Honor's Chemistry: *Fall Semester Final*   **Name**_____

1. Explain what is wrong with the statement "My friend burned a piece of paper (a hydrocarbon) that had the final exam on it and it *disappeared*". (Be sure to use a chemical equation, identify reactants and product(s) and include energy).

2. Write a balanced chemical equation for the reaction forming magnesium chloride precipitate from its elements. Draw a picture to help me visualize what is happening.

3. Identify three specific errors made during experiments that would disobey the scientific method.

4. Describe the difference between a natural law and a theory.

5. Suppose that you attempt to turn on a lamp, but the bulb does not light. Using the scientific method, describe how you might solve this problem. Be as complete as you can, and identify the elements of the scientific method in your explanation.

6. The substance looked *pale yellow* and had a *density of 3.6 g/mL*. It *burned readily in air*, and *produced bubbles when reacted with acid*. When heated, it *changed from solid to liquid at 79°C*, and from *liquid to gas at 143°C*.

    Identify the following properties as either   chemical   or   physical

a. _____ pale yellow

b. _____ density of 3.6 g/mL

c. _____ burned readily in air

d. _____ produced bubbles when reacted with acid

7. Is there any difference between the properties of pure water that has been boiled and condensed and the properties of pure water that has been frozen and then melted? Explain

8. You are given a flask that contains sea water that has been contaminated with oil. Some sand is also present in the flask. Describe how you would separate the sand, oil, sea salt, and water from each other.

9. Complete the following table:

Element (atom/ion)	Symbol	Atomic Number	No. of protons	No. of Neutrons	Mass Number	No. of electrons	Charge
		17		18		18	
		1		0			+1
sodium atom	$^{23}_{11}$Na						

10. Write the formula for the compounds that would be formed from the following ions:

Na^+ and Cl^- _____

Al^{3+} and Br^- _____

K^+ and S^{2-} _____

Mg^{2+} and Cl^- _____

11. Compare Rutherford's model of the atom to Thomson's model. Explain Rutherford's reasoning in developing his model

12. How might the results of Rutherford's experiment have been different if he had used aluminum foil (atomic number 13) rather than gold foil (atomic number 79)?

13. a   aluminum sulfide   _____

b. SF_2 _____

c. phosphorus trichloride   _____

d. $Zn(NO_3)_2$ _____

e. iron(III) oxide   _____

f. CuI

g. HNO_3 _____

h. aluminum hydroxide   _____

i. $CaBr_2$ _____

j. hydrochloric acid   _____

k. $Ba_3(PO_4)_2$ _____

l. magnesium sulfite   _____

m. $LiC_2H_3O_2$ _____

n. nitrogen trichloride   _____

o. $CuSO_3$ _____

p. sodium carbonate   _____

14. Round each number to the indicated number of significant figures and express it in scientific notation:

   a. 2501 (2 S.F)   _____

   b. 0.030490 (3 S.F)   _____

   c. 172590 (1 S.F.)   _____

   d. 40035.2 (2 S.F)   _____

15.
   a 12.6 m x 2.0 m x 13.84 m =   _____

   b. 13 cm + 10.4 cm + 1.25 cm =   _____

   c. $(1.360 \times 10^5 \text{ cm})$ x $(6.05 \times 10^{-2} \text{ cm})$ =   _____

   d. 11.63 mL − 8.8 mL =   _____

   e. $\dfrac{(12.36 \text{ g} - 11.25 \text{ g})}{10.31 \text{ mL}}$ =   _____

   f. $\dfrac{18.5 \text{ m}}{0.035 \text{ s}}$ =   _____

16. If 4 quarts = 1 gallon, and 1.06 quarts = 1 liter, how many liters are there in a 55.0 gallon container?

17. To three significant figures how many seconds are there in exactly 1 "microyear"?

18. Describe to a General Chemistry student how to make a measurement correctly

19. Your friend tells you that the number 1.2000 is more accurate than 1.2×10^0.
    Is your friend correct? Explain.

20. Your friend says that smoking a mercury-laced cigarette is cool. You aren't convinced
    and decide to look up the LD_{50} value of mercury. It is 0.4 mg/kg. Assuming you
    weigh 150 lbs and that 2.2 lb = 1 kg. How much mercury can you safely smoke?

21. List 3 intensive properties and 3 extensive properties of a BabyRuth candy bar.

         INTENSIVE   EXTENSIVE

22. Classify the following materials as elements, compounds, or mixtures:
       a. Lead (II) chloride   b. ozone   c. vinegar   d. heavy water   e. tin foil

23. Draw and label a phase diagram for a *non-pure* substance that has a melting point of ~22°C and a boiling point of ~89°F.

24. Which has more kinetic energy a 400 mg bullet moving at 250 m/s or a lead ball, moving at 0.01 m/s. The radius of the lead ball is 30 dm and the density of lead is 11.2 g/cm^3. [V = 4/3 π r^3]

25. Justify why or why not we should pursue an energy program of nuclear fusion in the United States. You need to explain the differences in fission and fusion, site advantages and disadvantages of each.

26. How much heat will be absorbed by a 20 g piece of ice (at 254 K) that is warmed to 150°F?

Latent heat of vaporization (H_2O) = 2256 J/g
Latent heat of fusion (H_2O) = 333 J/g
Specific heat of water (liquid) = 4.184 J/g°C
Specific heat of water (solid) = 2.077 J/g°C
Specific heat of water (gas) = 2.042 J/g°C

27. What is the final temperature of a 20 g block of ice (at 273 K) that is placed in 300 g of water (T = 50°C)

28. Explain how Archimedes principle would be used to determine if a gold crown was "pure" gold. What other information would you need to know to be certain?

29. Given the following: U-235

    a. Write the longhand and shorthand electron configuration for U-235

    b. How many protons ___, neutrons___, and electrons___ does the element have?

    c. Write the formula for an isotope of this element.

30. Given that light has a wavelength of 412 nm. What is its energy?

31. Draw an energy level diagram for an Al^{3-} anion. Be sure to explain how the Aufbau principle, Pauli exclusion principle and Hund's rule have been obeyed.

32. Compare and contrast the terms ions, atoms, and isotopes in subatomic structure

33. Calculate % a mass of an isotope "X": given that the average atomic mass of "X" is 54.3 g/mol and the element has only two isotopes (X-50 comprises 38% abundance).

34. Why do metals generally have lower ionizations energies than nonmetals?

35. What differences in atomic structure (microscopic) explain the observable (macroscopic) differences in salts and compounds made from two non-metals?

36. a) Draw the Lewis structure for the phosphite ion.

    b) What is the apparent charge on the P atom in the phosphate ion?

    c) What is the percentage composition in ammonium nitrite?

37. Which has more atoms: 396 g titanium (II) sulfate;

    2.3×10^{22} molecules trichloro nonaoxide or

    4.5×10^3 dm^3 of methane (CH_4) gas @ STP?   Show work for credit.

38. Find the mass, in grams, of 2.65×10^{24} molecules of Cl_2.
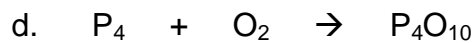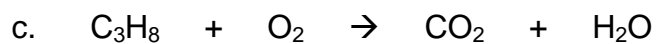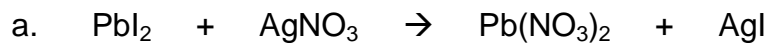
39. How many grams of sulfur are present in 83.2 g of sulfur dioxide?

40. How many hydrogen *atoms* are in 52.0 g of water?

41. Determine the empirical formula for a compound that contains 14.7 g of nickel and 40.0 g of bromine.
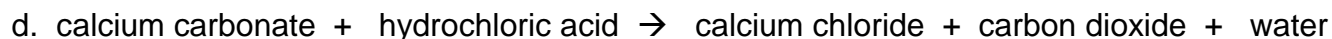
What is its molecular formula if its molecular mass is _____.

42. Balance the following chemical equations:

a. PbI_2 + $AgNO_3$ → $Pb(NO_3)_2$ + AgI

b. Mg + $TiCl_4$ → $MgCl_2$ + Ti

c. C_3H_8 + O_2 → CO_2 + H_2O

d. P_4 + O_2 → P_4O_{10}

e. Na_2CO_3 + HCl → $NaCl$ + CO_2 + H_2O

43. Write balanced equations for the following reactions:

a. zinc + hydrochloric acid → zinc chloride + hydrogen (gas)

b. barium chloride + ammonium sulfate → barium sulfate + ammonium chloride

c. calcium hydroxide + nitric acid → calcium nitrate + water

d. calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water

e. bromine + sodium iodide → sodium bromide + iodine

f. magnesium + iron(III) chloride → magnesium chloride + iron

44. Write a balanced chemical equation for the reaction, including abbreviations for the physical states.
   a. Lithium metal reacts with water to form aqueous lithium hydroxide and hydrogen gas.

   b. Iron(III) nitrate in water solution reacts with potassium sulfide in water solution to form aqueous potassium nitrate and solid iron(III) sulfide. Write a balanced chemical equation for the reaction, including abbreviations for the physical states.

45. Potassium chlorate ($KClO_3$) decomposes to form potassium chloride and oxygen gas. If 5.4 moles of potassium chlorate decompose, how many moles of oxygen could be produced?

59. What mass of $FeCl_2$ could be produced from 35.0 g of Fe and excess HCl if the balanced reaction is

$$Fe \quad + \quad 2\,HCl \quad \rightarrow \quad FeCl_2 \quad + \quad H_2$$
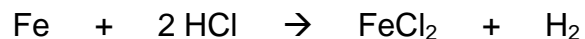
46. When ammonia burns in pure oxygen, the reaction is:

$$4\,NH_3 \quad + \quad 3\,O_2 \quad \rightarrow \quad 2\,N_2 \quad + \quad 6\,H_2O$$
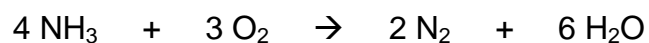
47. What masses of nitrogen and water could be produced from 45.0 g of ammonia?

48. Copper metal reacts with a solution of silver nitrate, $AgNO_3$, to produce copper (II) nitrate and silver metal. In carrying out this reaction, a piece of copper wire was immersed in a solution of silver nitrate until the reaction stopped. The original mass of the copper wire was 2.36 grams. After the reaction stopped, the mass of the wire was 1.03 grams. What mass of silver was produced?

49. If a piece of aluminum of mass 4.50 g and temperature 99.5^oC is dropped into 12.0 g of water at 21.0^oC, what will be the final temperature of the water-aluminum mixture? The specific heat capacity of aluminum is $0.902 \ J/(g \cdot \ ^oC)$.

50. Write electron configurations for each of the following. DO NOT use noble gas shorthand.

   a) Al

   b) Fe

   c) Sn

51. Identify the elements that have the following electron configurations. If the configuration shows the atom in an excited state, write the ground state configuration for the atom.

a) $1s^2 2s^2 2p^6 3s^2 3p^2$

b) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

c) $1s^2 2s^2 2p^3 3p^1$

52. Using atomic structure in your explanation, account for the general trend in atomic size as you go from left to right across a period and from top to bottom down a group on the periodic table.