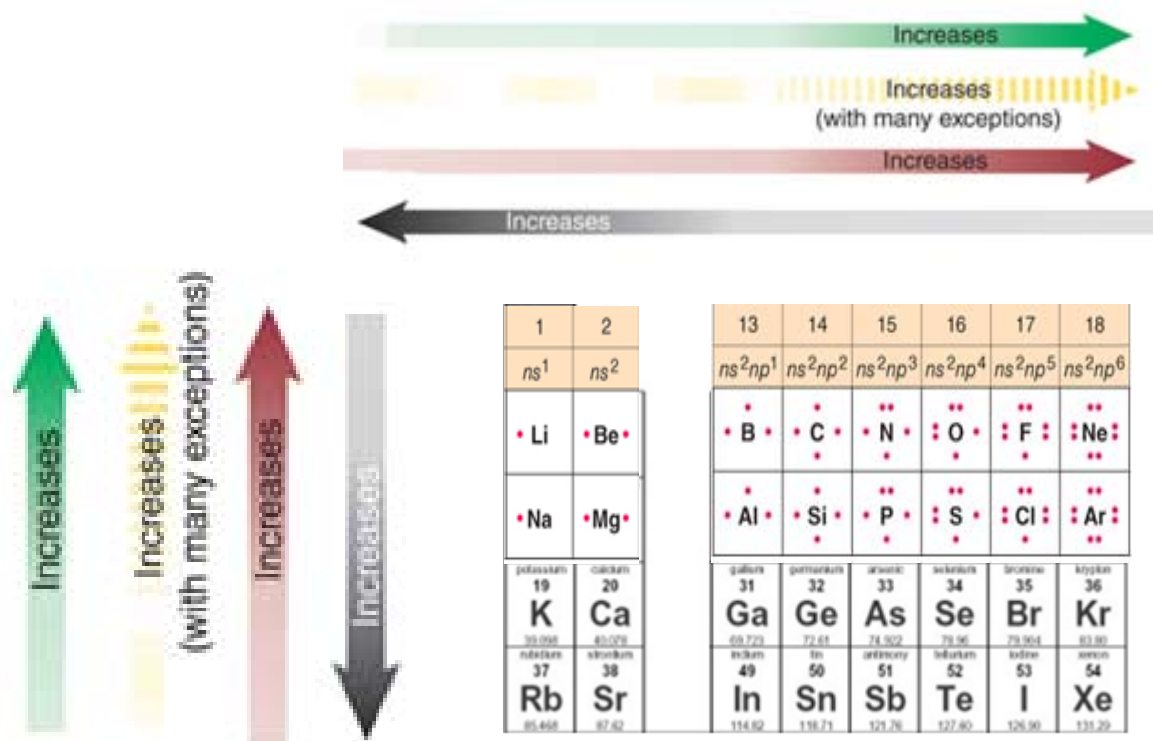
Modification of Fig 8.5 and 7.19

Use periodic trends and electronegativity to *predict* the nature of bonding in chemical species.
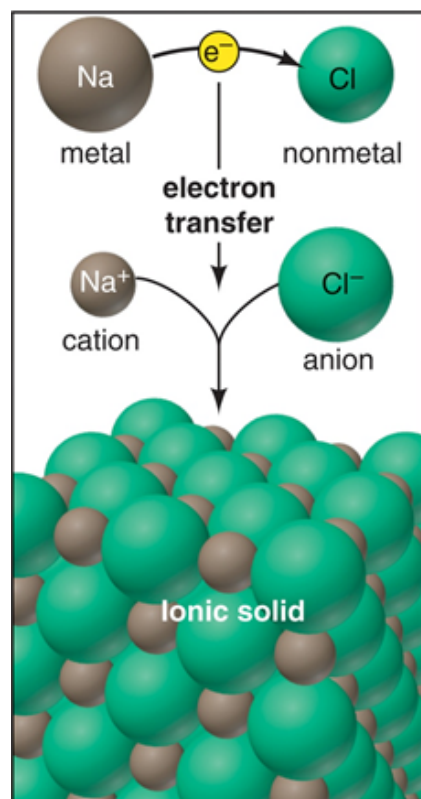
Fig 8.3
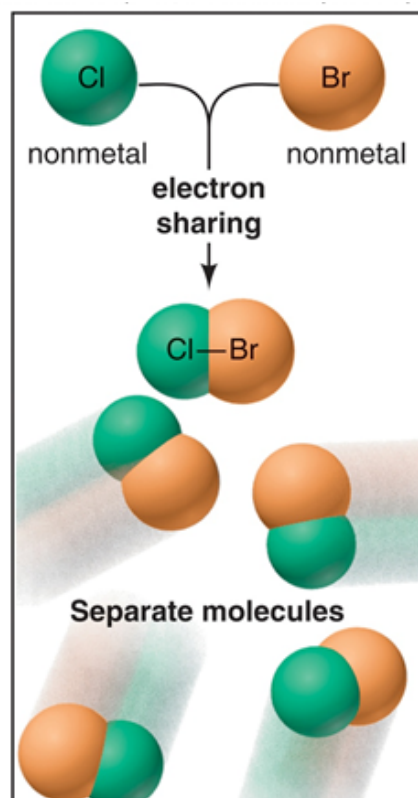
A Ionic bonding

B Covalent bonding
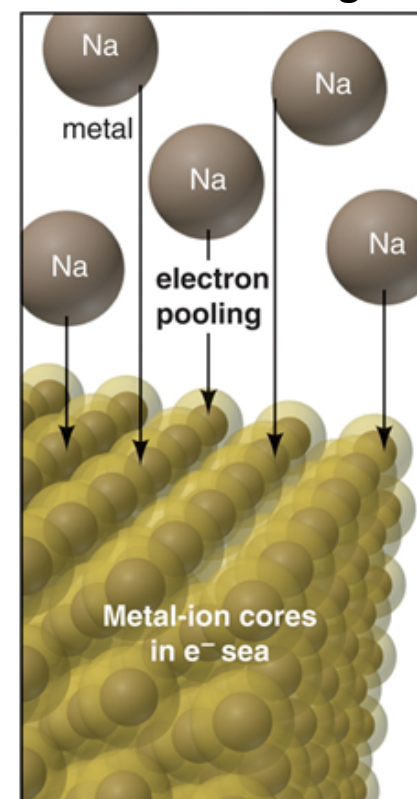
C Metallic bonding

Use periodic trends and electronegativity to *predict* the nature of bonding in chemical species.

Fig 8.26 and 8.27
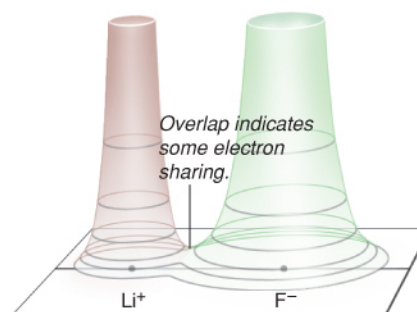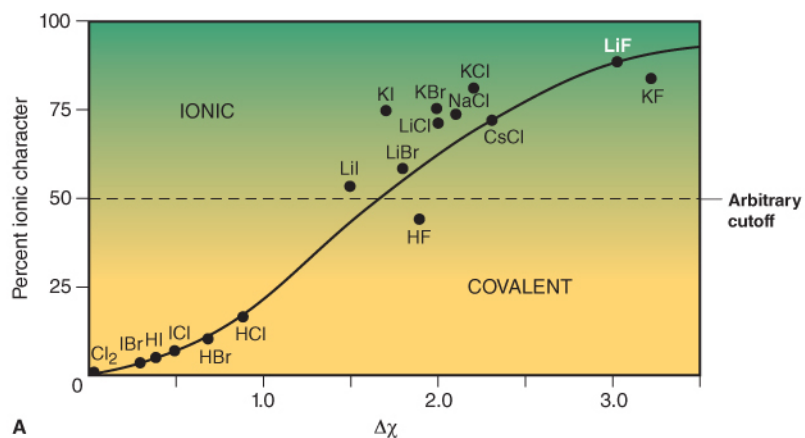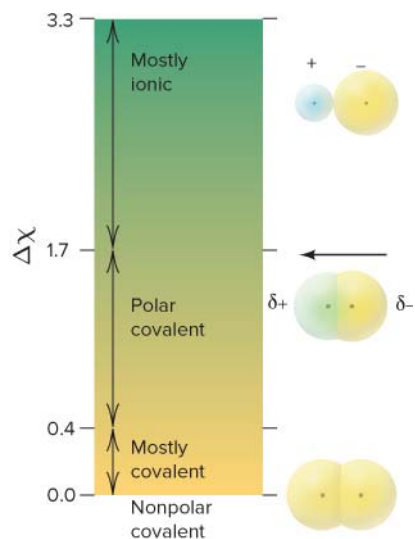
Draw Lewis structures for *atoms*

Group	1	2
Valence electrons	ns^1	ns^2
Period 2	· Li	· Be ·
Period 3	· Na	· Mg ·

13	14	15	16	17	18
ns^2np^1	ns^2np^2	ns^2np^3	ns^2np^4	ns^2np^5	ns^2np^6
· B ·	· C ·	· N ·	: O ·	: F :	: Ne :
· Al ·	· Si ·	· P ·	: S ·	: Cl :	: Ar :

Period

Draw Lewis structures for atoms, **_molecules_** that minimize formal charges and/or follow the octet rule.

e.g.'s H_2O NH_3 C_3H_8 HNO_3

Group	1	2		13	14	15	16	17	18
Valence electrons	ns^1	ns^2		ns^2np^1	ns^2np^2	ns^2np^3	ns^2np^4	ns^2np^5	ns^2np^6
2	•Li	•Be•		•B•	•C•	•N•	:O•	:F:	:Ne:
3	•Na	•Mg•		•Al•	•Si•	•P•	:S•	:Cl:	:Ar:

Period

Draw Lewis structures for atoms, molecules and ***ions*** that minimize formal charges and/or follow the octet rule.

e.g.'s H_3O^+ SCN^- NO_3^-

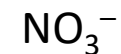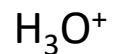| Group	1	2		13	14	15	16	17	18
Valence electrons	ns^1	ns^2		ns^2np^1	ns^2np^2	ns^2np^3	ns^2np^4	ns^2np^5	ns^2np^6
2	• Li	• Be •		• B •	• C •	• N •	: O •	: F :	: Ne :
3	• Na	• Mg •		• Al •	• Si •	• P •	: S •	: Cl :	: Ar :

Period

Identify trends in covalent bond strength.