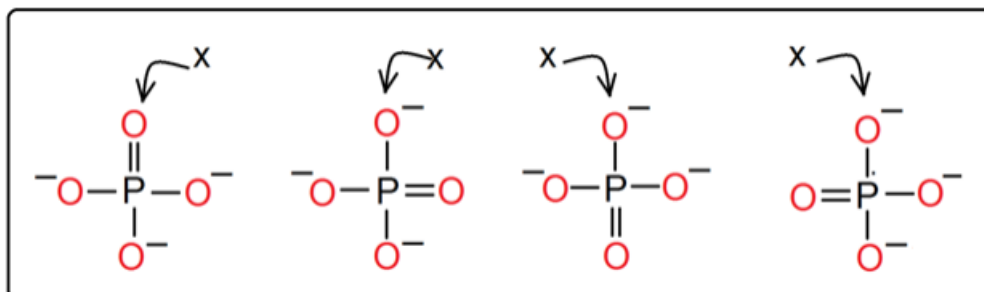


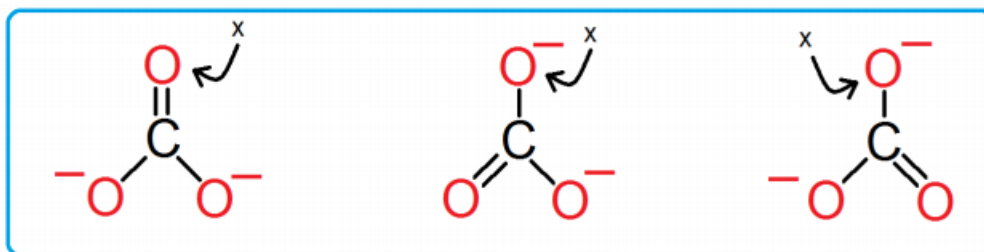
Your Name: _____

Directions: Due between 1900 and 2000, Friday, 4 December 2015. You may turn it in physically at my office or you may turn it in electronically via email attachment ... completed. If it's after 2000, it's late; if it's in complete, it's late; a zero will be recorded for your grade in either (or both cases).

1) According to resonance theory, each bond in the phosphate ion (PO_4^{3-}) is consistent with the observation that the four bonds in the phosphate ion have the same bond length. Given that the P–O bond energy is 376.6 kJ/bond and that the P=O bond energy is 460.2 kJ/bond, determine the bond energy for the O labeled "X" in the diagram, below.



2) According to resonance theory, each bond in the carbonate ion (CO_3^{2-}) is consistent with the observation that the three bonds in the carbonate ion have the same bond length. Given that the C=O bond energy is 745 kJ/bond and that the C–O bond energy is 358 kJ/bond, determine the bond energy for the O labeled "X" in the diagram, below.



3) When studying bonds between atoms, the phrase “bond order” is used. The bond order is defined as the number of bonding pairs of electrons between the atoms ...

Stability	Example	Structure	Number of Bonding Pairs	Energy	Bond Order
Most Stable	N ₂	N≡N	3	↑Energy	3
	O ₂	O=O	2		2
	O ₃	O=O—O	(2+1)/2 = 1.5		1.5
Least Stable	F ₂	F—F	1	↓Energy	1

... for molecules with localized bonds, i.e., the electrons don't contribute to resonance forms. Remember the bond energy problems with the resonant forms focusing on one atom as the bonds moved around, impacting the bond energy on one oxygen in previous worksheets? Note also that higher bond orders have shorter bond lengths, whereas, smaller bond orders have longer bond lengths. Do you see how this correlates with the stability as indicated in the above table? Armed with this knowledge, then, determine and illustrate the bond order of the following sets of atoms and determine which has the highest bond order; and based **only** on the bond order determine which molecule has the strongest bonds.

A) Hydrogen, nitrogen and chlorine

B) Fluorine, chlorine and bromine

C) Nitrogen, ozone and hydrogen

4) What mass of calcium carbonate is required to neutralize 50 mL of 18 M phosphoric acid? Write out the correctly balanced chemical reaction.

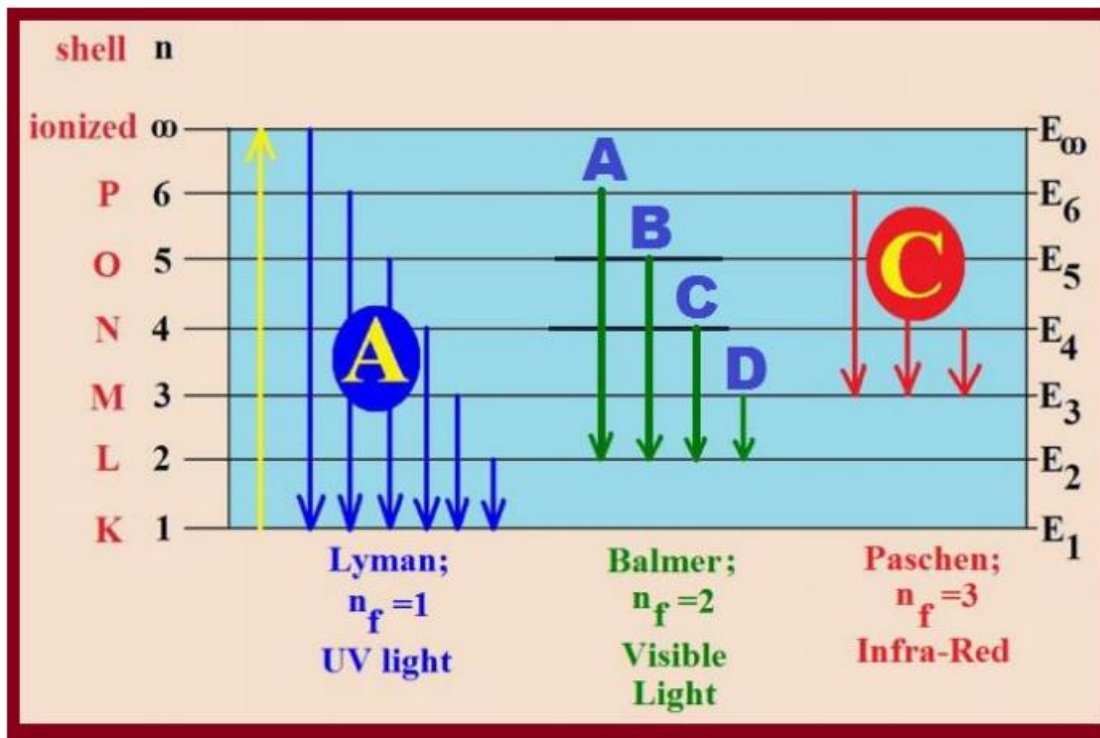
5) If you have 500 g of calcium carbonate and 10 mL 18M sulfuric acid, write out the correctly balanced reaction and determine the limiting reagent. Show your work.

6) List the rules of electrolytes.

7) Which of the following quantum numbers are permitted? Why aren't all permitted? Be detailed in your explanation.

Quantum Set	n	ℓ	m	s
A	1	0	0	$\pm\frac{1}{2}$
B	3	3	-2	$\pm\frac{1}{2}$
C	2	1	-2	$\pm\frac{1}{2}$
D	2	0	1	$\pm\frac{1}{2}$
E	3	1	-3	$\pm\frac{1}{2}$
F	4	2	-1	$\pm\frac{1}{2}$

8) Utilizing the graphic of the Lyman, Balmer and Paschen Series, below, which electron in the Balmer series gives off the shortest wavelength of light? Longest? How do you know?



9) Using the universal gas law, derive a formula to determine the density of a gas. Using your equation, determine the density of the 7-Up elements at 740 mm Hg and 68°F.

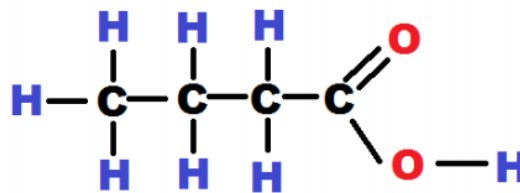
10) Explain Hunds' Rule and the Pauli Exclusion Principle.

11) Define isobar, isotone, isomer and isotope. Give examples of each not in the notes (You may have to use a Chemistry textbook).

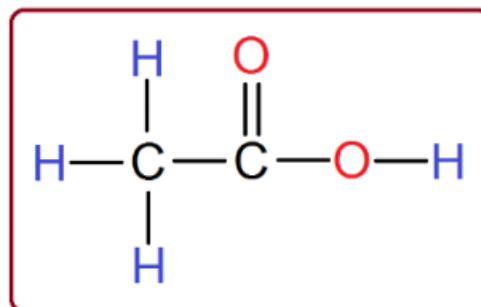
Average Bond Energies (kJ/mol)							
Single Bonds				Multiple Bonds			
H—H	432	N—H	391	I—I	149	C=C	614
H—F	565	N—N	160	I—Cl	208	C≡C	839
H—Cl	427	N—F	272	I—Br	175	O=O	495
H—Br	363	N—Cl	200			C=O*	745
H—I	295	N—Br	243	S—H	347	C≡O	1072
		N—O	201	S—F	327	N=O	607
C—H	413	O—H	467	S—Cl	253	N=N	418
C—C	347	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(CO₂) = 799

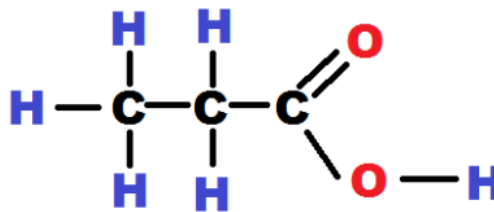
12) Using the above table, determine the ΔE for the following reaction: $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{C}\equiv\text{O} \rightarrow \text{HC}_4\text{H}_7\text{O}_2$. $\text{HC}_4\text{H}_7\text{O}_2$ has the following structure:



13) Using the above table, determine the ΔE for the following reaction: $\text{CH}_3\text{OH} + \text{C}\equiv\text{O} \rightarrow \text{HC}_2\text{H}_3\text{O}_2$. $\text{HC}_2\text{H}_3\text{O}_2$ has the following structure:



14) Using the above table, determine the ΔE for the following reaction: $\text{CH}_3\text{CH}_2\text{OH} + \text{C}\equiv\text{O} \rightarrow \text{HC}_3\text{H}_5\text{O}_2$. $\text{HC}_3\text{H}_5\text{O}_2$ has the following structure:



15) Write out and describe/explain the orbital hybridizations you studied for this course. Draw each corresponding molecular geometry.

16) If the mean velocity of a gas fits the equation:

Where $R = 8.314 \text{ J/mol/K}$, MW = molecular weight of the gas, T is in Kelvins and v = the speed of a gas in m/sec, what's the average speed of the following gases, below, at 25°C ? Show all of your work. Neglect units other than m/sec in your answers (NOTE: question starts with "If" ...)

$$v = \frac{3RT}{MW}$$

A) Hydrogen

B) Nitrogen

C) Oxygen

D) Fluorine

E) Chlorine

F) Bromine

G) Iodine

17) Define paramagnetism, diamagnetism and ferromagnetism. Could you identify one or the other by looking at the periodic table? How?

18) You have 10 grams of each of the following: hydrochloric acid, sulfuric acid, potassium dichromate, potassium oxalate, sodium sulfate and lithium nitrate. You need to dissolve each in 250 mL of water. What is the final M and N of each solution?

19) What's the percent composition of ammonium ion in magnesium ammonium phosphate?

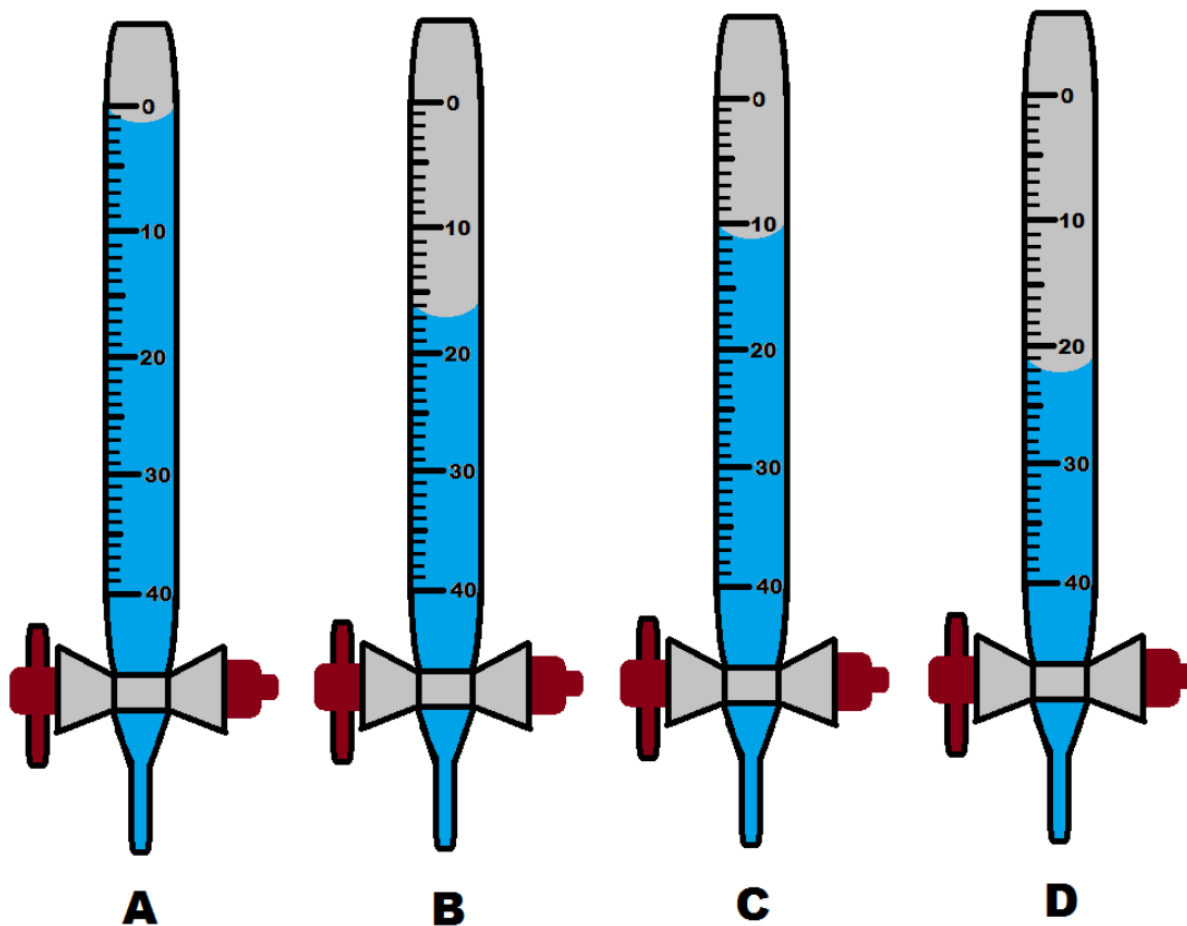
20) Complete the table below:

Ion	Number p ⁺	Number n	Number e ⁻
B ³⁺			
P ⁻⁵			
Br ⁻¹			
Ca ²⁺			
O ²⁻			
Sr ²⁺			

21) Using the following table of reactants and products, answer each part for each reaction.

Reaction	Reactant A	Reactant B	Product A	Product B
1	Cuprous oxide	Silver	Silver(I) oxide	Copper
2	Sodium nitrate	Zinc	Zinc (II) nitrate	Sodium
3	Dichromate ion	Potassium iodide	Chromium (III)	Iodine
4	Potassium permanganate	Oxalic acid	Manganese (II)	Carbon dioxide

If you produced 6 g of product B in the lab from each reaction, what's your percent yield in each reaction if you have 20 g of each reactant A and reactant B?



22) Given the above images of burets, determine the volume reading to the nearest significant figure.

23) Complete the following table – make sure to show your work.

	Mass of object (g)	Density (ρ) (g/cm ³)	Volume of Object (cm ³)
A	5.063	0.625	
B	7.264	1.348	
C	9.835	2.596	
D	11.642	0.684	

24) List the 4 oxy acids for Cl, Br and I by name and formula. Provide the oxidation state of the Cl, Br and I in each oxy acid. Show your work.

25) According to the Law of Conservation of Mass and the Law of Definite Proportions, 39 grams of potassium, 26 grams of chromium and 32 grams of oxygen will give you how many grams of potassium chromate? Write out the formula for potassium chromate, too.