PROBLEM SET #10 STOICHEMETRY EXERCISE

1. The mole and Avogadro’s Number:

a) How many atoms are in 12 molecules of glucose, C6H1206?

b) How many moles of fluorine gas (F2 molecule) are present in 55.0 grams of fluorine (F2)?

c) What is the mass (g) of a single molecule of CO2? Hint: Express your answer in terms of grams per molecule.

d) What is the atomic mass of an element that weighs 9.12 x 10^23 g?

e) What is the mass (grams) of 0.216 mol of C8H904?

2. Balancing Equations and the Mole Concept:

a) Balance the equation and determine the number of moles of potassium chlorate (KCI03)produced if 16 moles of potassium chloride and 12 of oxygen is combined in an addition reaction. Which chemical is in excess?

b) How many moles of H20 will be produce from the complete combustion of 4.4g of C3H8?

c) A sample of ammonium dichromate (NH4)2Cr207, contains 2.25 mol of hydrogen atoms. What is the number of moles of oxygen atom in the sample?

d) Balance the equation and determine the mass (grams) of nitrogen dioxide produce when 102.0 grams of ammonia reacts with excess oxygen to produce nitrogen dioxide and water.

3. Calculations and Chemical Equation:

a) Calculate the mass (grams) of hydrogen formed when 25.0 g of aluminum reacts with excess 1-IC1. The other product from this reaction is aluminum chloride.

b) Carbon dioxide, c02, and ammonia, NH3, combines together to form urea, CH4N20, plus water, Write a balanced equation and calculate the mass of ammonia (in grams) that would be needed to make two moles of urea.

c) How many grams of oxygen are required to burn the 14.4 9 of C51412?

d) How many moles of 02 are needed to produce 11.0 9 of P406 from phosphorus?

e) What is the percent yield for a reaction when 6.50 grams of Fe203 combines with carbon monoxide to produce 3.85 9 of iron? (not balanced)

\_\_\_Fe203 + \_\_\_CO -- > \_\_\_Fe + \_\_\_CO2

f) How many molecules of nitrogen monoxide is produced if 92.0 g of nitrogen dioxide is combine with excess water according to the following reaction? (Not balanced)

\_\_\_NO2(g) + \_\_\_H20(I) -- > \_\_\_HNO3 (g) + \_\_\_NO(g)

PROBLEM SET #12 IDEAL GAS LAW AND APPLICATIONS TO STOICHEMETRY

(Remember to use scientific notation and round off all your answers to the correct number of significant figures.)

1. A sample of nitrogen gas, N2, occupies 3.0 L at a pressure of 3.0 atm. What volume (L) will it occupy when the pressure is reduced to 1.0 atm and the temperature remains constant?

2. The pressure of hydrogen gas in a constant-volume cylinder is 2.25 atm at 0.00 'C. What will the pressure (atm) be if the temperature is raised to 80.0 °C?

3. A 325-mL sample of air is at 720,0 torr and 50.0 °C, What volume (ml) will this gas occupy at 900.0 torr & 60.0 \*C?

4. A quantity of oxygen occupies a volume of 77.7 L at STP. How many moles of oxygen are present?

5. What volume (m1) would 9.50 g of nitrogen gas, N2, occupy at 200.0 K and 2.00 atm?

6. Calculate the density of ammonia gas, NH3, at STP. Round off your answer to 3 significant figures and express your answer in g /ml.

7. In a laboratory experiment, 259 mi. of gas was collected over water at 24.0 °C and 751 torr. Calculate the volume (m1) that the dry gas would occupy at STP.

8. 50.0mL of argon, Ar, is collected at 60.0 °C and 820.0 torr, how much does this sample weight in grams?

9. Exhaled breath is a mixture of nitrogen, oxygen, carbon dioxide and water vapor. What is the partial pressure of carbon dioxide (torr) in exhaled breath at 37.0°C if the partial pressure of oxygen is 116 torr and that of nitrogen is 569 torr? Assume atmospheric pressure is 1.00 atm.

PROBLEM SET #13: CONCENTRATION CALCULATIONS OF AQUEOUS SOLUTIONS

Show calculation setups and answers for all problems.

1. What will be the percent composition by weight of a solution made by dissolving 15.0 g of zinc nitrate, Zn(NO3)2, in 45.0 g of water? What is the % m/m for water in this solution?

2. How many moles of sodium hydroxide, NaOH, are required to prepare 2.00 L of 0.330 M solution?

Zn(NO3)2 H20

3. What will be the molarity of a solution if 3.50 g of potassium hydroxide, KOH, are dissolved in water to make 250.0 mL of solution?

4. What volume of aqueous solution must be used (mL) to prepare 0.400 M solution from 50.0 mg of KOH?

5. What weight of potassium bromide, KBr, could be recovered by evaporating 650.0 g of 15,0 percent KBr solution to dryness?

6. Calculate the weight of hydrogen chloride in 35.0 mL of concentrated HCI (12.00 M) solution,

7. A sulfuric acid solution has a density of 1.73 g/mL. and contains 80.0 percent H2504 by weight. What is the molarity of this solution?

8. On the average; glucose (C6l-11206) makes up about 0.100% by weight of human blood. How much glucose is there in 1.00 kg of blood?

9. Describe in detail by words and pictures how to prepare 300.0 ml of 0.250 M HCI from a 1.00 M HCI stock solution?

10. A sample of potassium hydrogen oxalate, KHC204, weighing 0.717 g, was dissolved in water and titrated (completely neutralized) with 18.47 mL of art NaOH solution. Calculate the molarity of the NaOH solution.

11. Sulfuric acid reacts with sodium hydroxide according to this equation:

H2S04+ 2 NaOH -- > Na2S04 + 2 H20

A 10.00 mi. sample of the H2504 solution required 13.71 mL. of 0.309 M NaOH for neutralization. Calculate the molarity of the acid. (State the path to be used to solve this stoichiometry problem)

Complete the following table by filling the '?’. Water is the solvent and you can assume the density of water is 1.0 g / cc. (Show complete work to receive full credit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | Solute (molar mass) | Amount Solute | Volume of Solvent | Volume of Solution | Concentration of solution |
| A | H2SO4, 98g/mol | **?** | -------- | 500mL | 15%w/w |
| B | **?** | 117g | 2L | 2L | 1.0M |
| C | NaOH, 40g/mol | 0.250g | -------- | **?** | 0.5%w/v |
| D | C6H12O6, 180g/mol | 0.015mg | 0.125L | -------- | **?** |
| E | CH3COOH, 60g/mol | 25mL | **?** | -------- | 5.00%v/v |

PROBLEM SET #14: EQUILIBRIUM AND LECHATELIER PRINCIPLE

1. Given the endothermic equilibrium system:

BiC13(aq) + H20(g) = BiOCI(s) + 2HCI (aq) at a point at which the solution is colorless and a small amount of BiOCl(s) is observed.

For each stress (a-e below)

i) State which way the reaction shift, to the left (L), the right (R) or no change (NC).

ii) State what would be observed.

iii) Explain the shift in terms of LeChatelieris Principle.

a) water vapor is added

b) a few drops of concentrated HCI is added to the system from part - a

c) a few drops of concentrated NaOH is added to the system in part - b

d) heat is added to the original reaction shown in equation 1

e) more BiOCI(s) is added to the reaction shown in equation 1

2. Using LeChatelier's principle, predict the direction of the net reaction in each of the following system, as a result of decreasing the volume of the chamber for the reaction mixture. Explain your answer for full credit

a) N2(g) + O2(g) < -- > 2N0(g)

b) PCl5(g) < -- > PCl5(g) + Cl2(g)

c) CO(g) + Cl2(g) < -- > COCl2(g)

3. Using LeChatelier's principle, predict the direction of the net reaction in each of the following system, as a result of increasing the temperature. Delta H is an indicator or whether the reaction releases heat, delta H (+) or heat is absorb, delta H (-).

a) 3O2(g) < -- > O3(g) delta H = + 284 kJ

b) 2SO3(g) + O2(g) < -- > 2SO5(g) delta H = -198.2 kJ

c) 2H@O(g) < -- > 2H2(g) + O2(g) delta H = + 584 kJ

4. For the following equilibrium system, which of the changes will form more CaCO3? (more moles CaCO3) Be sure to explain your answer for full credit.

CO2(g) + Ca(OH)2(s) < -- > CaCO3(s) + H20(l) delta H = -113 kJ

a) Decrease temperature at constant pressure (no phase change)

b) Increase volume at constant temperature.

c) Increase partial pressure of CO2.

d) Remove one-half of the initial CaCO3,

PROBLEM SET #15: THE pH SCALE and ACID BASE CALCULATIONS

Be sure to use the correct number of significant figures in all your answers.

1. State four differences between an acid and a base.

2. What is the chemical formula for a hydrogen ion? Hydronium ion?

3. What is the difference between a weak acid and a dilute acid: a strong acid and a concentrated acid? Can you give one example of each?

4. An acid is a proton \_\_\_\_\_\_\_\_ and a base is a proton \_\_\_\_\_\_\_\_.

5. Calculate the pH of each and determine whether each of the following solutions is acidic or basic:

a. [H+] = 1.0 x 10^-11 M solution

b. [OH-1] = 1.5 x 10^-3 M solution

c. [H+] = 5.0 x 10^-5 M

6. A solution has a hydroxide ion concentration of 6.1 x 10^-4 M. What is the pH? Is this solution acidic or basic?

7. Calculate the pH of each of the following hydrogen ion concentrations. (Use correct number of significant figures)

a. 1.0 x 10^-8M

b. 1.5 x 10^-10 M

c. 5.5 x I0^-12M

d. 3.5 x 10^-7M

8. Calculate the hydrogen ion concentration given me following pH readings.

a. 2.00

b. 9.50

c. 10.40

d. -1.25 (is this a reasonable question?)

9. Given either the pH or p0H, find the other.

a. pH 2.0

b. p0H 11.71

c. p0H 6.65

d. pH 4.25

e. p0H 8.88

f. pH 3.33

10. Processed cheese must be at a pH of 5.5 to 5.9 to prevent the growth of unwanted microorganisms. You are the quality control supervisor who determines whether or not the cheese leaves the plant. If a report on a sample comes back with [0H-] of 7.76 x 10^-9, would you send the cheese to the market?

PROBLEM SET 316: STRUCTURE OF ORGANIC COMPOUNDS, MOLECULAR MODELS

1. For each of the following pairs of structures, determine whether they are:

i) Different conformations of the same molecules. Name the organic compound.

ii) Different compounds that are structural isomers. In this case, what is the IUPAC name of each?

iii) Different compounds that are not structural isomers. In this case, what is the IUPAC name of each?

2. For each organic compound below determine the following:

i) the chemical formula of each.

ii) the number of 1, 2, 3 and 4 degree carbons

iv) For (a) write the condense formula and write the IUPAC name.

For (b) write the structural and condense formula.

For (c) draw the projection structural formula and write the IUPAC name.

3. Explain why the name of the following compounds is not the correct IUPAC name. Then give the correct IUPAC name for the compound.

i) 1,6 bimethylhexane

ii) 1,2-dimethyl-3-cyclohexene

iii) 3,4,5,5,6 Pentamethylhexane

iv) 4,5-trimethy1-6-heptene

4. Draw all the possible isomers of heptane and give the IIUPAC name for each.

5. Draw all the possible isomers of C4H8C12 and give the IIUPAC name for each.

6 Which is more stable, benzene (C6H6) or cyclohexane (C6H12). Justify your answer by looking up the energies of these compounds. What does conjugation mean in terms of these structures?

PRE LAB QUESTIONS

Answer these pre lab questions before beginning the experiment.

1. Define the following terms below.

a) Isotope

b) atomic mass unit

c) molar mass

d) mole

2. Write out Avogadro's number using non-scientific notation.

3. i) What is the mass (in grams) of one mole of gold atoms?

ii) Assuming that the price of gold is $ 11,000.00/kg, what is the approximate $ value of one mole of gold atoms?

iii) How much in $ is one mole of pennies?

iv) Which will make you more wealthy, one mole of pennies (6.02 x 10^23 pennies) or one mole of gold atoms (6.02 x 1023 atoms)?

4, i) Which is greater in terms of mass, a mole of sodium atoms or a mole of sulfur atoms?

ii) Which of the two is greater in terms of number of atoms?

5. Could donuts be quantified in terms of mass instead of number? Explain.

6. Invent a term to describe a certain number of something you use that doesn't already have a convenient means of quantification. Define this new term.

POST LAB QUESTIONS

You must show all calculations using dimensional analysis for full credit. Use scientific notation and round off to proper number of significant figures. Answer these post lab questions and turn in to your instructor before you leave lab unless told otherwise by instructor.

1. Calculation for Iron Cube

i) Rewrite the mass of the iron cube in the space provided.

iii) Calculate the number of iron atoms in the cube.

2. Calculations for 50.0 mL H20

i) Rewrite the mass of the 50 mL of water.

iii) How many molecules are in this amount of water?

iv) How many H-atoms does this represent?

v) How many 0-atoms does this represent?

vi) How many water molecules do you drink per day?

Assume you drink 1.5 L of water. Density (H20) = 1.0 9/cc

vii) How many mL of water should you weigh out to have one mole of water?

3. Calculation for Sugar Packet

i) Rewrite the mass of the sugar packet.

iii) How many molecules of sugar are in the packet? (assume the sugar is pure sucrose, C12H22O11).

iv) Calculate the number of atoms of carbon in the packet.

v) Calculate the number of atoms of oxygen in the packet.

vi) Calculate the number of atoms of hydrogen in the packet.

4. You are a scientist and you have made a new "compound" composed of just Hex-Nuts and bolts (in a different ratio than the 2:1 ratio in this lab). A 13.7 Kg sample of the new "compound" is separated into its component 'elements" with the following result: 3.84 Kg of Hex-Nuts and 9.90 Kg of bolts. How many Hex-Nuts are present in the 13.7 kg sample? How many bolts are present? What is the ratio of Hex-Nuts to bolts in the new compound? Write this as a formula BxNy where x and y are the ratio you determine in your calculations.

PRE LAB QUESTIONS

Answer these pre lab questions and turn in to your instructor before the beginning of lab.

1. Define the unit "ppm".

2. Define residue in the context of this experiment.

3. What common ions might be found in tap water?

4. 150 ml of water is collected from a local lake. The water is weighed and evaporated to dryness. The data is shown below. Calculate the concentration of the residue in % mass, ppm and ppb. (Show calculation for full credit)

Mass water sample + beaker 570.055 g

Mass beaker + residue 420.143 g

Mass beaker 420.025 g

POST LAB QUESTIONS

1. If the residue is not heated to dryness but is still somewhat moist, how would this effect the final amount of residue calculated in your results? Would you expect the calculated concentration of the residue to be higher or lower than the true value?

2. If a large piece of dirt, say 10 mg, falls into the beaker just before the sample is weighed the second time, what effect would this have on the weight of dissolved solids found? Would you expect the calculated concentration of the residue to be higher or lower than the true value?

3. If a large amount of water splatters out of the beaker during the evaporation process. How would this affect the final result? Would you expect the calculated concentration of the residue to be higher or lower than the true value?

4. How would the result of this experiment change if the mass were all measured to a tenth of a gram instead of a thousandth of a gram (± 0.001). Would you expect the calculated concentration of the residue to be higher or lower than the true value? Comment on what would happen to the accuracy and precision of your measurements.

5. If you calculated a salt-tainted solution of about 3.5%, what would the molarity of this solution? Assume the density of this solution is 1.03 9/cc. (BTW, this is the concentration of salt in sea-water)