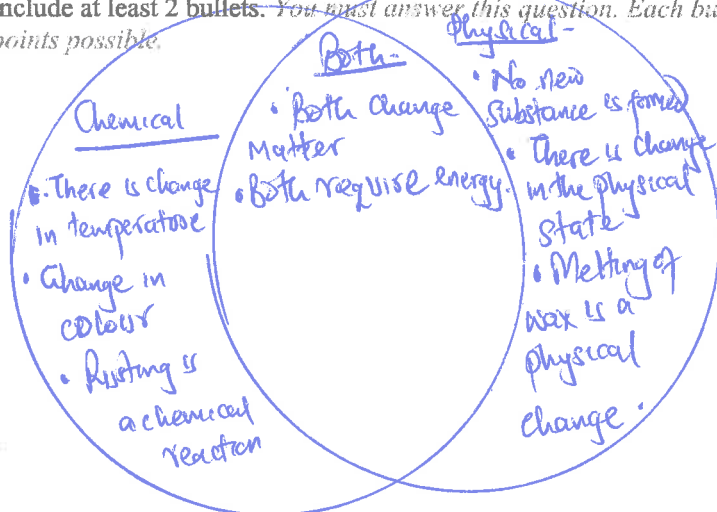


Ch 9: Chemical Reactions

1. **Physical vs. Chemical Changes:** Draw a Venn diagram to compare/contrast chemical and physical changes. In the chemical only circle, include at least 3 bullets (one of the 3 being an example). In the physical only circle, include at least 3 bullets (one of the 3 being an example). In the shared space, include at least 2 bullets. ~~You must answer this question.~~ Each bullet is worth .5 points for a total of 4 points possible.



2. **Balancing, Classifying, & Driving Forces:** Write out the equations for the following descriptions. Use states of matter symbols. Balance. Classify (abbreviations are ok to use: S, D, SR, DR, C, AB, ppt, Rx) in as many ways as possible and name driving forces (abbreviations are okay to use: ppt, H₂O, gas, toe-). **Include states of matter.** Don't forget to check your reactivity chart & solubility table!
Choose 2 of the following 4 problems (a-d) to do for a total of 10 points possible.

a. Hydrochloric acid reacts with solid sodium hydroxide.

- (3 pts) BALANCED Equation: $\text{HCl}_{(aq)} + \text{NaOH}_{(s)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$
- (1 pts) Classification(s): Double replacement reaction.
- (1 pts) Driving Force(s): formation of water

b. Butane (C₄H₁₀) gas undergoes complete combustion.

- (3 pts) BALANCED Equation: $2\text{C}_4\text{H}_{10(g)} + 13\text{O}_{2(g)} \rightarrow 8\text{CO}_{2(g)} + 10\text{H}_2\text{O}_{(l)}$
- (1 pts) Classification(s): Combustion (exothermic reaction)
- (1 pts) Driving Force(s): Production of Carbon dioxide gas.

c. Solid lead (II) reacts with hydrochloric acid.

- (3 pts) BALANCED Equation: _____
- (1 pts) Classification(s): _____
- (1 pts) Driving Force(s): _____

d. Solutions of silver (I) nitrate and calcium bromide react.

- (3 pts) BALANCED Equation: _____
- (1 pts) Classification(s): _____
- (1 pts) Driving Force(s): _____

Ch 2: Measuring & Sig Figs

1. **Dimensional Analysis: Show all work.** Put your final answer with correct units on the blank provided.

Choose 2 of the following 3 problems (a-c) to do for a total of 8 points possible.

- a. (4 pts) At the 2017 NFL Combine, wide receiver and NFL prospect John Ross (later drafted by the Cincinnati Bengals) ran a 40 yard dash in 4.22 seconds. Convert this to kilometers per hour. (1 in = 2.54cm and 1 yard = 36 inches).

40 yards in 4.22 seconds
1 yard = 36 inches
40 yards = ?

$$= \frac{40 \cancel{\text{yd}} \times 36 \cancel{\text{in}}}{1 \cancel{\text{yd}}}$$

Answer: _____

= 1440 inches
1 inch → 2.54 cm
1440 inch = ?

$$= 1440 \times 2.54$$

$$= 3657.6 \text{ cm}$$

1 cm = 10^{-5} km
3657.6 cm → ?

$$= \frac{3657.6 \times 10^{-5}}{1}$$

$$= 0.036576 \text{ km}$$

1 hr = 3600 seconds
? = 4.22 seconds

$$= \frac{4.22 \times 1}{3600} = 1.172 \times 10^{-3}$$

$$D = 0.036576 \text{ km}$$

$$T = 1.172 \times 10^{-3} \text{ hr}$$

$$S = \frac{D}{T} = \frac{0.036576}{1.172 \times 10^{-3}}$$

$$= 31.21 \text{ km/hr.}$$

- b. (4 pts) Suppose your car holds 19.2 gallons and is 1/3 full. Your car gets 21 miles/ gallon. You see a sign on the freeway saying "Next gas 100 miles." You are worried about getting stranded so you quickly pull over to the side of the road and do some quick math to check. Do you need to call AAA (or your parents) to come get you, or do you have enough gas to get to the gas station?

Capacity = 19.2 gallons
Amt gas in car = $\frac{1}{3} \times 19.2 = 6.4$ gallons
How many miles will 6.4 gallons cover?
21 miles → 1 gallon
? → 6.4 gallons

$$= \frac{6.4 \times 21}{1}$$

$$= 134.4 \text{ miles}$$

There is enough gas to get to the next gas station 100 miles away.

Answer: _____

- c. (4 pts) Suppose your car gets 17 miles/gallon and your tank holds 18.8 gallons and you drove 11,500 miles in the year and paid an average price of \$41.30 per tank each time you filled your tank. Your friend's car gets 25 miles/gallon and her tank also holds 18.8 gallons. She too drove an average of 11,500 miles in the year and paid an average price of \$41.30 per tank each time she filled her tank. How much more do you pay for gas in the year as compared to your friend? (This is why it is important to consider gas mileage when you go to buy a car...)

Answer: _____

Ch 10: The Mole

1. **Mole Calculations: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. Complete 2 of the following 4 (a-d) questions for a total of 8 points possible.

- a. (4 pts) 0.445 g of carbon monoxide at STP is contained in a flask. How many liters is this?

Answer: _____

- b. (4 pts) How many atoms are there in 398 mg of copper (II) sulfate?

Answer: _____

- c. (4 pts) Suppose you have 9.7×10^{24} atoms of zinc (II) chloride. Calculate its mass.

Molar Mass of $\text{ZnCl}_2 = 136 \text{ g}$
 $1 \text{ mol} \rightarrow 6.022 \times 10^{23} \text{ atoms}$
 $\leftarrow 9.7 \times 10^{24} \text{ atoms}$
 $\Rightarrow \frac{9.7 \times 10^{24} \times 1}{6.022 \times 10^{23}} = 16.108 \text{ Mols}$

Answer: _____

$1 \text{ mol} \rightarrow 136 \text{ g}$
 $16.108 \text{ M} \rightarrow ?$
 $= \frac{16.108 \times 136}{1}$

$= 2190.69 \text{ g}$
 $\underline{\underline{2.19 \times 10^3 \text{ g}}}$

- d. (4 pts) How many atoms are there in 211 cg of silver (I) phosphide?

Atoms in Silver(I) phosphide, Ag_3P_2 .
 $1 \text{ cg} \rightarrow 0.01 \text{ g} = \frac{211 \times 0.01}{1} = 2.11 \text{ g}$
 $211 \text{ cg} \rightarrow ?$
 $1 \text{ mol} \rightarrow 354 \text{ g} = \frac{2.11 \times 1 \text{ mol}}{354}$
 $? \leftarrow 2.11 \text{ g}$

Answer: _____

$\Rightarrow 5.96 \times 10^{-3} \text{ Mols}$

$1 \text{ mole} \rightarrow 6.022 \times 10^{23} \text{ atoms}$
 $5.96 \times 10^{-3} \rightarrow ?$
 $\frac{5.96 \times 10^{-3} \times 6.022 \times 10^{23}}{1}$

$= 3.589 \times 10^{21} \text{ atoms}$
 $\underline{\underline{3.589 \times 10^{21} \text{ atoms}}}$

2. **Molecular/Empirical Formulas: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. You must complete this problem - it is worth 6 points possible.

- a. (6 pts) Find the empirical and molecular formulas for a compound composed of 62.1% C, 13.8% H and 24.1% N when you have 175 g/mol of it.

62.1% C, 13.8% H, 24.1% N.

Convert mass of each element to moles/c.

$$62.1\text{g} \times \frac{1}{12} = 5.175 \text{ Moles C}$$

$$13.8 \times \frac{1}{1} = 13.8 \text{ Moles H.}$$

$$24.1\text{g} \times \frac{1}{14.0} = 1.72 \text{ Moles N}$$

Divide each mol by the smallest no. of Moles. Calculated.

$$\frac{5.175}{1.72} = 3.01 \approx 3$$

$$\frac{1.72}{1.72} = 1$$

$$\frac{13.8}{1.72} = 8.02 \approx 8$$

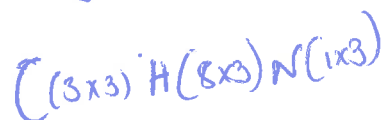
The Empirical formula is $\text{C}_3\text{H}_8\text{N}$.

Calculating Molecular formula.

Find Molar mass of $\text{C}_3\text{H}_8\text{N}$.

$$(12 \times 3) + (8 \times 1) + (14 \times 1) = 58 \text{ g/mol.}$$

$$\frac{175 \text{ g/mol}}{58 \text{ g/mol}} = 3.02 \approx 3$$



Molecular formula is



Empirical: $\text{C}_3\text{H}_8\text{N}$

Molecular: $\text{C}_9\text{H}_{24}\text{N}_3$

Ch 11: Stoichiometry

1. **Limiting Reactant/Excess Reactant/% Yield: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. Choose 1 of the following 2 problems (a or b) to do and do all parts (i-iv) for a total of 15 points possible.

a. Consider the following reaction: a solution of sodium hydroxide reacts with sulfuric acid.

- i. (4 pts) Balanced chemical equation with states of matter:



- ii. (5 pts) Suppose 17.5 g of sodium hydroxide reacts with 20.2 g of sulfuric acid. How much of the aqueous salt product is produced in grams?

$$\text{NaOH} \rightarrow 17.5 \text{ g}$$

$$\text{H}_2\text{SO}_4 \rightarrow 20.2 \text{ g}$$

$$\text{Molar mass of } 2\text{NaOH} \rightarrow 2(11+8+1) = 40 \text{ g/mol}$$

$$\text{No. of Moles} = \frac{17.5}{40}$$

$$= 0.4375 \text{ Moles}$$

$$\text{Molar Mass of } \text{H}_2\text{SO}_4 = (1 \times 2) + 16 + (4 \times 32) = 98 \text{ g/mol}$$

$$\text{No. of Moles} = \frac{20.2}{98} = 0.2061 \text{ Moles}$$

$$\text{Molar Mass of } \text{Na}_2\text{SO}_4 = (1 \times 2) + 16 + (8 \times 32) = 142 \text{ g/mol}$$

$$\text{Mole Ratio of NaOH} : \text{Na}_2\text{SO}_4 = 2 : 1$$

$$\text{No. of Moles in } \text{Na}_2\text{SO}_4$$

$$= \frac{0.4375}{2} = 0.21875$$

$$\text{Mass product} = 70 \times 0.21875$$

$$= 15.31 \text{ g}$$

Answer: _____

- iii. (3 pts) First, which is the excess reactant? Then, determine (in grams) how much of the excess reactant is leftover.

$$\text{Moles of } \text{Na}_2\text{SO}_4 \text{ from NaOH} \rightarrow 0.21875$$

$$\text{Moles of } \text{Na}_2\text{SO}_4 \text{ from } \text{H}_2\text{SO}_4 \rightarrow 0.2061$$

H_2SO_4 is the excess reactant since it gives more moles of Na_2SO_4 .

$$\rightarrow 0.4375 \text{ mol} \times \frac{17.5}{1} = 7.66 \text{ g}$$

7.66 g is the mass of the excess reactant.

Excess Reactant: H_2SO_4

Amt Leftover: 7.66 g

- iv. (3 pts) If you did the experiment in the lab and found that the % yield for the aqueous salt product was 94.7%, how many grams of this product were actually made?

$$\% \text{ yield for salt produced} = 94.7\%$$

$$100\% = 7.66 \text{ g}$$

$$94.7\% \rightarrow ?$$

$$= \frac{94.7 \times 7.66}{100} = 7.25 \text{ g}$$

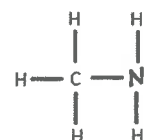
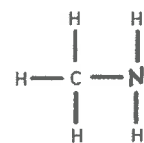
Answer: 7.25 g

- b. Consider the following reaction: solutions of nickel (II) oxide and aluminum chloride react.

Ch 12: States of Matter

1. **Short Answer:** Complete 2 of the following 3 questions (a-c) to do for a total of 6 points possible.

- a. (3 pts) To the right are 2 molecules. Show any/all intermolecular force(s) that would exist by drawing dotted lines between the atoms that would have attraction. Tell what type of force of attraction the dotted line represents and WHY you think so. Feel free to re-draw the molecules if it helps your explanation. (3 pts)



- b. (3 pts) You are given 2 unknown solutions and asked to identify which is polar and which is non-polar. Based on your knowledge from this chapter and what you learned in your chemistry class, explain *in detail* how you would determine which is which with only the materials accessible to you in your home.

Polar liquids dissolve in water (other polar liquids) and non polar liquids will dissolve in non polar liquids. Take one of the unknown liquids and add into water, if they mix and form a uniform liquid, then it is polar. If they do not dissolve into each other, it is a non polar. Take the unknown solution and add it into cooking oil which is non polar substance, if they mix, then it is a non polar.

- c. (3 pts) For each representative solid, liquid and gas listed, complete the chart of information requested.

Characteristic to explore	Solids (use <u>NaCl</u> as the example)	Liquids (use <u>H₂O</u> as the example)	Gases (use <u>O₂</u> as the example)
Describe particle spacing	Particles are touching with little space between them.	Particles are touching with a bit of space between them.	Particles have big distances between them.
Describe particle motion	Particles don't move past each other. They vibrate in place.	Particles glide over one another and move towards bottom of the container.	Particles are in continual straight line motion.
What is the intramolecular force present? Include a drawing if necessary.	Van der waal	Van der Waal	Van der Waal
What is the intermolecular force present between 2 of the same molecules? Include a drawing if necessary.		Hydrogen bonding	

Ch 13: Gas Laws

Ion dipole forces

London Dispersion forces.

1. **Short Answer:** Complete 1 of the following 2 questions for a total of 3 points possible.

c) Explain in details how and why the molecular motion of gas particles effect each of the following: temperature, pressure and volume.

⇒ An increase in temperature will result in increase in kinetic energy of the gas molecules and the particles will move faster. Consequently, there will be increase in pressure and volume to the increased movement of particles. Notably, the increase in temperature, not only does it result to increased movement of particles but also the gas molecules expand with the increased temperature exerting a lot of pressure within the enclosed area.

- b. (3 pts) Your friend tells you that they are doing an experiment at home to prove Boyle's Law. They say they got a basketball and measured the pressure by seeing how high the ball bounced (since low pressure balls would not bounce), then they inflated the ball with more air to see if there was an effect on the pressure (ie bounce height). You're the teacher. Based on what you know about gas laws, what grade would you give your friend...justify the grade with your explanation.

2. Calculations: Show all work. Include units and correct number of sig figs. Write your answer on the blank provided. Complete 2 of the following 4 questions (a-d) for a total of 8 points possible.

- a. (4 pts) Calculate the number of grams of oxygen gas (O_2) in 125 mL of gas at STP.

Using Ideal gas laws eqn. $PV = nRT$

At STP Temp = 273 K, Pressure = 1 atm

$$P = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}$$

$$n = \frac{PV}{RT} = \frac{1 \text{ atm} \times 0.125 \text{ L}}{0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \times 273 \text{ K}}$$

Answer: _____

$$n = 0.005577 \text{ mol}$$

To get the No. of grams of oxygen, we use the molar mass of oxygen.

$$0.005577 \text{ mol} \times \frac{32 \text{ g}}{1 \text{ mol}}$$

$$= \underline{\underline{0.178 \text{ g } O_2}}$$

- b. (4 pts) What is the pressure (in kPa) exerted by the hydrogen gas that is produced from the reaction between 12.34 grams of hydrochloric acid and sufficient amount of calcium. You must know that the gas was collected in a 0.25 L container at 25°C.

Balanced Equation



No. of moles in 12.34 grams of HCl.

Using Molar Mass of H_2 .

$$\text{No. of Moles} = \frac{12.34 \text{ g}}{36.5 \text{ g/mol}}$$

$$= 0.338 \text{ Mol}$$

from the balanced eqn, The no. of Moles of $H_2(g)$ is $\frac{0.338}{2} \text{ Mol} = 0.169 \text{ Moles}$.

$$PV = nRT$$

$$P = \frac{nRT}{V} = \frac{0.169 \text{ Mol} \times 0.0821 \text{ L atm} \times 273 \text{ K}}{V}$$

Answer: 0.25 K

$$P = 16.53888 \text{ atm}$$

Convert in kPa.

$$P = 16.53888 \times 101.3$$

$$\Rightarrow 1675.388 \text{ kPa}$$

- c. (4 pts) I have a volume of gas equaling 27.0L at a pressure of 3.5 atm and a temperature of 385 K. If I raise the pressure to 11.2 atm, and measure the final volume to be 56.0 L, what is the final temp in K? Put your final answer in scientific notation.

Answer: _____

- d. (4 pts) What volume of carbon dioxide is produced at 21°C and 1.13 atm when 0.146 grams of propane (C_3H_8) undergoes complete combustion with 44.0 g of oxygen gas?

Answer: _____

Ch 14: Solutions

1. **Short Answer:** Complete 1 of the following 3 questions (a-c) for a total of 3 points possible.

- a. (3 pts) Explain what the phrase "like dissolves like" means. Use specific examples in your explanation. Also include examples of where dissolving would not happen between 2 substances and tell why it doesn't happen. (3 pts)

- b. (3 pts) Explain scientifically from what you have learned about water in your chemistry career why even in nature PURE water is hard to find.

Pure water has a neutral pH of 7. Water (H_2O) is made of hydrogen and oxygen molecules. It is used as a universal solvent. Notably, with two hydrogen nuclei, water will always dissolve all soluble ions from any object. Therefore, it is hard to get pure water or to purify water since it dissolves many materials. It readily dissolves ions from the surrounding.

- a. (3 pts) Explain how a solution could be concentrated but not saturated. Use the example of coffee OR hot cocoa in your explanation.

2. **Calculations:** Show all work. Include units and correct number of sig figs. Write your answer on the blank provided. Complete 1 of the following 2 questions (a or b) for a total of 4 points possible.

- a. What volume of solution is created when 13 g of HCl is used to create a 5.0 M solution? (4 pts)

Answer: _____

- b. What is the molarity of a solution that contains 17.0 g of Calcium carbonate dissolved in 1255 mL of solution? (4 pts)

Using Molar Mass of $CaCO_3$, we evaluate the No. of moles of 17.0 g
$$\text{No. of moles} = \frac{17.0 \text{ g}}{100.09 \text{ g/mol}}$$
$$\text{No. of moles of } CaCO_3 = \frac{17.0}{100.09 \text{ g/mol}} = 0.1698 \text{ mol.}$$

$$\text{Molarity} = \frac{\text{Mol. g solute}}{\text{L. g solution.}}$$

$$= \frac{0.1698 \text{ Mol}}{1.255 \text{ L.}}$$

$$= 0.135 \text{ Mol/L}$$

$$= 1.35 \times 10^{-1} \text{ Mol/L}$$

Answer: 0.135 Mol/L

3. **Calculations: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. Complete 1 of the following 2 questions (a or b) for a total of 5 points possible.

- a. **Calculate** then **explain in a numbered procedure** how you would create 1.5 L of stock solution from scratch in order to have a 2.75 M Sodium hydroxide solution. (5 pts)

$$\text{Molarity} = 2.75 \text{ M}$$

$$\text{Volume} = 1.5 \text{ L.}$$

The No. of Moles of solute

$$= 2.75 \times 1.5$$

$$= 4.125 \text{ moles}$$

Mass of 4.125 moles of NaOH can be calculated from molar mass of NaOH.

$$\text{Mass of 4.125 moles of NaOH} = 4.125 \times 40 \text{ g}$$

$$= 165 \text{ g}$$

To make 2.75 M NaOH soln, we add 165 g of NaOH to the 1.5 L of stock solution.

- b. **Calculate** then **explain in a numbered procedure** how if given 2000. mL of a 1.50 M solution of KI, you make 150. mL of a 0.25M solution of KI. (5 pts)

Ch 18: Acids & Bases

1. **Calculations: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. Complete 2 of the following 4 questions for a total of 8 points possible.

- a. (4 pts) You are given an unknown solution and told to determine if it is an acid or base. Explain/describe 3 methods or tests you could do to determine this. Include what potential

outcomes you would look for in order to classify the solution as an acid or a base.

Litmus paper

Blue litmus paper turns red in acidic solution. Red litmus paper turns blue in basic solution. There is no change in color in either red or blue litmus paper in a neutral solution.

Indicators or dyes

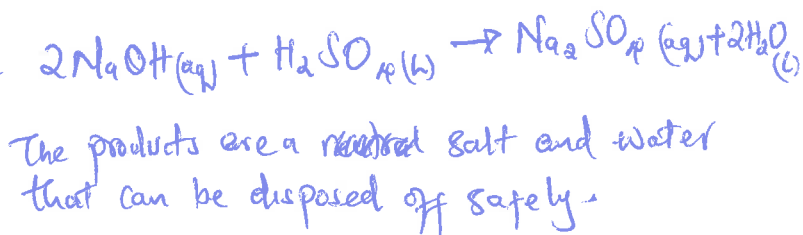
They show different colours in acidic or basic solutions. eg phenolphthalein turns pink in alkaline solutions.

Electronic pH meter

Used to electronically measure the accurate pH of a substance.

- b. (4 pts) You are given a highly concentrated amount of sulfuric acid to dispose of down the drain. How would you go about neutralizing this acid? Write the chemical equation as proof that you have created a safe product to dispose of.

Pour the concentrated ~~sulfuric~~ sulfuric acid into a solution of Sodium Hydroxide. Test the pH with litmus paper until it shows neutral solution. If so you continue to neutralize the solution.



- c. (4 pts) You and your friend are creating a stock solution of Calcium carbonate. You want to add water to the compound and mix. Your friend argues that you cannot just add water to the chemical because if you add water to acids, that is bad. Who is right, you or your friend? Explain your reasoning in detail.

- d. (4 pts) Identify which is the acid and which is the base in each equation below. Justify your answer with an explanation.



1. Explain:



1. Explain:

2. **Calculations: Show all work.** Include units and correct number of sig figs. Write your answer on the blank provided. Complete 2 of the following 3 (a or b) questions for a total of 8 points possible.

- a. (4 pts) Calculate the pH and pOH of a solution with an H^+ ion concentration of $3.56 \times 10^{-4} \text{ M}$.

H^+ ion Concentration of $3.56 \times 10^{-4} \text{ M}$.

$$\begin{aligned}\text{pH} &= -\log [\text{H}^+] \\ &= -\log [3.56 \times 10^{-4}] \\ &= \underline{\underline{3.45}}\end{aligned}$$