Second semester final exam review problems

\_\_\_\_\_\_\_\_\_\_\_\_1. Aluminum reacts with a solution of copper II chloride to produce copper metal and aluminum chloride. What is the number of moles of copper produced when 4.30 grams of aluminum react?

\_\_\_\_\_\_\_\_\_\_\_\_2. What is the mass of sodium chloride when 2.0 grams of copper II chloride react with excess sodium carbonate solution?

\_\_\_\_\_\_\_\_\_\_\_\_3. What is the mass of lead II chloride if 4.5 grams of copper II chloride react with lead II nitrate solution in excess?

\_\_\_\_\_\_\_\_\_\_\_\_4. What is the mass of sodium sulfate if 3.9 gram of iron II sulfate react with a sodium hydroxide solution in excess?

\_\_\_\_\_\_\_\_\_\_\_\_5. What is the minimum number of moles of O2 needed to produce 12.0 mole of CO2 for the reaction:

**2CO  (g) + O2  (g) → 2CO2 (g)**

\_\_\_\_\_\_\_\_\_\_\_\_6. What volume of O2 at STP must react to give 80 dm3 of CO2 at STP for the reaction:

**2CO  (g) + O2  (g) → 2CO2 (g)**

7. A 11.5 grams sample ofsodium reacts according to the reaction below.:

**2Na (s)  + 2H2O → 2NaOH(aq) + H2 (g)**

\_\_\_\_\_\_\_\_\_\_\_\_what is the volume of H2 produced at STP?

\_\_\_\_\_\_\_\_\_\_\_\_b. What is the mass of the sodium hydroxide produced?

8. When 6.40 g of CH3OH was mixed with only a slight excess of oxygen and allowed to react, 6.12 g of CO2 was obtained.

\_\_\_\_\_\_\_\_\_\_\_\_a. Based on the equation above, what was the theoretical yield (in grams) of CO2 in this experiment.

\_\_\_\_\_\_\_\_\_\_\_\_b. What was the actual yield of CO2 in this experiment in grams?

\_\_\_\_\_\_\_\_\_\_\_\_c. What was the percentage yield of CO2

\_\_\_\_\_\_\_\_\_\_\_\_9. An impure sample of aluminum sulfate is analyzed by forming a precipitate of barium sulfate in the following reaction

Al2(SO4)3 + 3 BaCl2 → 3 BaSO4 + 2 AlCl3

After washing and drying the precipitate, 2.00 g of barium sulfate is measured. If the original sample weighed 2.50 g, what was the percent purity of the original sample of aluminum sulfate?

10. If a 50 gram sample of magnesium reacts with 25 dm3 of oxygen

\_\_\_\_\_\_\_\_\_\_\_\_a. which reactant is limiting

\_\_\_\_\_\_\_\_\_\_\_\_b. Which reactant is in excess by how many grams?

\_\_\_\_\_\_\_\_\_\_\_\_c. How many grams of magnesium oxide form?

11. Ammonium chloride reacts with calcium hydroxide. If 227 grams of ammonium chloride reacts with 285 grams of calcium hydroxide,

\_\_\_\_\_\_\_\_\_\_\_\_which reactant is limiting

\_\_\_\_\_\_\_\_\_\_\_\_How many grams of calcium chloride form?

\_\_\_\_\_\_\_\_\_\_\_\_ 12. Sulfur dioxide reacts with dihydrogen sulfide to produce sulfur and water. When 7.50 g of dihydrogen sulfide reacts with 12.75 g of sulfur dioxide, a student gets 9.6 g sulfur in lab. What is the percent yield of the reaction?

13. In a reaction chamber, 3.00 grams of Al is mixed with 5.3 g of Cl2 to form AlCl3.

\_\_\_\_\_\_\_\_\_\_\_\_What is the limiting reactant?

\_\_\_\_\_\_\_\_\_\_\_\_What is the mass of product formed?

\_\_\_\_\_\_\_\_\_\_\_\_What is the mass of the excess unreacted?

14. A 80.0 g of copper reacts with 25.0 g of sulfur to form copper I sulfide.

\_\_\_\_\_\_\_\_\_\_\_\_What is the limiting reactant?

\_\_\_\_\_\_\_\_\_\_\_\_What is the mass of product formed?

\_\_\_\_\_\_\_\_\_\_\_\_What is the mass of the excess unreacted?

Heat and Energy problems

\_\_\_\_\_\_\_\_\_\_\_\_15. How much heat is released when 250 g of water changes to ice at 0oC?

\_\_\_\_\_\_\_\_\_\_\_\_16. What quantity of ice can be melted by 2.9 x 104 J of heat at 0oC?

\_\_\_\_\_\_\_\_\_\_\_\_17. What quantity of ice at 0oC will be melted by 1.18 x 104 J of heat?

\_\_\_\_\_\_\_\_\_\_\_\_18. What is the total amount of heat required to change 150 g of ice to steam?

19. Use your enthalpy of formation chart to calculate the ∆Hrxn of the following:

\_\_\_\_\_\_\_\_\_\_\_\_2 NH3 + 3 O2 + 2 CH4 → 2 HCN + 6 H2O(g)

\_\_\_\_\_\_\_\_\_\_\_\_Ca3(PO4)2 + 2 H2SO4 → 3 CaSO4 + 2 H3PO4

\_\_\_\_\_\_\_\_\_\_\_\_NH3 + HCl(g) → NH4Cl

\_\_\_\_\_\_\_\_\_\_\_\_C2H5OH + 3 O2 → 2 CO2 + 3 H2O

\_\_\_\_\_\_\_\_\_\_\_\_20. What is the final temperature when 5.0 g of Fe (specific heat capacity = 0.452 J/gºC) at 150 ºC is added to 100 mL of water at 25 ºC.

\_\_\_\_\_\_\_\_\_\_\_\_21. How many joules are needed to raise the temperature of iron that has a mass of 7.05 g from 25 ºC to 100 ºC. (The specific heat of iron = 0.452 J/gºC)

22. 5.0 grams of a substance is burned in a calorimeter. 120 kJ of energy is absorbed by the water.

\_\_\_\_\_\_\_\_\_\_\_\_If 250 mL of water starts at 21 ºC, what is the final temperature of the water?

\_\_\_\_\_\_\_\_\_\_\_\_What is the heat given off by the sample per gram?

\_\_\_\_omit\_\_\_\_\_\_\_\_23.

C2H4 (g) + 3 O2 (g) → 2 CO2 (g) + 2 H2O (l) ∆ H = - 845.2 kJ/mol

 2 H2 (g) + O2 (g) → 2 H2O (l) ∆ H = -573.2 kJ/mol

 2 C2H6 (l) + 7 O2 (g) → 4 CO2 (g) + 6 H2O (l) ∆ H = - 1987.4 kJ/mol

overall reaction:

 C2H4 (g) + H2 (g) → C2H6 (l)

\_\_\_\_omit\_\_\_\_\_\_\_\_24.

 2 SO2 (g) + O2 (g) → 2 SO3 (g) ∆ H = - 196.7 kJ/mol

 SO 3 (g)  + H2O (l) → H2SO4 (l) ∆ H = - 130.1 kJ/mol

overall reaction:

 2 SO2 (g) + O2 (g) + 2 H2O (l) → 2 H2SO4 (l)

Gas Laws

\_\_\_\_\_\_\_\_\_\_\_\_25. 500 cc of gas is collected at 28 oC and 730 mm Hg. Find the volume of the gas at STP.

\_\_\_\_\_\_\_\_\_\_\_\_26. A gas occupies 630 cc at standard conditions. Find its volume at 22 oC and 2.5 kPa.

\_\_\_\_\_\_\_\_\_\_\_\_27. 150 cc of gas is collected over water at 24 oC and 767.4 mm Hg. Find its volume at standard conditions when dry (check water vapor chart).

\_\_\_\_\_\_\_\_\_\_\_\_28. How much faster will helium diffuse than chlorine?

\_\_\_\_\_\_\_\_\_\_\_\_29. What is the partial pressure of neon in a container that has a total pressure of 105 kPa if the pressure of the argon in the sample is 98 kPa?

\_\_\_\_\_\_\_\_\_\_\_\_30. What is the pressure of a gas collected over water at 25 oC if the total pressure is 800 mm Hg?

\_\_\_\_\_\_\_\_\_\_\_\_31. What is the pressure of 1 L gas collected over water at 25 oC if it has a volume of 4 L at STP?

\_\_\_\_\_\_\_\_\_\_\_32. Solid potassium chlorate decomposes to produce solid potassium chloride and O2. Write a balanced equation. What volume of oxygen gas, measured at 40 oC and 85.4 kPa, will be produced when 13.5 g of potassium chlorate is decomposed

\_\_\_\_\_\_\_\_\_\_\_\_33. Solid iron II chloride is decomposed to produce solid iron and chlorine gas. What volume of chlorine gas, measured at 71.7 oC and 133 kPa, will be produced when 98.4 g of iron II chloride is decomposed?

\_\_\_\_\_\_\_\_\_\_\_\_34. A 441 dm3 sample of nitrogen gas at a pressure of 88.3 kPa is placed into a container of equal volume that already holds hydrogen gas at a pressure of 125.6 kPa. What is the partial pressure of the nitrogen in the new container? What is the total pressure in the new container?

\_\_\_\_\_\_\_\_\_\_\_\_35. What volume of O2 is required to react completely with 150 mL of C2H6 at STP?

2 C2H6 + 5 O2 → 4 CO2 + 6 H2O

\_\_\_\_\_\_\_\_\_\_\_\_36. In the problem above, if the reaction is raised from STP to 25 °C, what volume would to CO2 occupy after the reaction?

\_\_\_\_\_\_\_\_\_\_\_\_37. At 99 °C and 748 mm Hg, a sample of a volatile liquid is vaporized completely in a 256 cm3 flask, the condensed vapor weighs 1.097 g. Calculate the molar mass of the liquid

38. A 0.0754 g sample of X4H10 (g) has a volume of 30.6 cm3 at 801 mm Hg and 20 oC.

\_\_\_\_\_\_\_\_\_\_\_\_what is the molar mass of X4H10 (g)

\_\_\_\_\_\_\_\_\_\_\_\_what is the element X?

Solutions

\_\_\_\_\_\_\_\_\_\_\_\_39. What is the molarity of a solution that has 12.0 grams of sodium sulfate in a 200 mL solution?

\_\_\_\_\_\_\_\_\_\_\_\_40. What is the molarity of a solution that is prepared by dissolving 5.0 g of potassium hydroxide in 0.25 kg of H20?

\_\_\_\_\_\_\_\_\_\_\_\_41. How many mL of 0.250 *M* NaOH solution are needed to get 0.0200 moles of NaOH?

\_\_\_\_\_\_\_\_\_\_\_\_42. A 17.5 mL sample of acetic acid solution required 29.6 mL of 0.250 M NaOH for neutralization. What is the original concentration of acetic acid?

\_\_\_\_\_\_\_\_\_\_\_\_43. Chalk is composed of calcium carbonate, CaCO3. The water soluble-insoluble compound is formed when a solution of calcium chloride is added to a solution of sodium carbonate as shown below. How many milliliters of 0.250*M* CaCl2 are needed to react completely with 50.0 mL of 0.150*M* Na2CO3 solution?

 CaCl2 + Na2CO3 → CaCO3 + 2NaCl

\_\_\_\_\_\_\_\_\_\_\_\_44. A chemist wants to dilute 50 mL of 3.50 M H2SO4 to 2.0 M H2SO4. To what volume must it be diluted?

\_\_\_\_\_\_\_\_\_\_\_\_45. 2.3 g of ethanol (C2H5OH) is added to 500 g of water. Determine the molality of the resulting solution.

\_\_\_\_\_\_\_\_\_\_\_\_46. What is the molality of a solution in which 49 g of H2SO4 is dissolved in 250 g of water?

\_\_\_\_\_\_\_\_\_\_\_\_47. Determine the mass of water to which 293 g of NaCl is added to obtain a 0.25 molal solution?

\_\_\_\_\_\_\_\_\_\_\_\_48. Calculate the molarity of a solution containing 10.0 g of sulfuric acid in 500 mL of solution.

\_\_\_\_\_\_\_\_\_\_\_\_49. If I add 45 grams of sodium chloride to 500 grams of water, what will the boiling point be of the resulting solution? Kb(H2O) = 0.51 °C/m

\_\_\_\_\_\_\_\_\_\_\_50. What will the new melting point be for the solution in question #49? Kf(H2O) = 1.86 °C/m.

\_\_\_\_\_\_\_\_\_\_\_\_51. Which solution will have a higher boiling point: A solution containing 105 grams of sucrose (C12H22O11) in 500 grams of water or a solution containing 35 grams of sodium chloride in 500 grams of water?

Acids and Bases

\_\_\_\_\_\_\_\_\_\_\_\_52. What is the pH of a 10 -5 M KOH solution?

\_\_\_\_\_\_\_\_\_\_\_\_53. What is the pH of a solution if the [H+] = 8.26 x 10-5 M?

\_\_\_\_\_\_\_\_\_\_\_\_54. What is the pH of a 0.00162 M NaOH solution?

\_\_\_\_\_\_\_\_\_\_\_\_55/ What is the [H+] concentration of a solution whose pH is 7.30?

\_\_\_\_\_\_\_\_\_\_\_\_56. If 72.1 mL of 0.543 M HCl titrates completely with 39.0 mL of KOH, what is the molarity of the KOH solution?

\_\_\_\_\_\_\_\_\_\_\_\_57. What is the molarity of a NaOH solution of 80.3 mL of it is titrated by 17.1 mL of 0.0244 M HNO3?

\_\_\_\_\_\_\_\_\_\_\_\_58. What is the [H+] concentration if the pH is 13.7?

\_\_\_\_\_\_\_\_\_\_\_\_59. Calculate the amount of 12 M HCl needed to make 500 mL of a 2.7 M solution.

\_\_\_\_\_\_\_\_\_\_\_\_60. Calculate the pH of a 0.08 M solution of nitrous acid (Ka = 7.2 x 10-4)

\_\_\_\_\_\_\_\_\_\_\_\_61. What is the pH of a 0.0015 M solution of boric acid? (Ka = 5.8 x 10-10)

\_\_\_\_\_\_\_\_\_\_\_\_62. What is the pH of a 5.0 x 10-4 M solution of hydrofluoric acid? (Ka = 6.6 x 10-4)

\_\_\_\_\_\_\_\_\_\_\_\_63. Acetylsalicylic acid, more commonly known as aspirin, is a weak organic acid whose formula we will represent as Hasp. A water solution is prepared by dissolving 0.100 mol HAsp per liter. The concentration of H+ in this solution is found to be 0.095 M. Calculate the Ka for aspirin.

\_\_\_\_\_\_\_\_\_\_\_\_64. Nicotinic acid, C6H5O2N, (Ka = 1.4 x 10-5) is another name for niacin, an important vitamin. Determine [H+] in a solution prepared by dissolving 0.5 mol of nicotinic acid crystal (HNic) to one liter of water.

65. For butyrate ion, But-, Kb is 5.0 x 10 -10. For a 0.01 M solution of sodium buyrate, NaBut, calculate

\_\_\_\_\_\_\_\_\_\_\_\_ [OH-] \_\_\_\_\_\_\_\_\_\_\_\_ [H+] \_\_\_\_\_\_\_\_\_\_\_\_pH

Answers

**1. 0.239**

**2. 1.74**

**3. 9.3**

**4. 3.65**

**5. 6.0**

**6. 40**

**7. 5.6 20**

**8. 8.8 6.12 70.%**

**9. 49. %**

**10. Mg 2.64 83.2**

**11. AlCl3 283.8**

**12. 90.7**

**13. Cl2 6.73 1.57**

**14. Cu 100 5**

**15. -85,000**

**16. 85.3**

**17. 34.7**

**18. 452,7000**

**19. -120.8 -176.95 -1234.8**

**20. 25.67**

**21. 239**

**22. 135.8 -24 kJ**

**23. -138.1**

**24. -456.9**

**25. 435.6**

**26. 27,584**

**27. 135**

**28. 4.18**

**29. 7**

**30. 776.2**

**31. 5.07**

**32. 16.68**

**33. 73.5**

**34. 88.3 213.9**

**35. 0.375 L**

**36. 0.328 L**

**37. 135.5**

**38. 56 carbon**

**39. 0.42**

**40. 0.36**

**41. 0.08 L**

**42. 0.423**

**43. 0.03 L**

**44. 0.0875 L**

**45. 0.10**

**46. 2.00**

**47. 20.2**

**48. 0.204**

**49. 101.6**

**50. -5.77**

**51. NaCl**

**52. 9.00**

**53. 4.08**

**54. 11.21**

**55. 5.01 x 10-8**

**56. 1.00**

**57. 0.0052**

**58. 2.00 x 10-14**

**59. 0.1125**

**60. 2.57**

**61. 6.03**

**62.3.24**

**63. 0.09**

**64. 0.0026**

**65. 2.24 x 10.6 4.47 x 10-9 8.35**