Chemistry 115 – Exam 2 Study Guide

Know the definitions/meaning of aqueous, Avogadro’s number, molecule, formula unit, stoichiometry, endothermic, exothermic, limiting reactant, excess reagent, percent yield, mole, radioactivity, nuclear chemistry, radioisotope, alpha particle, beta particle, gamma ray, radioactive decay, positron, half-life, fission, fusion.

Know your nomenclature.

Know how to convert from grams to moles to molecules/formula units/ atoms and back.

Know how to determine empirical formulas and molecular formulas from percent composition and molar mass data.

Know how to write and balance chemical equations. Be able to evaluate single replacement reactions to develop an activity series. Be able to predict the products of single replacement reactions given activity series data (similar to the lab).

Know how to do stoichiometry from moles to moles, from gram to gram, from particle to particle, or any combination of the above. Be able to determine the limiting reagent and the amount of product produced when known quantities of two substances react. Be able to calculate a percent yield. Know how to calculate the heat absorbed or evolved from a reaction using stoichiometry. Know how to write nuclear reactions and predict products of , , or  decay, how to determine half-lives and percent decay for nuclear reactions

Below are some problems that may be similar to some of the problems on the exam.

1. Name the following compounds
   1. Na3BO3
   2. NCl3
   3. BeCO3
   4. Li2O
   5. TiF3
   6. IBr2
   7. K3PO3
   8. MgSO4
   9. CuClO4
   10. PBr5
   11. Zn(IO3)2
   12. Ba3(PO4)2
   13. MnSO3
   14. SO2
   15. V(BrO2)3
   16. XeF6
   17. SeS3
   18. Al(ClO)3
   19. NaCN
   20. Cd3N2
   21. CO
2. Write formulas for the following compounds
   1. Cesium phosphate
   2. Iron(II) fluoride
   3. Lithium carbonate
   4. Cobalt(III) sulfate
   5. Carbon tetraiodide
   6. Sodium perchlorate
   7. Barium iodite
   8. Potassium phosphate
   9. Nickel(III) borate
   10. Cadmium nitrate
   11. Sodium acetate
   12. Dibromine octoxide
   13. Silver hypobromite
   14. Aluminum sulfide
   15. Chromium(II) nitrite
   16. Cuprous sulfite
   17. Ammonium hydroxide
   18. Sodium chromate
   19. Potassium permanganate
3. Calculate the mass of 3.64 moles of zirconium.
4. How many moles of vanadium are there in 7.53 g of vanadium?
5. How many atoms of titanium are there in 5.24 moles of titanium?
6. How many moles of magnesium are there in 5.29 x 1021 atoms of magnesium?
7. What is the mass of 8.21 x 1025 atoms of sulfur?
8. How many atoms are in 7.22 g of xenon?
9. Calculate the molar mass of vanillin, C8H8O3.
10. Calculate the mass of 5.28 moles of vanillin
11. Calculate the number of molecules of vanillin in 82.9 moles of vanillin
12. Calculate the number of atoms of carbon in 35 molecules of vanillin
13. Calculate the number of molecules of vanillin in a bottle of vanilla containing 65.0 mg of vanillin.
14. Calculate the molar mass of naphthalene, C10H8.
15. Calculate the moles of naphthalene containing 6.29 x 1024 molecules of naphthalene
16. Calculate the mass of one molecule of naphthalene.
17. Calculate the mass of naphthalene containing 6.08 moles of carbon
18. Determine the empirical formula of ethyl butyrate, the principle component of pineapple oil. It is composed of 62.04% C, 10.41% H and 27.55% O
19. Determine the empirical formula of methyl butyrate, the principle component of apple flavor. It is composed of 58.80% C, 9.87% H, and 31.33% O
20. Determine the empirical formula of benzyl acetate, the scent of jasmine. It is composed of 71.98%C, 6.71%H, 21.31%O
21. Determine the empirical formula of acetaminophen, the active ingredient in Tylenol. It is composed of 63.56%C, 6.00%H, 9.27%N, and 21.17%O.
22. Determine the empirical formula of naproxen, the active ingredient in Aleve. It is composed of 73.03%C, 6.13%H, and 20.84%O.
23. Nicotine, a stimulant found in tobacco, has the following mass percent composition: 74.10%C, 8.70%H, 17.27%N. The molar mass of nicotine is 162.23 g/mol. Find the molecular formula of nicotine.
24. The following are molar masses and empirical formulas of several compounds containing carbon and other elements. Find the molecular formula of each compound.
    1. 163.26 g/mol, C11H17N
    2. 186.24 g/mol, C6H7N
    3. 312.29 g/mol, C3H2N
    4. 284.77 g/mol, CCl
    5. 131.39 g/mol, C2HCl3
    6. 181.44 g/mol, C2HCl
25. Write balanced chemical equations for each of the following:
    1. Solid copper reacts with solid sulfur(S8) to form solid copper(I) sulfide(Cu2S).
    2. Sulfur dioxide gas(SO2) reacts with oxygen gas(O2) to form sulfur trioxide gas(SO3)
    3. Aqueous hydrochloric acid(HCl) reacts with solid manganese(IV) oxide (MnO2) to form aqueous manganese(II) chloride(MnCl2), liquid water, and chlorine gas.
    4. Liquid benzene(C6H6) reacts with gaseous oxygen(O2) to form carbon dioxide(CO2) and liquid water(H2O).
    5. Solid magnesium reacts with aqueous copper(I) nitrate to form aqueous magnesium nitrate and solid copper.
    6. Gaseous dinitrogen pentoxide decomposes to form nitrogen dioxide and oxygen gas.
    7. Solid calcium reacts with aqueous nitric acid to form aqueous calcium nitrate and hydrogen gas.
26. Balance the following chemical equations
    1. Na2S + Cu(NO3)2 🡪 NaNO3 + CuS
    2. HCl + O2 🡪 H2O + Cl2
    3. H2 + O2 🡪 H2O
    4. FeS + HCl 🡪 FeCl2 + H2S
    5. BaO2 + H2SO4 🡪 BaSO4 + H2O2
    6. Co(NO3)3 + (NH4)2S 🡪 Co2S3 + NH4NO3
    7. Li2O + H2O 🡪 LiOH
    8. Hg2(C2H3O2)2 + KCl 🡪 Hg2Cl2 + KC2H3O2
    9. C6H14 + O2 🡪 CO2 + H2O
    10. C3H8 + O2 🡪 CO2 + H2O
    11. C8H18 + O2 🡪 CO2 + H2O
27. ~~If chromium(II) chloride reacts with calcium metal to form calcium chloride and chromium metal, write the balanced chemical equation for the reaction and tell which element is more active.~~
28. ~~If silver metal will not react with a solution of magnesium chloride, tell which metal is more active.~~
29. ~~Given the following activity series~~

~~Ca > Cu > Ni~~

~~Will a sample of copper metal react with nickel(II) chloride?~~

~~Will a sample of copper metal react with calcium chloride?~~

Consider the following balanced equation and use it to answer questions 30-36

2 N2H4(g) + N2O4(g) 🡪 3 N2(g) + 4 H2O(g)

1. How many molecules of N2 will be produced by the reaction of 16 molecules of N2H4 with excess N2O4?
2. How many moles of N2O4 are required to react with 5.34 moles of N2H4?
3. How many grams of water will be formed by the reaction of 9.35 g of N2O4 with excess N2H4?
4. How many moles of N2 will be produced from the reaction of 3.43 x 1025 molecules of N2H4 with excess N2O4?
5. How many molecules of water will be produced from the reaction of 15.0 grams of N2H4 with excess N2O4?
6. How many moles of N2 will be formed from the reaction of 4.36 moles of N2H4 with 3.62 moles of N2O4?
7. If 35.6 grams of water are formed from the reaction of 72.4 grams of N2H4 and 62.6 grams of N2O4, what is the percent yield?
8. If this reaction is exothermic, is heat a reactant or a product?
9. Write balanced nuclear equations for the alpha decay of each of the following nuclides
10. Write balanced nuclear equations for the beta decay of each of the following nuclides
11. Supply the missing symbol in each of the following nuclear equations
12. The half-life of sodium-24 is 15.0 hr. How many grams of this nuclide in a 4.00 g sample will remain after 60.0 hr?
13. Determine the half-life of a nuclide if after 1024 hours 3.12% of the sample remains?
14. Technetium-99 has a half-life of 6.0 hr. What percentage of the sample will remain undecayed after 36 hours? What percentage of the sample will decay after 48 hours?
15. Contrast the abilities of alpha, beta, and gamma radiations to penetrate a thick sheet of paper.
16. Why are the radionuclides used for diagnostic procedures usually gamma emitters?
17. What are some applications of nuclear chemistry to medicine?