Name _____

Veritas _____

Chemistry – Unit 11 Worksheet 1
Ionization energy

Plot graphs of successive ionization energies for B, Si, and Ca.

1. Compare the graphs – what are the common features? What are the differences?

2. Group the electrons for each element based on ionization energies. How many electrons are in each group? You can change the scale of the vertical axis to better differentiate between groups.

3. Is there a maximum number of electrons that can fit in each group? If so, what is it?

4. Plot graphs of successive ionization energies for a few more atoms. Does the evidence support your answer to #3?

5. Summarize the patterns you found in the table of successive ionization energies.

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Chemistry – Unit 11 – Worksheet 2
Periodic trends

1. Using the data in the table of ionization energies, plot the first ionization energy (IE_1) vs. the atomic number (Z) for the first 20 elements.

2. Using the data in the table on the 2nd sheet in the workbook, plot the atomic radius (in nm) vs. the atomic number.

Conclusion

1. Examine the graph of 1st ionization energy vs atomic number. Can a periodic trend be observed? If so, describe the trend.

2. Which group (or chemical family) has the highest ionization energies? Which group has the lowest?

3. Examine the graph of atomic radius vs atomic number. Can a periodic trend be observed? If so, describe the trend.

4. For a given period (a row in the Periodic Table), which group (a column in the table) appears to have the largest atomic radii? Which group has the smallest?

5. What appears to be the relationship between trends in IE and atomic radii?

Extension

Draw energy well diagrams for B, N, F and Na, Use these diagrams to explain the trend in 1st ionization energy as you move across a period. Explain why IE_1 for sodium is so much smaller than it is for fluorine.

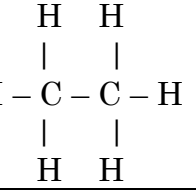
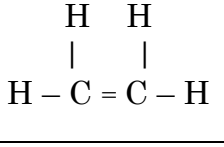
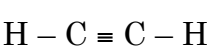
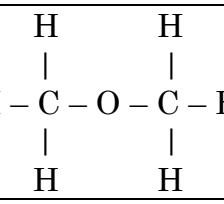
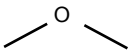
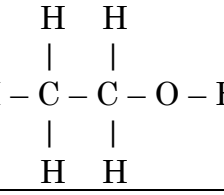
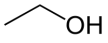
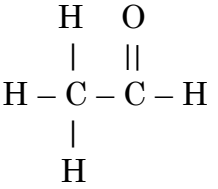
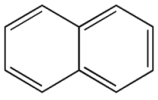
Now, use these diagrams to explain the trend in atomic radii as you move across a period. Explain why fluorine is smaller than oxygen, yet sodium is not smaller yet than fluorine.

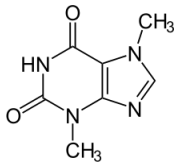
Worksheet 3

Worksheet 3

Chemistry – Unit 11 Worksheet 4

Molecular, line and structural formulas

Name	Molecular Formula	Structural Formula	Line Formula	Skeletal Formula
Ethane	C_2H_6		CH_3CH_3	
Ethylene	C_2H_4		$CH_2=CH_2$	
Acetylene	C_2H_2		$CH\equiv CH$	
Dimethyl ether	C_2H_6O		CH_3OCH_3	
Ethanol	C_2H_6O		CH_3CH_2OH	
Acetaldehyde			CH_3CHO	
Acetic acid			CH_3COOH	
Dimethylamine			$(CH_3)_2NH$	
Naphthalene				

Theobromine				

1. Write a structural formula based on the following molecular formulas:

a. Chloroform (a volatile liquid, was used in the past as an anesthetic – $CHCl_3$)	
b. Hydrogen cyanide (a volatile liquid that smells like bitter almonds, interrupts cellular respiration; it was used for capital punishment – HCN)	
c. Methanol (low flammability fuel, used in drag racing and remote control toy cars – CH_4O)	
d. Formaldehyde (a water soluble gas, the commercial name for the solution is Formalin, which is used for embalming – CH_2O)	
e. Hydrogen peroxide (an oxidizing liquid, unstable, used as a disinfectant and bleach – H_2O_2)	
f. Phosgene (toxic gas, affects the respiratory system, used in the past as a chemical warfare agent – $COCl_2$)	
g. Methyl mercaptan (a stinking gas, used as an additive to natural gas, which is odorless, to help the detection of gas leaks – CH_4S)	
h. Formic acid (an acidic liquid, responsible for the stinging sensation of ant bites – CH_2O_2)	

2. Write molecular formulas for the molecules composed of the following elements:

   a) Hydrogen and chlorine (hydrochloric acid, a soluble gas, found in the stomach and helps the digestion of food)

   _____

   b) Hydrogen and sulfur (hydrogen sulfide, the gas responsible for the foul smell of rotten eggs)

   _____

   c) Carbon and oxygen (the gas which makes soft drinks fizz)

   _____

   d) Phosphorus and hydrogen (phosphine, a gaseous pesticide used in grain storage)

   e) Carbon and sulfur (a liquid, used in organic synthesis)

   _____

   f) Carbon and chlorine (a liquid, used in the past as a solvent in dry cleaning)

   _____

Name _____

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Chemistry – Unit 11 Worksheet 5
Lewis structures

Sketch Lewis dot diagrams for the following molecules.

1. CH_4

2. H_2O

3. NF_3

4. H_2O_2

5. C_2H_6

6. C_2H_4

7. C_2H_2

8. HCN

9. CH_3OCH_3

10. CH_3CH_2OH

11. CH_3COOH

12. CH_2O_2

Name _____

Veritas _____

Chemistry – Unit 11 Worksheet 6

Bond energy and electronegativity

Examine the bond dissociation energies for the molecules below.

Bond	Energy (kJ/mol)	Bond	Energy (kJ/mol)	Bond	Energy (kJ/mol)	Bond	Energy (kJ/mol)
F – F	159	I – F	271	F – F	159	H – F	570
Cl – Cl	243	I – Cl	211	F – Cl	256	H – Cl	431
Br – Br	193	I – Br	179	F – Br	280	H – Br	366
I – I	151	I – I	151	F – I	271	H – I	298
H – H	436						

Recall that energy is required to break a bond and is released when one is formed. Calculate the ΔH for the reaction $X_2 + Y_2 \rightarrow 2XY$.

Record your answers in the table below.

Bond	ΔH (kJ/mol)	Bond	ΔH (kJ/mol)	Bond	ΔH (kJ/mol)
I – F	-232	F – F		H – F	
I – Cl		F – Cl		H – Cl	
I – Br		F – Br		H – Br	
I – I		F – I		H – I	

1. What do you note about the sign of ΔH for the reactions above? Which combinations of atoms (homoatomic or heteroatomic) have lower chemical energy?

2. What generalization can you make about the value of ΔH and the position of the elements in the halogen column?

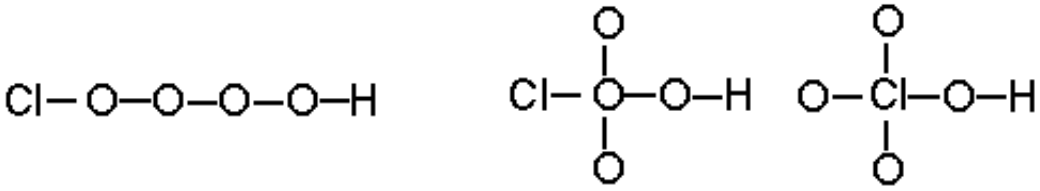
3. If you were to put hydrogen in the halogen family, where would you place it, based on your answer to #2?

Chemistry – Unit 11 Worksheet 7

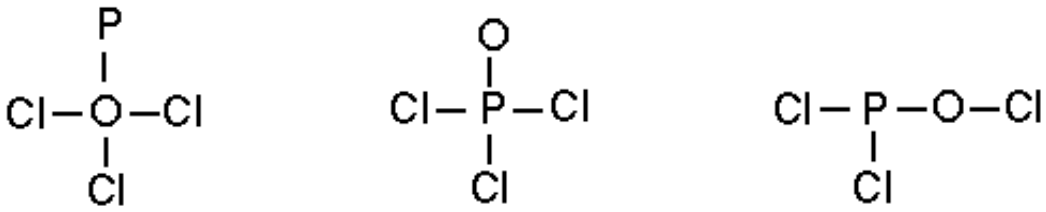
Electronegativity and molecular structure

Decide, based on the table of electronegativity values shown below, which one of the structures for each molecule is more energetically favorable than the others.

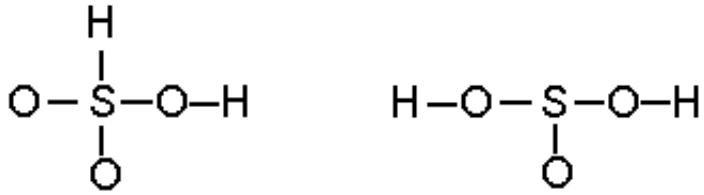
1. $HClO_4$



2. $POCl_3$



3. H_2SO_3



H 2.1																
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.9	Ni 1.9	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.6