There will be a Unit Test on _____

Bring: A non-graphing calculator. YOU WILL NOT HAVE AN ION SHEET TO USE ON THIS TEST. You will need to be able to use a periodic table to determine the charge on ions (for "A" columns only.) (A periodic table will be given on the test.)

Worksheets to Study:

9.0, 9.1, 9.2, 9.3, 18.0, 18.1, 18.2, 4.00, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5.

You might also want to try the **practice quiz on light and electron configurations.** (It was on the back of WS 4.1, which was yellow)

See also the **final exam study guide** # 4, 5, 20-27.

Topics to Study:

Stoichiometry! (Chapter 9)

Given a chemical reaction, can you convert from moles, grams, or molecules of one reactant or product to moles, grams, or molecules of another reactant or product? You may need to balance the rxn first.
Limiting Reactants: If given two starting amounts of reactants, you should be able to:
- Determine the amount of product that can form
- Determine which reactant is limiting, and which reactant is excess

Percent Yield Calculations – Know the formula, and be able to use it.

(See pages 3 and 4 of this handout for some stoichiometry practice problems.)

Solutions and Concentration (covered in chapter 12 pages 387 and 388, and 404-407)
Solutions were covered in chapter 18 of the old book, which is why the worksheets were numbered 18.0 and 18.1…)

Know definitions and be able to apply them: Solute, Solution, Solvent, Dilute, Concentrated
Can you identify the solute and solvent in a given solution?
Know the definition for Molarity : Molarity = $\frac{\text{moles solute}}{\text{Liters solution}}$
Be able to solve for the molarity of a solution if given the mass or moles of solute, and the overall solution volume in liters or mL.
Be able to calculate the mass of solute that must be dissolved in a solution with a given volume and molarity.
Be able to use stoichiometry to determine the molarity of a solution.

(See pages 3 and 4 of this handout for some solutions practice problems.)

Continued, next page!

Light and Atomic Models (Chapter 4)

Electromagnetic Radiation.
Memorize and be able to use the formulas $E = h\nu$ and $c = \lambda\nu$.
(The value of h will be given, but the value for c will NOT.)
Know how to convert between meters and nanometers, and between Hertz and Megahertz or kilohertz.
(kilo = 10^3 and Mega = 10^6 will be given, but nano = 10^{-9} will NOT be given.)
Be able to rank the types of EM radiation according to energy, or frequency, or wavelength.
How are energy, frequency, and wavelength related; which have direct vs. inverse relationships?

~~Complementary Colors: What are the three pairs of complementary colors? If you are told the color that a solution absorbs the most strongly, can you determine the color a solution will appear, and explain?~~

Atomic Models:
Know rough dates (and order) for Dalton, Thomson, Rutherford, Bohr, and MQMM.
Be able to sketch and describe each of the above atomic models.
For Thomson, Rutherford, and Bohr: What part of the atom, or what about the atom, did they discover?
For Thomson, describe the experiment/equipment he used.
For Rutherford and Bohr, be able to explain:
What's the evidence for their atomic model? (What experiment(s) did they do, and what were the results?)
What was their logic: How did they use the experimental evidence to argue for their model?

Modern Quantum Mechanical Model (MQMM):
What is an orbital? Be able to draw an s, p, or d orbital.
Electron configurations for atoms: $1s^2 2s^2$ etc. **No chart** will be given for the order… you'll need to draw the chart yourself, or know the periodic table pattern.
Electron configurations for ions: $1s^2 2s^2$ etc. You'll need to be able to predict the charge on the ion based on the periodic table, like on WS 4.5
How does the periodic table relate to electron configurations?
For example, which section of the table is the d-filling section?
Which column's (which family's) electron configurations all end in s^1? p^5? (etc.)
Determine the number of valence electrons in an atom or ion.
How does the electron energy relate to n-level?
Does the electron have to absorb or emit energy to increase/decrease its n-level?
Why does low n-level generally correspond to low potential energy?
What parts of the atom are attracted to each other vs repelled by each other, and why?
Can you use the words "photon" , "quantum", "ground state" and "excited state"?

Be able to **compare and contrast** the different atomic models, for example:
Which/Whose models have charges within them?
Which have a nucleus?
Which contain electrons?
Which include the concept of "quantized energy levels"?
What is the difference between an "orbit" and an "orbital", and which models do these words fit with?

The Periodic Table (Chapter 4, and Chapter 5 pages 133 – 149)
Families vs Periods… which is which?
For a given element, is it more likely to have chemical properties similar to another element in its same period, or same family. Why?
Identify alkali metals, alkali earth metals, halogens, noble gases, lanthanides, actinides, representative elements, transition metals, inner transition metals.
For each "A" column, how many valence electrons do the elements have? Why?
For each "A" column, what type of ion does the element usually form? (what charge) How many electrons do the elements lose or gain when they form ions, and why?
What is the difference between an atom and an ion?
Metals and Nonmetals: Where are metals vs nonmetals found on the table?
How do metals and nonmetals compare in terms of chemical properties?

Stoichiometry Practice Problems:

Reaction: $2\ H_3PO_4 + 3\ Zn \text{ -----> } Zn_3(PO_4)_2 + 3\ H_2$

1a. If 30. grams of zinc react, what mass of zinc phosphate can form?
b. A solution contains 9.0 x 10^{22} molecules of phosphoric acid. What mass of zinc can react with this solution?
c. How many moles of zinc can react with 2.4 moles of phosphoric acid?
d. What mass of hydrogen gas can form, if 0.222 moles of phosphoric acid react?
e. How many Zinc atoms must react in order to form 100. grams of zinc phosphate?

2a. If 3.00 x 10^{23} phosphoric acid molecules are allowed to react with 3.44 grams of zinc, how many moles of zinc phosphate can form? Identify the limiting and excess reactants.
b. Suppose that in lab, 0.0169 moles zinc phosphate were collected when the reaction in (a) was done. Calculate the percent yield for the experiment.

3. If 0.323 moles of phosphoric acid are allowed to react with 1.2 x 10^{24} Zn atoms, what mass of hydrogen gas can form? Identify the limiting and excess reactants.

4. If 10.0 grams of phosphoric acid are allowed to react with 0.888 moles of Zn, how many molecules of hydrogen gas can form? Identify the limiting and excess reactants.

Solutions Practice Problems:

5. Identify the solute(s) and the solvent in each of these solutions:
a. A solution containing 175 g water and 250 grams salt.
b. A solution containing 175 g water and 250 g liquid propanol
c. $MgSO_{4(aq)}$
d. A mixture of gases containing 4 grams methane, 40 grams helium, and 400 grams of neon.
e. Gasoline that contains 80 mL C_8H_{18} per 30 mL C_7H_{16}.
f. $AlCl_{3(aq)}$

6. A solution was made by dissolving 78 grams of lithium sulfate into 389 mL of water. The total solution volume after dissolving was 421 mL.
a. Calculate the concentration of lithium sulfate in this solution.
b. If you needed to make 500. mL of 0.444 Molar lithium sulfate, what mass of lithium sulfate would you need to use?
c. Another solution has a volume of 750 mL, and contains 0.49 moles of lithium sulfate. Calculate the molarity of this solution.
d. If you have 2000. mL of 0.80 M lithium sulfate solution, and you heat the solution up in order to evaporate the water, what mass of solid lithium sulfate would remain?

7. An experiment is done to determine the concentration of a solution hydrochloric acid (HCl).
A solution of HCl is added to a beaker containing solid calcium carbonate. The HCl and calcium carbonate are allowed to react for two days, and the following data table is obtained:

Volume of HCl(aq) solution: 275 mL
Mass of beaker and $CaCO_3$ (before the reaction): 84.67 g
Mass of beaker and remaining $CaCO_3$ (after the reaction.): 72.89 g

a. Write the balanced reaction (with subscripts) that occurs between the HCl solution and the calcium carbonate.
b. Calculate the molarity of the hydrochloric acid.

8. An experiment is done to determine the concentration of a solution of sodium phosphate.
150. mL of the "unknown molarity" sodium phosphate solution are mixed with an excess of zinc chloride solution, and a white precipitate forms. The precipitate is filtered, washed, and dried in the oven.
11.4 grams of precipitate were formed in the reaction.
a. Complete the reaction that occurred (balance and do phase subscripts):

$Na_3PO_{4(aq)}$ + $ZnCl_{2(aq)}$ ------> _____

b. Which substance was the precipitate?_____
c. Based on the mass of precipitate that formed, use stoichiometry to calculate the moles of sodium phosphate that were in the sodium phosphate solution.
d. Calculate the molarity of the sodium phosphate solution.

9. Pure potassium dichromate, $K_2Cr_2O_7$, is an orange solid at room temperature. It dissolves into water to make an orange colored solution. Suppose that you have three solutions of potassium chromate dissolved in water.
"Solution 1" contains 0.118 moles of potassium dichromate, and has a volume of 200. mL.
"Solution 2" contains 0.257 moles of potassium dichromate, and has a volume of 750. mL.
"Solution 3" contains 0.348 moles of potassium dichromate, and has a volume of 650. mL.

~~a. What color would you expect the solutions to absorb the most strongly? explain.~~
b. Which of these solutions is most dilute?
c. Which of these solutions is the most concentrated?
~~d. If a few mL of each solution are placed in a cuvette in a spectrometer, which solution would have the highest absorbance of the color of light you chose in part (a)?~~
e. If you are going to make 800. mL of 0.300 molar $K_2Cr_2O_7$, what mass of potassium dichromate would you need to weigh out?

Answers: (See the website for the solutions with work shown)
1a. 59 g b. 15 g c. 3.6 moles d. 0.671 g e. 4.68×10^{23} atoms
2a. ~~0.249 moles~~ or 0.0175 moles. Phosphoric acid was excess, Zn was limiting b. 96.4% yield
3. 0.977 grams or ~~4.0 grams~~ Phosphoric acid was limiting, Zn was excess
4. 9.21×10^{22} molecules, or ~~5.35×10^{23}~~ molecules. Phosphoric acid was limiting, Zn was excess
5. Solutes: a. salt b. water c. MgSO4 d. methane and helium e. C7H16 f. AlCl3
Solvents: a. water b. propanol c. water d. neon, e. C8H18 f. water
6. a. 1.7 M b. 24.4 grams Li2SO4 c. 0.65 M d. 180 grams
7.a. 2 HCl(aq) + CaCO3(s) -----> CaCl2(aq) + H2O(liquid) + CO2 (gas) b. 0.860 M
8. a. 2 Na3PO4(aq) + 3 ZnCl2(aq) ------> 6 NaCl(aq) + Zn3(PO4)2(s)
b. Zn3(PO4)2 is the precipitate; it was the solid that formed. c. 0.0591 moles d. 0.394 M
~~9. a. blue. (see key online for explanation.)~~
b. Solution #2 was the most dilute (it had the lowest molarity of 0.343 M)
c. Solution #1 (it had the highest molarity of 0.590 M was the most concentrated.
~~d. Solution #1 was the most concentrated so will absorb the most light (highest absorbance.)~~
e. 70.6 grams

Other available practice problems (besides your worksheets!)
For EM radiation (light) and electron configurations, see the practice quiz on the back of WS 4.1.
For more practice with all topics, see the FINAL EXAM STUDY GUIDE, problems 4, 5, and 20-27.