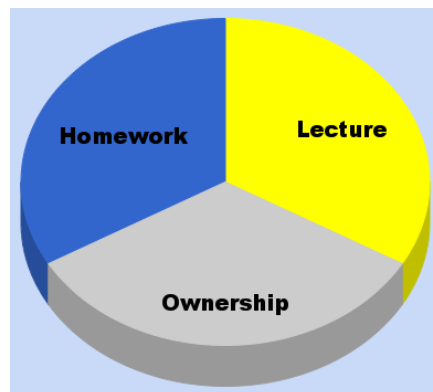


Your Name: \_\_\_\_\_

Directions: Complete this prior to class for turn in as you walk in Monday, 30 Nov 2015. Please make a copy for yourself as you will not be getting this worksheet returned. **Incomplete work will be recorded as a zero ("0").**



- 1) Using nomenclature from your lab experiment on naming chemicals, write the formulas for the following:
  - A) Potassium dichromate
  - B) Calcium silicate
  - C) Ferrous ammonium sulfate
  - D) Cuprous hydroxide
  - E) Aluminum hexafluorosilicate
  - F) Francium ammonium phosphate
  
- 2) Write the names of the formulas using nomenclature standards you learned in lab.
  - A)  $K_2CrO_4$
  - B)  $CaC_2O_4$

C)  $\text{H}_2\text{CO}_3$

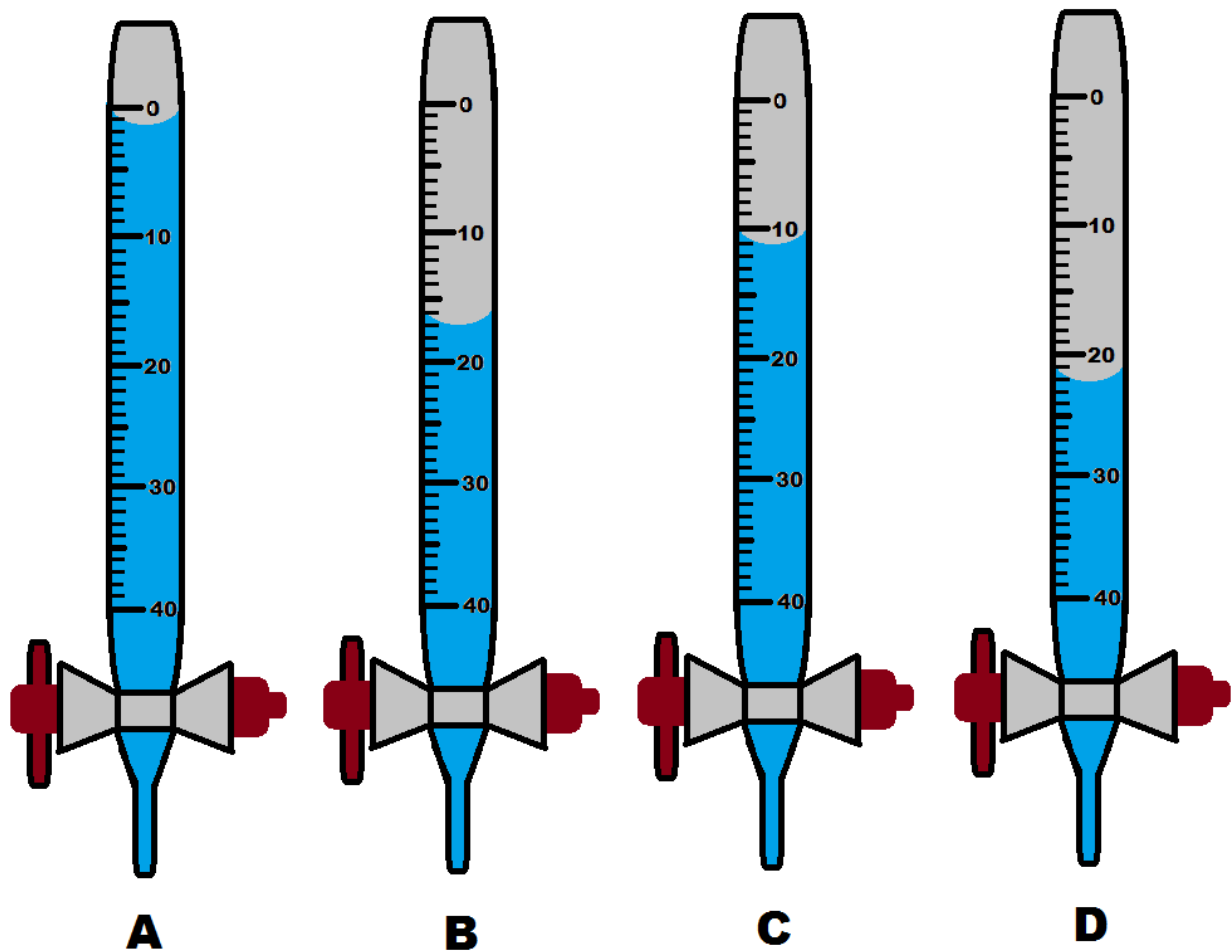
D)  $\text{KHCO}_3$

E)  $\text{Fe}_2(\text{CO}_3)_3$

F)  $\text{MgNH}_4\text{PO}_4$

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

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



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

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

|   | Mass of object (g) | Density ( $\rho$ ) (g/cm <sup>3</sup> ) | Volume of Object (cm <sup>3</sup> ) |
|---|--------------------|---|-------------------------------------|
| A | 5.063              | 0.625                                   |                                     |
| B | 7.264              | 1.348                                   |                                     |
| C | 9.835              | 2.596                                   |                                     |
| D | 11.642             | 0.684                                   |                                     |

7) Complete the table below:

| Ion              | Number p <sup>+</sup> | Number n | Number e <sup>-</sup> |
|------------------|-----------------------|----------|-----------------------|
| B <sup>3+</sup>  |                       |          |                       |
| P <sup>-5</sup>  |                       |          |                       |
| Br <sup>-1</sup> |                       |          |                       |
| Ca <sup>2+</sup> |                       |          |                       |
| O <sup>2-</sup>  |                       |          |                       |
| Sr <sup>2+</sup> |                       |          |                       |

8) 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 |

A) Write the formula for each reactant and product in the table.

B) Write out and completely balance each reaction.



C) In each reaction identify the reducing agent and the oxidizing agent.

D) If you have 20 g of each reactant A and reactant B, how much product C will you form from each reactant?





E) What's the limiting reagent in each reaction? Why?

F) If you produced 6 g of product C in the lab from each reaction, what's your percent yield in each reaction?

9) What's the percent composition of C in potassium oxalate?

10) What's the percent composition of potassium in potassium dichromate?

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

- 12) 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?

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

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

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  $25^\circ\text{C}$ ? Show all of your work.

A) Hydrogen

B) Nitrogen

C) Oxygen

D) Chlorine

E) Bromine

F) Iodine

G) Fluorine

14) Do you recognize the above gases in # 13? Collectively they're known as the what?

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

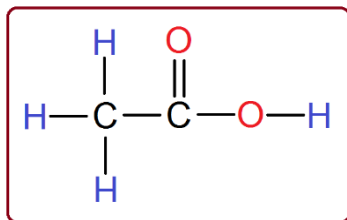
16) Write out and describe/explain the orbital hybridizations you studied for this course. Draw each corresponding molecular geometry.



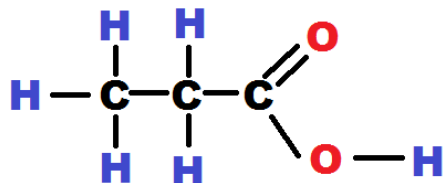
| Average Bond Energies (kJ/mol) |     |       |     |                |     |      |      |
|--------------------------------|-----|-------|-----|----------------|-----|------|------|
| Single Bonds                   |     |       |     | Multiple Bonds |     |      |      |
| H—H                            | 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(CO<sub>2</sub>) = 799

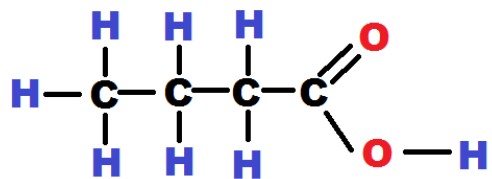
17) Using the above table, determine the  $\Delta E$  for the following reaction:  $\text{CH}_3\text{OH} + \text{C}\equiv\text{O} \rightarrow \text{HC}_2\text{H}_3\text{O}_2$ .  
 $\text{HC}_2\text{H}_3\text{O}_2$  has the following structure:



18) Using the above table, determine the  $\Delta E$  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:



19) Using the above table, determine the  $\Delta E$  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:



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

21) According to the Law of Conservation of Mass and the law of Definite Proportions:

A) 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.

B) 5 grams of calcium, 3 grams of carbon and 8 grams of oxygen will give you how many grams of calcium oxalate? Write out the formula for calcium oxalate, too.

C) 11 grams of strontium, 4 grams of sulfur and 8 grams of oxygen will give you how many grams of strontium sulfate? Write out the formula for strontium sulfate, too.

D) 27 grams of aluminum, 31 grams of phosphorus and 64 grams of oxygen will give you how many grams of aluminum phosphate? Write out the formula for aluminum phosphate.

22) Describe and illustrate the shapes of the s, p, d and f orbitals. How many subshells are in each orbital? How many electrons does each orbital hold in total?

23) Explain Hund's Rule and the Pauli Exclusion Principle.

24) Which of the following molecules is/are soluble in water? Which are insoluble?

A) LiOAc

B) AgCl

C) AgBr

D) NH<sub>4</sub>OAc

E) BaSO<sub>4</sub>

F) MgSO<sub>4</sub>

G) HgCl<sub>2</sub>

H) Hg<sub>2</sub>Cl<sub>2</sub>

I) CuS

J) CaCO<sub>3</sub>

K) SrCO<sub>3</sub>

L) Fe(OH)<sub>3</sub>

25) Explain, using the combined gas law, breathing.

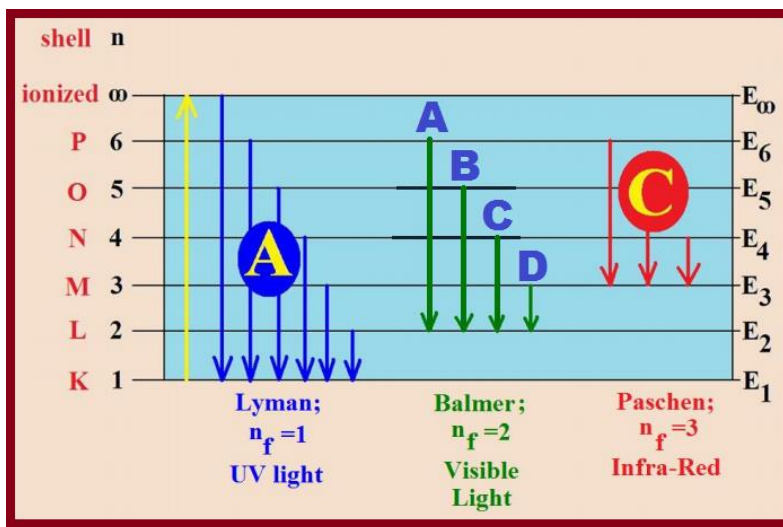
26) Using the universal gas law, derive a formula to determine the density of a gas.

27) Using your equation from #26, determine the density of the 7-Up elements at 740 mm Hg and 68°F.

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

| Quantum Set | n | $\ell$ | 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 | $\pm\frac{1}{2}$ |

29) 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?



30) List the rules of electrolytes.

31) 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.

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

33) 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 <sub>2</sub> | N≡N       | 3                       | ↑Energy | 3          |
|              | O <sub>2</sub> | O=O       | 2                       |         | 2          |
|              | O <sub>3</sub> | O=O—O     | (2+1)/2 = 1.5           |         | 1.5        |
| Least Stable | F <sub>2</sub> | 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?



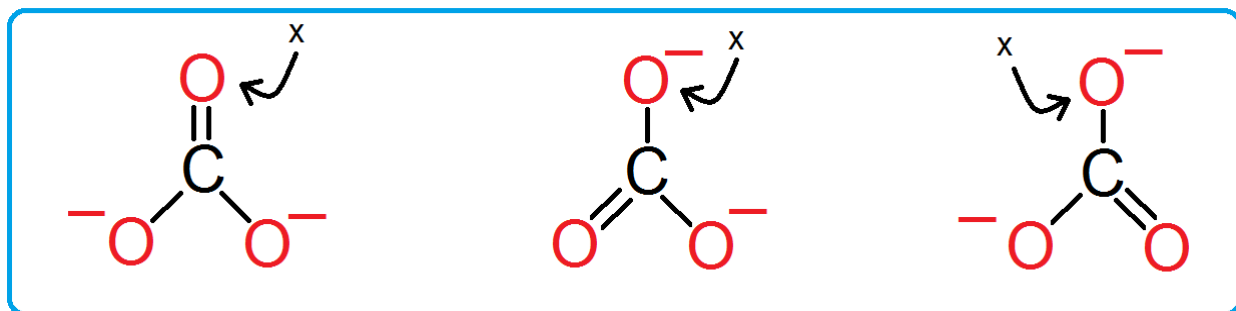
Armed with this knowledge, then, determine and illustrate the bond order of the following sets of atoms and determine which has the highest bond order; and based only on the bond order determine which molecule has the strongest bonds.

A) Hydrogen, nitrogen and chlorine

B) Fluorine, chlorine and bromine

C) Nitrogen, ozone and hydrogen

34) Here's something that will let you combine Lewis Structures (lab) with Thermochemistry (reading) in your spare time: <http://science.uvu.edu/ochem/index.php/alphabetical/q-r/resonance-theory/> According to resonance theory, each bond in the carbonate ion ( $\text{CO}_3^{2-}$ ) is consistent with the observation that the three bonds in the carbonate ion have the same bond length. Given that the  $\text{C}=\text{O}$  bond energy is 745 kJ/bond and that the  $\text{C}-\text{O}$  bond energy is 358 kJ/bond, determine the bond energy for the O labeled "X" in the diagram, below.



35) According to resonance theory, each bond in the phosphate ion ( $\text{PO}_4^{3-}$ ) 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.

