

# Periodic Table of the Elements

1 H Hydrogen 1.01																	2 He Helium 4.00
3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.31											13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.88	23 V Vanadium 50.94	24 Cr Chromium 51.99	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.63	33 As Arsenic 74.92	34 Se Selenium 78.97	35 Br Bromine 79.90	36 Kr Krypton 83.80
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.95	43 Tc Technetium 98.91	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.90	54 Xe Xenon 131.29
55 Cs Cesium 132.91	56 Ba Barium 137.33	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.85	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.20	83 Bi Bismuth 208.98	84 Po Polonium [208.98]	85 At Astatine 209.98	86 Rn Radon 222.02
87 Fr Francium 223.02	88 Ra Radium 226.03	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [277]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [282]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]

# General Chemistry

202-SN1-RE

with Olivia Bibollet-Bahena

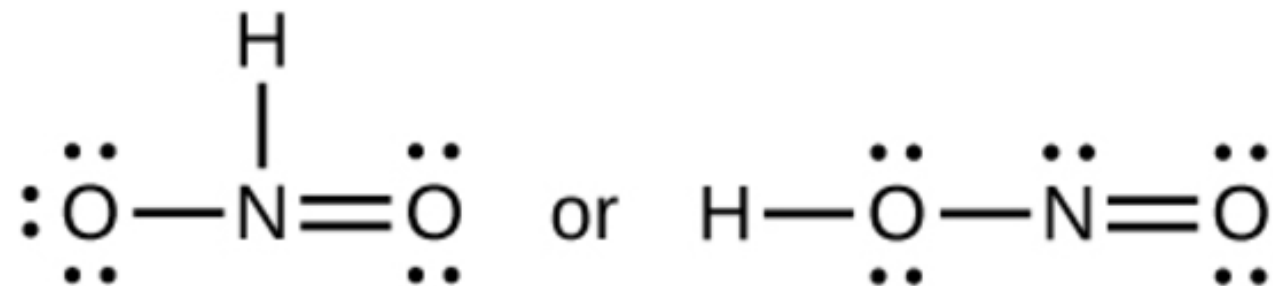
Office: 5<sup>th</sup> floor

57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 144.91	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.06	71 Lu Lutetium 174.97
89 Ac Actinium 227.03	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium 237.05	94 Pu Plutonium 244.06	95 Am Americium 243.06	96 Cm Curium 247.07	97 Bk Berkelium 247.07	98 Cf Californium 251.08	99 Es Einsteinium [254]	100 Fm Fermium 257.10	101 Md Mendelevium 258.10	102 No Nobelium 259.10	103 Lr Lawrencium [262]

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Metalloid
- Nonmetal
- Halogen
- Noble Gas
- Lanthanide
- Actinide

Which of the following structures would we expect for nitrous acid? Determine the formal charges:

OpenStax Chap. 7 Q62



What are the geometry and shape of each central atom? What are the bond angles?

First molecule:

N: trigonal planar, trigonal planar, 120 degree angles

Second molecule:

O: tetrahedral, bent, less than 109.5 degree angles

N: trigonal planar, bent, less than 120 degree angles

# Exercise

Which of the following molecules has a dipole moment?

- a)  $\text{CF}_4$
- b)  $\text{SF}_4$
- c)  $\text{XeF}_4$
- d) All of these have a dipole moment.
- e) None of these has a dipole moment.

Draw the Lewis structure first.

Dipole moments result from differences in electronegativity and geometry. Both the **tetrahedral** ( $\text{CF}_4$ ) and **square planar** ( $\text{XeF}_4$ ) geometries result in dipole moments of zero. The **see-saw** geometry of  $\text{SF}_4$  produces a dipole moment.

# Geometry and Dipoles

- Consider the chemical formula  $XeI_2F_2$ .
- Determine two possible stable geometries for this chemical formula, one which is polar and one which is not.

Draw the Lewis structures.

$XeI_2F_2$  has a square planar shape. When the two I atoms are opposite each other and the two F atoms are opposite each other, the molecule will be nonpolar. When I is across F, then a dipole moment is created.

# Exercise

True or false:

Lone pairs always make a molecule polar.

-If true, explain why.

-If false, provide a counter-example.

False, lone pairs do not always make a molecule polar. They might be arranged so that they are symmetrically distributed to minimize repulsions, such as  $\text{XeF}_4$ .

# Exercise

Which of the following statements best describes  $\text{BF}_3$  and  $\text{NF}_3$ ?  
(*Note: Geometry refers to the electron pair arrangement, and shape refers to the atom arrangement.*)

- a) They have variable geometries and shapes due to their potential resonance structures.
- b) They have the same geometry and different shapes.
- c) They have the same geometry and the same shape.
- d) They have different geometries and the same shape.
- e) They have different geometries and different shapes.

# Exercise

Predict  $\Delta H$  for the reaction of methane with chlorine and fluorine to give Freon-12 ( $\text{CF}_2\text{Cl}_2$ ):



$$\Delta H = [4(413) + 2(239) + 2(154)] - [2(485) + 2(339)] + 2(565) + 2(427)]$$

$$\Delta H = 2438 \text{ kJ} - 3632 \text{ kJ}$$

$$\Delta H = -1194 \text{ kJ}$$

Single Bonds				Multiple Bonds			
H—H	432	N—H	391	I—I	149	C=C	614
H—F	565	N—N	160	I—Cl	208	C≡C	839
H—Cl	427	N—F	272	I—Br	175	O=O	495
H—Br	363	N—Cl	200			C=O*	745
H—I	295	N—Br	243	S—H	347	C≡O	1072
		N—O	201	S—F	327	N=O	607
C—H	413	O—H	467	S—Cl	253	N=N	418
C—C	347	O—O	146	S—Br	218	N≡N	941
C—N	305	O—F	190	S—S	266	C≡N	891
C—O	358	O—Cl	203			C=N	615
C—F	485	O—I	234	Si—Si	340		
C—Cl	339			Si—H	393		
C—Br	276	F—F	154	Si—C	360		
C—I	240	F—Cl	253	Si—O	452		
C—S	259	F—Br	237				
		Cl—Cl	239				
		Cl—Br	218				
		Br—Br	193				

\*C=O(CO<sub>2</sub>) = 799

Using the bond energies on the previous slide, determine the approximate enthalpy change for each of the following reactions:

