Practice Problems: (From the Chemistry A Final Exam Review Sheet)

1. Titanium has a density of 4.5 g/cm^3.
a. Find the mass of 144 cubic centimeters of titanium.

b. Find the volume of 12.3 grams of titanium.

2. A metal's density is determined using water displacement.
Use the following data to calculate the density of the metal.

Mass of empty beaker: 62.33 g
Mass of beaker and chunk of metal: 78.73 grams
Initial water level in a graduated cylinder: 43.8 mL
Volume of water and metal together: 45. 9 mL

3. Make the following conversions:

a. 75 milligrams to grams

b. 6.00×10^7 micrograms (μg) to kilograms (kg)

c. 472 centimeters to feet

d. 8.0 feet per minute to millimeters per hour

e. 100. cubic inches to cubic centimeters.

f. 14.7 pounds per square inch to kilograms per square meter. (1 pound = 453.8 grams)

4. Round each calculator answer to the correct number of significant figures

a. 112.000 / 2.10 = 53.333333 ----->_____

b. 112.000 + 2.10 = 114.1 -----> _____

c. 12.5 x 16 = 200 ----->_____

d. 0.0022 x 198 = 0.4356 ----->_____

e. 3335.67 / 74.126 = 45 ---->_____

f. 75.9762 - 73.97 = 2.0062 ----->_____

g. 75.97 - 73.97 = 2 ----->_____

5.

Symbol	#protons	# neutrons	#electrons	mass#	charge	atomic #
$^{75}As^{+5}$	_____	_____	_____	_____	_____	_____
_____	_____	36	28	66	_____	_____
_____	_____	_____	54	131	_____	53
_____	_____	10	10	_____	-2	_____
_____	_____	_____	9	19	_____	9

6. How many protons and neutrons are in the most common isotope of phosphorus? p____ n_____

7. Iridium has two common isotopes. 62.7% of Iridium ions are Ir-193 (Mass = 192.963 amu) and the remainder are Ir-191 (mass = 190.9606 amu).
a. Calculate the atomic mass of iridium based on the data.

b. How many protons and neutrons are in Ir-193? p_____ n_____

c. How many protons and neutrons are in Ir-191? p_____ n_____

8. Give the symbol for four ions that have the same number of electrons as Neon._____

9. Formula Writing: Fill in the missing name or formula. Classify any compounds as ionic or covalent.

copper (II) sulfate	Iron (III) phosphate	zinc phosphate	chlorine
N_2O_4	PF_5	B_2O_3	Al_2O_3
Na_3PO_4	Cl_2O_7	$PbCO_3$	Sn_3N_4
ammonium carbonate	Iron (II) carbonate	Ag_2SO_3	SO_3
ferric hydroxide	CO_2	$SiBr_4$	Zinc acetate

NO	N_2O	Helium	nitrogen	CuO	Cu_2S

10. a. Write the formula for ferric iodide.

b. Write a balanced chemical equation for the reaction that would occur if iodine and iron reacted to form ferric iodide. Include phase subscipts.

c. Which element is oxidized in this reaction?

d. Which element is reduced in this reaction?

e. How many electrons (total) are transferred in the reaction?

f. What type of compound formed in this reaction? Explain how you know.

11. a. Which can more commonly form ions with an "ide" ending: <u>metals</u> or <u>nonmetals</u>?

b. Explain why, in terms of how metals and nonmetals change their numbers of electrons when they form ions.

Some ions end in "ide" and some end "ite" or "ate" (for example, "chloride" , "chlorite", "chlorate")
c. How are "ide" ions similar to "ite" ions?

d. How are "ide" ions different from "ite" ions?

e. How are "ate" ions similar to "ite" ions, and how are they different?

12. Moles! Make the following conversions.
a. 3.08×10^{22} iron atoms to moles

b. 3.32 grams of hydrogen gas to moles

c. 10.0 moles of carbon dioxide to grams

d. 3.2×10^{20} molecules of carbon dioxide to grams.

e. 3.2×10^{20} molecules of carbon dioxide to atoms.

f. 24 grams of iron to atoms.

13. a. Determine the percent composition of each element in $(NH_4)_2S$.

b. How many grams of nitrogen are in 20.0 grams of ammonium sulfide?

c. What mass of carbon is in 15.0 grams of glucose sugar ($C_6H_{12}O_6$)?

d. If you needed to extract 20.0 kg iron from iron III oxide, what mass of iron III oxide would you start with?

14. a. What is the empirical formula of $C_8H_{12}O_4$?

b. A compound with a molecular weight of roughly 80 amu is 85.7% carbon (by weight), and the remainder is hydrogen. Find the empirical formula and the molecular formula.

c. A compound is 26.6 %potassium, 35.3% chromium, and 38.1% oxygen by mass. Find the empirical formula.

15. A crucible containing copper powder is heated until the copper oxidizes to form copper oxide. The following data is obtained:

Mass of crucible: 26.000 g
Mass of crucible and copper powder (before reaction): 27.021 g
Mass of crucible and copper oxide product (after reaction): 27.272 g

a. Determine these masses:

the mass of copper powder, before the reaction:

the mass of copper oxide that formed:

the mass of oxygen that bonded with copper:

b. What is the percent oxygen in the copper oxide product?

c. Was the product copper (I) oxide or copper (II) oxide? (which one)

16. An experiment was done to determine the percent iron in iron (III) sulfate. Some solid iron (III) sulfate was dissolved into water, and then was reacted with Zinc in a single replacement reaction. The iron that formed was washed, dried, and weighed, and the following data was obtained.

Mass of empty beaker: 54.44 g
Mass of beaker and solid iron (III) sulfate: 58.84 grams
Mass of empty evaporating dish: 42.21 grams
Mass of evaporating dish and iron powder that formed: 43.47 grams

a. Use the lab data to calculate the percent iron in iron (III) sulfate.

b. Write the formula for iron (III) sulfate.
c. Use your formula to calculate the book value for the percent iron in this compound.

d. What was the percent error for the experiment?

e. Write a balanced reaction for zinc reacting with the iron (III) sulfate, with phase subscripts.

17. An experiment was done to determine molarity of a hydrochloric acid solution. The solution of hydrochloric acid is added to some zinc wire in a beaker, and is allowed to react for several days. The zinc wire that remains after the reaction is washed, dried, and weighed. The same beaker was used throughout the experiment, and the following data was obtained:

Volume of acid used (measured by grad. cylinder): 60.0 mL
Mass of empty beaker: 52.00 g
Mass of beaker and zinc wire (before the reaction): 58.33 grams
Mass of beaker and zinc wire (after drying in the oven): 56.77 grams

a. Write the reaction that occurred between zinc and hydrochloric acid. Include subscripts.

b. Determine the mass of zinc that was consumed by the reaction with HCl.

c. Use stoichiometry to determine the moles of HCl required to react with the mass of zinc calculated in (b).

d. Recall that the formula for a solution's molarity is equal to the moles solute per liter solution. Calculate the molarity of the HCl solution.

e. What would be a sign that the reaction was complete.. how would the contents of the beaker look when the HCl was first added, vs how would it look after the reaction was done?

f. Which substance was the limiting reactant in this experiment?

18. Reactions! Predict products for each reaction. A few are N.R. Do phase subscripts and balancing.

a. $Ca_{(s)} + N_{2(g)}$ ------>_____

b. $FeCl_{3(aq)} + Ag_2SO_{4(aq)}$ ------>_____

c. $Al_{(s)} + Ni(NO_3)_{2(aq)}$ ------>_____

d. $C_4H_{10(l)} + O_{2(g)}$ ------>_____

e. $HNO_{3(aq)} + Al_{(s)}$ ------>_____

f. $H_2O_{(l)} + Al_{(s)} +$ ------>_____

g. $C_{10}H_{16}O_{(l)} + O_{2(g)}$ ------>_____

h. $HCl_{(aq)} + Li_2CO_{3(aq)}$ ------>_____

i. $K_{(s)} + O_{2(g)}$ ------>_____

j. $F_{2(g)} + FeCl_{3(aq)}$ ------>_____

k. $C_3H_7OH_{(l)} + O_{2(g)}$ ------>_____

l. $Zn_{(s)} + Al(NO_3)_{3(aq)}$ ------>_____

m. $P_{(s)} + Na_{(s)}$ ------>_____

n. $I_{2(s)} + NaCl_{(aq)}$------>_____

o. $Al(NO_3)_{3(aq)} + NaCl_{(aq)}$ ------>_____

p. $HCl_{(aq)} + LiOH_{(aq)}$ ------>_____

q. $FeCl_{3(aq)} + AgNO_{3(aq)}$ ------>_____

r. $Pb(NO_3)_{4(aq)} + Zn_{(s)}$ ------>_____

s. $Pb_{(s)} + H_2O_{(l)}$ ------>_____

t. $Al_{(s)} + HC_2H_3O_{2(aq)}$ ------>_____

u. $HNO_{3(aq)} + MgCO_{3(s)}$ ------>_____

v. $Al(NO3)3 + Li2CO3_{(aq)}$ ------>_____

w. $K_{(s)} + Cl2_{(g)}$ ------->_____

19. $3\ Zn_{(s)} + 7\ H_2SO_{4(aq)} + K_2Cr_2O_{7(aq)} \text{ -----> } Cr_2(SO_4)_{3(aq)} + 7\ H_2O_{(l)} + 3\ ZnSO_{4(aq)} + K_2SO_{4(aq)}$

a. If 10.0 grams of sulfuric react, what mass of zinc sulfate will be produced?

b. If 6.55 grams of zinc sulfate are collected in (a), what was the percent yield?

c. How many moles of sulfuric acid are needed to produce 0.211 moles of chromium sulfate?

d. How many water molecules will form, if 1.1×10^{21} zinc atoms react?

20. $2\ Fe_{(s)} + 6\ HCl_{(aq)} \text{ -------> } 2\ FeCl_{3(aq)} + 3\ H_{2(g)}$

a. If 50.0 grams of iron are allowed to react with 85.0 grams of HCl, how many grams of iron chloride can form?

$$2\ Fe_{(s)} + 6\ HCl_{(aq)} \text{ -------> } 2\ FeCl_{3(aq)} + 3\ H_{2(g)}$$

b. If 1.0×10^{23} iron atoms are allowed to react with 22.0 grams of acid, how many moles of hydrogen gas can form?

c. If 0.10 moles of iron are allowed to react with 14.2 grams of acid, what mass of hydrogen gas can form?

Suppose that a 0.100 mole piece of iron is placed into a solution containing 0.200 moles of hydrochloric acid, and is left alone for a few days.

d. When the reaction is done, how many moles of hydrogen gas should have formed?

e. What one of these shows reasonable values for the amounts of Fe and HCl that are leftover after the rxn? You should be able to choose the right answer without doing any more math.

a. 0.000 moles of iron, and 0.150 moles of HCl
b. 0.000 moles of iron, and 0.250 moles of HCl
c. 0.133 moles of iron, and 0.000 moles of HCl
d. 0.033 moles of iron, and 0.000 moles of HCl

21. For each atom or ion:
a. Write the electron configuration.
b. Underline the valence electrons, and indicate the number of valence electrons it has.

Am	At
Cs	C
Ge	magnesium ion
Nb	bromide ion

c. Give the formula for 3 other ions (include at least 1 cation and 1 anion) that have the same number of electrons as bromide ion.

d. Give the formula for 3 ions (include at least 1 cation and 1 anion) that have the same number of electrons as Xenon.

22. For each pair, which "thing" has more energy?
(assume that the electrons mentioned are in the same type of element.)

a. An electron in a 4s orbital or An electron in a 3s orbital

b. EM radiation with a frequency of 1.21×10^{14} Hz. or with a frequency of 8.21×10^{13} Hz.

c. An electron in a 5s orbital or An electron in a 5f orbital

d. EM radiation with a wavelength of 1774 nm, or with a wavelength of 344 nm.

e. yellow light or green light

f. An electron that is 0.2 nm away from the nucleus, or an electron that is 0.08 nm away from the nucleus.

23. For each pair, indicate whether they are attracted to or repelled by each other, and explain your answer.

a. the nucleus and an electron

b. an electron and another electron

c. an electron and a proton

24. Use your answer(s) to #24 to explain why higher n-level has higher/lower (which one?) potential energy.

25a. Determine the frequency, in MegaHertz, of EM radiation with a photon energy of 6.99×10^{-26} J.

b. Determine the energy, in Joules, of EM radiation with a wavelength of 4.1 nm.

c. Find the wavelength, in nm, of EM radiation with a frequency of 1.21×10^{14} Hz.