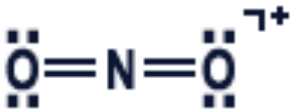
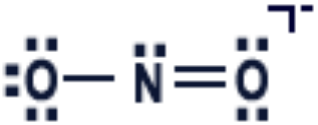
3.10 Molecular Geometries and Bond Angles

a



b



c ✓

d

Which of the above molecules has the smallest bond angle?

a

AX_2E_0
Linear
180°

b

AX_2E_1
Trigonal planar
120°

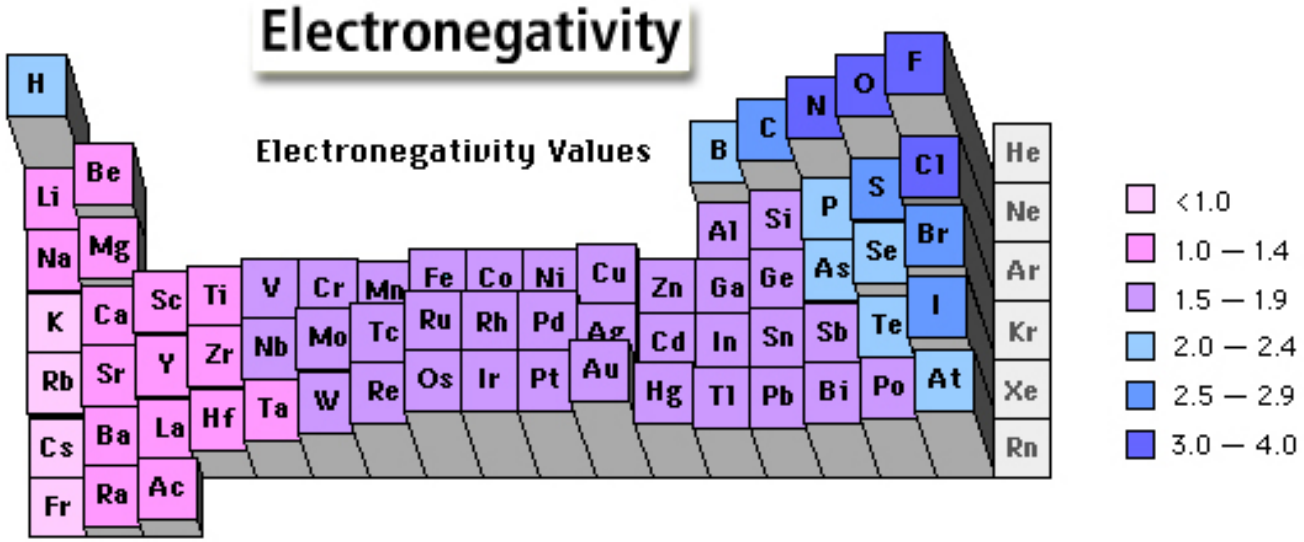
c

AX_2E_2
Tetrahedron
~109
2 Lone Pairs

d

AX_3E_1
Tetrahedron
~109°
One Lone Pair

3.11 How Do We Determine if a Molecule is Polar



? Polar bond ... a difference in electronegativity

:N≡N:

↳ Non polar bond

:C≡O:

↳ Polar bond

→

:C≡O:

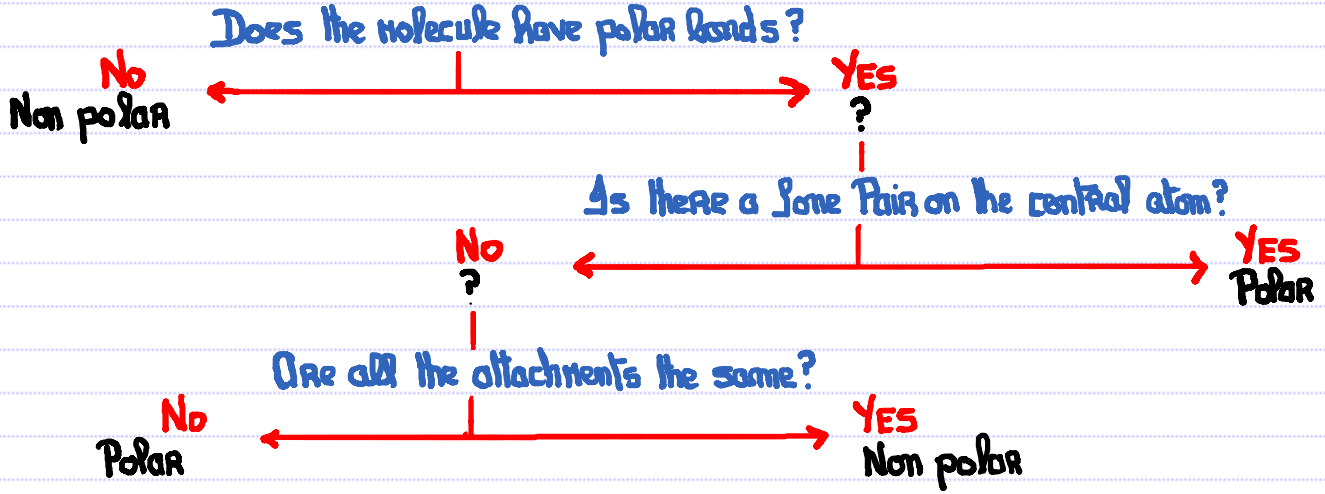
Polar Molecule

O more electronegative.

3.11 How Do We Determine if a Molecule is Polar

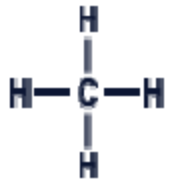
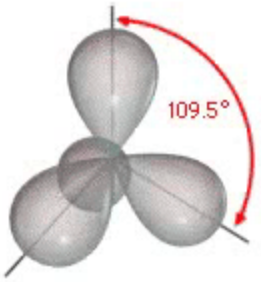
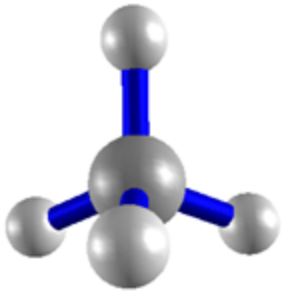
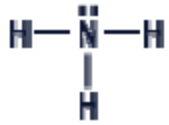
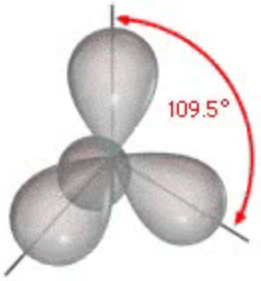
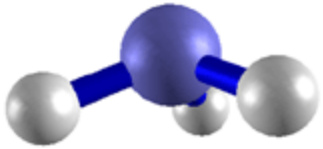
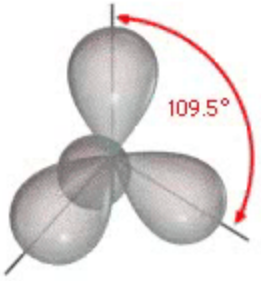
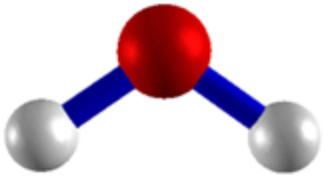
If the vector sum of the polar bonds is $\neq 0$, then the molecule is polar.

The following series of questions work to determine Molecular Polarity for simple molecules whose X+E = 2, 3 or 4.



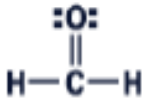
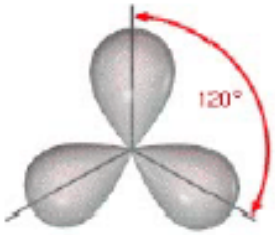
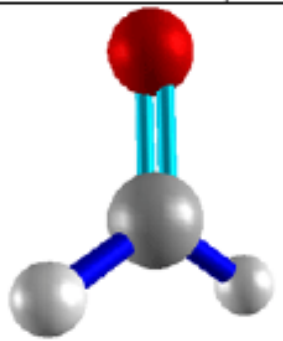
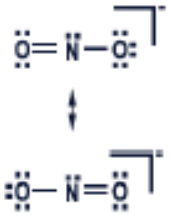
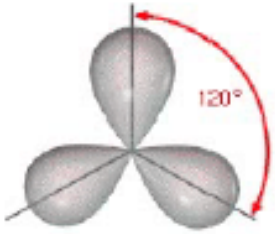
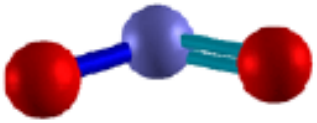
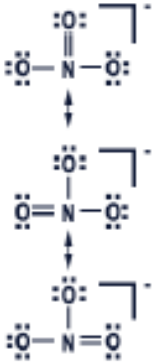
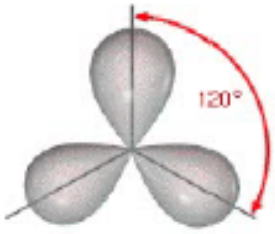
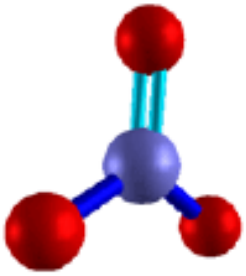
3.11 How Do We Determine if a Molecule is Polar

Molecular Geometry Worksheet ... Fall 2008 ... Whelan ... Page 1

Lewis Structure	Classification	X+E	Parent Geometry	Molecular Geometry	Bond Angle	Polarity
CH_4 	AX_4E_0	4	 Tetrahedron	 Tetrahedron	~109°	NP
NH_3 	AX_3E_1	4	 Tetrahedron	 Trigonal pyramid	~109°	P
H_2O 	AX_2E_2	4	 Tetrahedron	 Bent/Angular (109°)	~109°	P

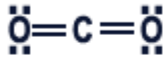
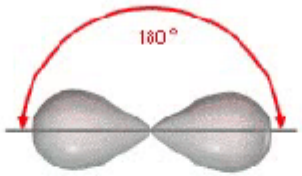
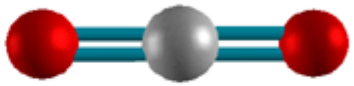
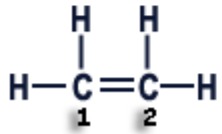
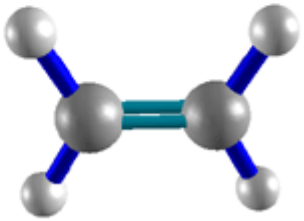
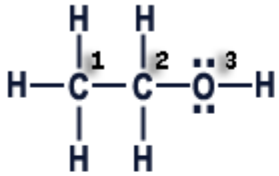
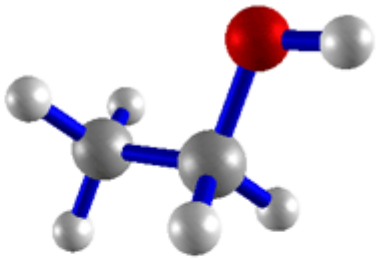
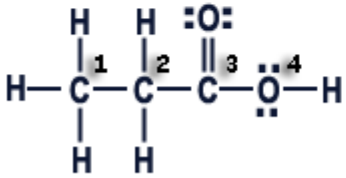
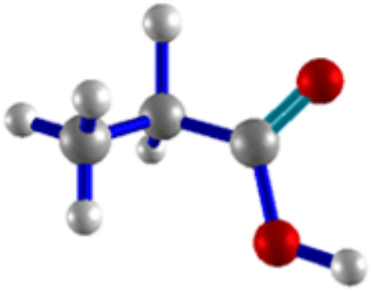
3.11 How Do We Determine if a Molecule is Polar

Molecular Geometry Worksheet … Fall 2008 … Whelan … Page 2

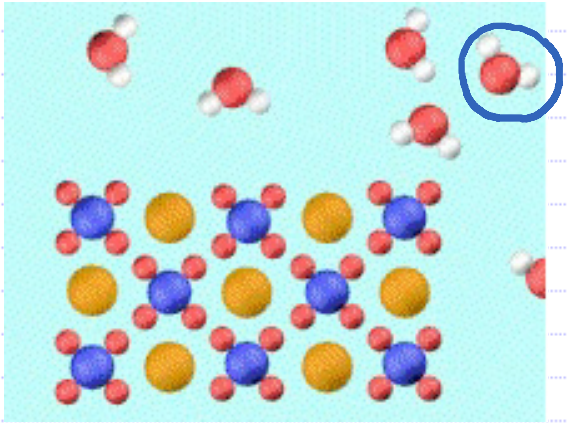
Lewis Structure	Classification	X+E	Parent Geometry	Molecular Geometry	Bond Angle	Polarity
H_2CO 	AX_3E_0	3	 Trigonal planar	 Trigonal planar	120°	P
NO_2^- 	AX_2E_1 AX_2E_1	3 3	 Trigonal planar	 Bent/Angular (120°)	120°	P
NO_3^- 	AX_3E_0 AX_3E_0 AX_3E_0	3 3 3	 Trigonal planar	 Trigonal planar	120°	NP

3.11 How Do We Determine if a Molecule is Polar

Molecular Geometry Worksheet ... Fall 2008 ... Whelan ... Page 3

Lewis Structure	Classification	X+E	Parent Geometry	Molecular Geometry	Bond Angle	Polarity
CO_2 	AX_2	2	 Linear	 Linear	180°	NP
C_2H_4 	1: AX_3E_0 2: AX_3E_0	3 3	1: Trigonal planar 2: Trigonal planar		1: 120° 2: 120°	
C_2H_5OH 	1: AX_4E_0 2: AX_4E_0 3: AX_2E_2	4 4 4	1: Tetrahedron 2: Tetrahedron 3: Tetrahedron		1: ~109° 2: ~109° 3: ~109°	
C_2H_5COOH 	1: AX_4E_0 2: AX_4E_0 3: AX_3E_0 4: AX_2E_2	4 4 3 4	1: Tetrahedron 2: Tetrahedron 3: Trigonal planar 4: Tetrahedron		1: ~109° 2: ~109° 3: 120° 4: ~109°	

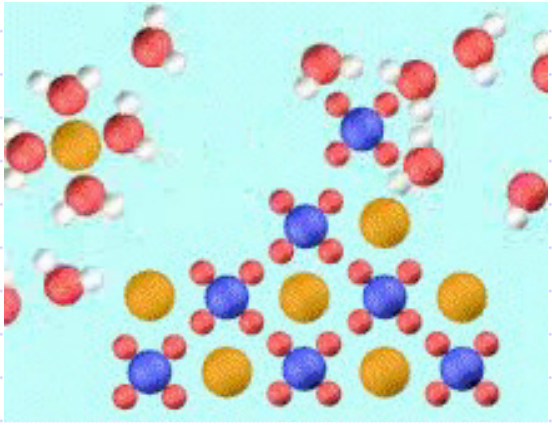
3.11 Consequence of Molecular Polarity



H_2O

$K^+ \ldots\ldots MnO_4^-$

6 × H_2O attach to each ion.



Solubility of Some Common Substances

Compound	Solubility in H_2O g/100mL	
NaCl	35.7	0°C
O_2	4.5×10^{-3}	18°C
N_2	2.0×10^{-3}	18°C
NH_3	89.5	0°C
CO_2	0.179	18°C
HCl	72.1	20°C

H_2O → Polar

$\bar{O}=\bar{O}$, $N \equiv N$ } Non polar

$\bar{O}=C=\bar{O}$ Non polar

"Like dissolves like"

3.11 Consequence of Molecular Polarity

Salad dressings ... Lead poisoning ... Chelating therapy

→ See class web site

EDTA: Ethylenediaminetetraacetic acid.