

AP Chemistry Summer Assignment

Philosophy: Homework is meant to be used for three reasons:

1. Practicing concepts that you have learned already
2. Getting a preview of concepts to be learned
3. Discovering what you need further practice/help/reinforcement on

This is the way homework and labs are used in AP Chemistry. The assignments are due on the day of the test and it is up to you to plan your time as needed. The temptation is to leave it until the last minute. This will NOT lead to success in AP Chemistry.

Because homework is used for YOUR benefit only, I will make answer keys available so that you can check your work. AND, homework is only worth 2% of your overall grade. All of this is to disincentivize cheating/copying/procrastination and to really incentivize you to use it as a tool (and to gain some self-discipline).

The summer assignment is no different. Below is a table outlining the topics that will be covered throughout the year. The middle column are the topics that I am expecting will be review for you. This means that I am expecting you to be able to tackle problems and concepts in that column with confidence.

To guide you, I am adding example problems and the answer key. Those topics with which you are less confident, are the topics that you should be prioritizing during your summer study. I will be providing links to concise and well-presented college board videos (if you have access to the AP Classroom AP Chemistry) as well as suggestions of good chemistry youtubers that you might find helpful. I don't care what kind of resource you use, I care that it is good quality and that it is helpful to you. If you have questions, do not hesitate to ask me.

Due dates:

Part I: Due by July 15

Please answer the following questions:

1. What is your name, preferred name, preferred pronouns?
2. Why are you taking AP Chemistry?
3. What science and math classes have you taken in high school prior to this course?
4. What science and math classes will you be taking this year?
5. What excites you about AP Chemistry?
6. What concerns do you have about AP Chemistry?

Part II: I expect you to have confidence in **all** of the topics in the middle column by the first day of classes in September. If you have **ANY** questions, need help, need any explanations etc. do not hesitate to reach out to me. I honestly do not mind answering questions throughout the summer as needed. I will be less available in the weeks right before classes, so please, please use the summer to begin some practice of self-discipline that will help you throughout the year.

Sixth formers: This is for you especially. Applying for college is like having an additional class added to your course load. Do not underestimate the time, energy and emotional drain it will have, especially during the fall semester. Learning how to manage your time is the best gift that you can give to your future self.

Overview of AP Chem course: Your summer work should concentrate on making sure you are as confident as possible about all of the material in the “Review” column from day 1.

Topic (units on college board)	Review (I will assume you know with confidence)	New (will be taught in class)
1. Stoichiometry (1.1-1.4, 4.1-4.9) Test: ~Sept. 15	<ul style="list-style-type: none"> •Molar mass, balancing equations •Percent composition •Empirical formula from percent composition •Molecular formula from empirical formula and molar mass •Determining oxidation states •Reaction types (net ionic, redox, acid/base, exo and endothermic) •Mixtures vs pure •Representations of solutions (mostly ionic) •Structures of ionic solids •Stoichiometry: percent yield, LR •Chemical and physical changes •Polyatomic ions: formula, charge 	<ul style="list-style-type: none"> •Average isotopic mass •Empirical formula by combustion analysis •Complex redox problems •Hydrates •Review of energy and bonds (formation = release, breaking = requires) •Hess's Law intro •Beer's law in the lab •Additional polyatomic ions
2. Kinetics: (5.1-5.11) Test: ~Oct. 9	<ul style="list-style-type: none"> •Measuring the rate of a reaction •Factors affecting the rate of a reaction 	<ul style="list-style-type: none"> •Quantitative analysis of rates of reaction •Rate law calculations by initial rates •Rate law calculations by graphing •Rate constant calculations •Boltzmann distribution curve
3. Thermochemistry (6.1-6.9) Test: ~Oct. 20	<ul style="list-style-type: none"> •Heat capacity, specific heat •Phase changes •Heats of reaction •Calorimetry •Types and effect of IMFs 	<ul style="list-style-type: none"> •Bond enthalpy •Hess's Law
4. Equilibrium (7.1-7.12) Test: ~Nov. 18	<ul style="list-style-type: none"> •Equilibrium reactions vs reactions that go to completion •Calculating K_c •Predicting shift based on Q 	<ul style="list-style-type: none"> •Q vs K_c •K_c vs K_p •K_{eq} and x^2 •Le Chat and ICE box •K_{sp} •Common ion effect
5. Acids and bases (8.1-8.11) Cumulative Test: ~Dec. 15	<ul style="list-style-type: none"> •Strong acids and strong bases •Conjugate acid/base pairs •pH, pOH calculations •Titration between strong acid and strong base •Spectator ions 	<ul style="list-style-type: none"> •K_a, K_b, K_w •Titration curve calculations •Titration curve calculations other than SA: SB •Polyprotic acids •Salts •Buffers

<p>6. Thermo and electrochemistry (9.1-9.11)</p> <p>Test: ~Jan. 23</p>	<ul style="list-style-type: none"> •Assigning oxidation numbers •Balancing simple redox reactions •Reading reduction potential tables 	<ul style="list-style-type: none"> •Entropy •Gibb's free energy and spontaneity •Balancing redox reactions in an acidic solution •Balancing redox reactions in a basic solution •Constructing and interpreting galvanic cells •Cell-potential calculations for ideal and non-ideal situations •Faraday's Law •Electrolysis •Nernst Equation and interaction with Gibb's and Equilibrium
<p>7. Atomic structures and properties (1.5-1.8, 3.11-3.13)</p> <p>Test: ~Feb. 13</p>	<ul style="list-style-type: none"> •Atomic structure •Basic electron configuration 	<ul style="list-style-type: none"> •Electron configurations (atoms, ions, ionic compounds, islands of stability) •Z-effective •Spectroscopy: PES, IR, visible, x-ray, microwave •Beer's Law •Photoelectric effect •Periodic trends
<p>Compounds, structures and properties (2.1-2.7, 3.1-3.3, 3.6-3.10)</p> <p>Test: ~March 3 (MCQ only) and March 5 (FRQ only)</p>	<ul style="list-style-type: none"> •distinguishing between ionic and molecular compounds •Basic Lewis structures 	<ul style="list-style-type: none"> •Bond distance •IMFs: phase changes •Solids: ionic, metallic, alloys, covalent network •Lewis structures: isomers •Resonance and formal charge, pi bonding •VSEPR, shapes, angles, hybridization •Deviations from ideal gases
<p>Gases and wrap-up (3.4-3.6)</p> <p>Test: ~Apr. 14 (MCQ Unit 9 only) Apr. 16 (FRQ cumulative)</p>	<ul style="list-style-type: none"> •PV = nRT calculations •Dalton's Law 	<ul style="list-style-type: none"> •Graham's Law •Molar volume and Avogadro •Deviations from ideal gases

Sample Problems: Show all work for credit, no work, no credit. Justify means show with math or with words. Be precise and don't assume that what is left out is understood to be true. You do not need to use complete sentences, just complete thoughts.

Unit 1

- How many grams of $\text{Fe}(\text{NO}_3)_3$ would contain 8.0 g of oxygen?
- A laboratory experiment was performed to determine the empirical formula of a compound by burning element "Q" in the presence of oxygen to form an oxide. All student groups investigated the formation of the same compound. Partial lab data, along with mole calculations from four groups of students, are shown in the table below. Which lab group must have an experimental error in their procedure? Justify your answer.

Group	Mass of element Q (g)	Moles of element Q	Mass of oxygen (g)	Moles of oxygen
A	5.86	0.100	2.40	0.151
B	3.51	0.060	1.46	0.091
C	2.63	0.045	1.42	0.089
D	4.63	0.079	1.90	0.119

- What is the percent by mass of nitrogen in sodium cyanide, NaCN ?
- Write the correct equation for the dissociation of sodium sulfate in water.
- Given the following neutralization reaction:

$$\text{Mg}(\text{OH})_2 + 2 \text{HCl} \rightarrow \text{MgCl}_2 + 2 \text{H}_2\text{O}$$
 What volume of 5.00 M HCl is required to react completely with 5.83 g of $\text{Mg}(\text{OH})_2$?
- 1.50 g of lead(II)nitrate (331.23 g/mol) is poured into a solution that contains 1.25 g sodium iodide (149.89 g/mol). A precipitate forms, the reaction is shown below

$$\text{Pb}(\text{NO}_3)_2 + 2 \text{NaI} \rightarrow \text{PbI}_2 + 2 \text{NaNO}_3$$
 - Write the net ionic equation for this reaction
 - Identify the limiting reactant. Justify your answer.
 - Calculate the mass of precipitate expected.
 - The mass of precipitate actually recovered is 1.03 g. Calculate the percent yield.
 - What are the spectator ions?
- A compound is found to have 9.74% H, 51.6% O and 38.7% C by mass.
 - What is the empirical formula of the compound
 - If the molar mass of the compound is between 120 and 140 g/mol, what is the probable molecular formula?
- For the reaction: $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$
 - Find the oxidation states (number) for each element
 - Identify the reduction reaction and the reducing agent
 - Balance the reaction by electrons.
- Know the following polyatomic ions: formula and charge: nitrate, permanganate, hydroxide, chlorate, cyanide, carbonate, sulfate, chromate, dichromate, phosphate, ammonium
- Sketch the reaction diagram of a reaction that is exothermic and has two steps.

Unit 2

1. List five ways that the rate of a reaction can be measured?
2. List four ways to increase the rate of a reaction and explain how it works.
3. Explain what a catalyst is and how it works

Unit 3: $c_{\text{ice}} = 2.09 \text{ J/g}^\circ\text{C} = c_{\text{steam}}$ $c_{\text{water}} = 4.18 \text{ J/g}^\circ\text{C}$ heat of fusion_{water} = 334 J/g, heat of vaporization_{water} = 2,260 J/g

1. A 30.0 g piece of metal is heated to 95°C and placed in 200.0 g of H₂O at an initial temperature of 25°C. If the final temperature of the system is 28°C, what is the specific heat of the metal?
2. 45.0 g of a substance is combusted in a calorimeter that contains 200.0 g of H₂O at an initial temperature of 20°C. If the substance has a heat of combustion of 22 J/g, what will the final temperature of the system be?
3. Sketch the heating curve for water and calculate the amount of energy required to raise 25.0 g of water from -5°C to 125°C (be sure to include state changes).
4. Why is the heat of vaporization so much higher than the heat of fusion?
5. Rank the following in terms of increasing boiling point and justify your answer by identifying the types of IMFs in each compound. CO₂, MgO, NaI, NH₃, PCl₃

Unit 4

1. Sketch the graph of the following:
 - a. Reaction that goes to completion
 - b. Reaction that goes to equilibrium that favors the products
 - c. Reaction that goes to equilibrium that favors the reactants
2. For the reaction: $2\text{NH}_{3(g)} \rightleftharpoons \text{N}_{2(g)} + 3 \text{H}_{2(g)}$
 - a. Write the K_c expression
 - b. If 5 moles of NH_{3(g)} are placed in a 0.5 L container, calculate the initial concentration of NH_{3(g)}.
 - c. No other gases were present when the NH_{3(g)} was added and the reaction was allowed to reach equilibrium. At equilibrium, the concentration of NH_{3(g)} was 4M. What were the equilibrium concentrations of N_{2(g)} and H_{2(g)}?
 - d. Sketch the graph of the reaction making sure to add the appropriate y-axis values.
 - e. Calculate the K_c for the reaction.
3. For the reaction: $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2 \text{NO}_{2(g)}$ $K_c = 3 \times 10^{-4}$
 - a. Write the K_c expression
 - b. If 2 moles of N₂O₄ and 1×10^{-2} moles of NO₂ are both placed in a 2 L container
 - i. Calculate the molarity of each compound
 - ii. Calculate the Q/K_i
 - iii. Which way will the reaction shift to reach equilibrium? Justify your answer

Unit 5

- List the six strong acids
- List the six strong bases
- Give the conjugates of the following
 - Conjugate acids of SO_4^{2-}
 - Conjugate acid of NH_3
 - Conjugate base of H_2SO_4
 - Conjugate base of H_2O
- Calculate the pH and pOH
 - 3×10^{-4} M solution of HCl
 - 4×10^{-3} M solution of LiOH
- Which will have a lower pH?
 - A 3 M solution of HF, or a 3 M solution of HI. Explain.
 - A 3 M solution of HBr, or a 3 M solution of H_2SO_4 . Explain
 - A 3 M solution of NaOH, or a 3 M solution of AgOH. Explain.
- How many mL of a 0.4 M solution of HCl is required to completely titrate 60 mL of a 0.5 M solution of NaOH?
- For the titration of H_2SO_4 and LiOH
 - Write the balanced equation
 - Write the net ionic equation
 - Identify the spectator ions

Unit 6

- Determine the correct oxidation state (number) of
 - N in NH_3
 - N in N_2O_4
 - Cr in $\text{Cr}_2\text{O}_7^{2-}$
- Given the following reduction potentials
$$\text{Sn}^{2+} + 2e^- \rightarrow \text{Sn} \quad -0.14 \text{ V}$$
$$\text{Au}^{3+} + 3e^- \rightarrow \text{Au} \quad +1.50 \text{ V}$$
 - Which reaction will be the reduction reaction?
 - Write the oxidation reaction.
 - Calculate the E°_{cell} potential for the reaction
 - Balance the reaction

Unit 7 atomic structures and basic electron configuration

- Complete the following table

particle	location	charge	mass
proton			
			1 amu
		negative	

- Write the ground state electron configuration of
 - F (long hand)
 - Br (short hand)
 - S^{2-} (short hand)
 - Zn^{2+} (short hand)

Unit 8 distinguishing molecular vs ionic compounds, basic lewis structure

1. Identify the following compounds as either molecular or ionic
 - a. FeCl_2
 - b. C_3H_8
 - c. $\text{Ni}(\text{NO}_3)_2$
 - d. NH_3
2. Draw the Lewis structure for
 - a. Na_2O draw the before and after
 - b. MgF_2 draw the before and after
 - c. CCl_4
 - d. PCl_3
 - e. CO_2
 - f. N_2
 - g. HCN
 - h. C_3H_8
 - i. C_3H_6
 - j. C_3H_4

Unit 9

1. Calculate the number of moles of gas required to fill a 3.5 L balloon at a pressure of 1.2 atm and a temperature of 17°C .
2. A 2.6 L balloon at a pressure of 1.5 atm and a temperature of 27°C rises to an altitude where the pressure drops to 0.7 atm and a temperature of -5°C . What is the new volume of the balloon?
3. A container holds 2.5 moles of $\text{N}_{2(g)}$, 1.5 moles of $\text{O}_{2(g)}$ and 2 moles of $\text{CO}_{2(g)}$. If the total pressure of the container is 2.4 atm, calculate the partial pressures of each gas.

Answer Key

Unit 1

11. How many grams of $\text{Fe}(\text{NO}_3)_3$ would contain 8.00 g of oxygen?

$$8.00\text{gO} \left[\frac{241.86\text{gFe}_2\text{O}_3}{9(16.00\text{gO})} \right] = 13.4\text{gFe}_2\text{O}_3$$

12. A laboratory experiment was performed to determine the empirical formula of a compound by burning element "Q" in the presence of oxygen to form an oxide. All student groups investigated the formation of the same compound. Partial lab data, along with mole calculations from four groups of students, are shown in the table below. Which lab group must have an experimental error in their procedure? Justify your answer.

Group	Mass of element Q (g)	Moles of element Q	Mass of oxygen (g)	Moles of oxygen
A	5.86	0.100	2.40	0.151
B	3.51	0.060	1.46	0.091
C	2.63	0.045	1.42	0.089
D	4.63	0.079	1.90	0.119

Divide moles O by moles Q. A=1.5, B=1.5, C=2 and D=1.5 so C is the outlier with the moles O per mole Q

13. What is the percent by mass of nitrogen in sodium cyanide, NaCN? Doesn't specify

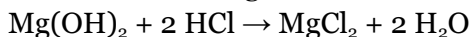
number of significant figures so maybe take it to tenths.

$$\frac{14.0}{(23.0 + 12.0 + 14.0)}(100) = 28.6\%$$

14. Write the correct equation for the dissociation of sodium sulfate in water.



15. Given the following neutralization reaction:

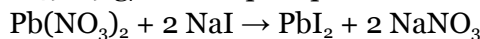


What volume of 5.00 M HCl is required to react

completely with 5.83 g of $\text{Mg}(\text{OH})_2$? 5.83 has 3 sig figs, so answer needs to have 3 sig figs

$$5.83\text{g} \left(\frac{1\text{molMg}}{58.32} \right) \left(\frac{2}{1} \right) \left(\frac{1\text{L}}{5\text{mol}} \right) = 0.0400\text{L}$$

16. 1.50 g of lead(II)nitrate (331.23 g/mol) is poured into a solution that contains 1.25 g sodium iodide (149.89 g/mol). A precipitate forms, the reaction is shown below



- a. Write the net ionic equation for this reaction



- b. Identify the limiting reactant. Justify your answer. NaI only given 1.25g

$$1.50\text{gPb} \left(\frac{1}{331.23\text{gPb}} \right) \left(\frac{2\text{Na}}{1\text{Pb}} \right) \left(\frac{149.89\text{g}}{1} \right) = 1.35\text{gNaI needed}$$

- c. Calculate the mass of precipitate expected.

$$1.25\text{gNa} \left(\frac{1}{149.89\text{gNa}} \right) \left(\frac{1\text{Pb}}{2\text{Na}} \right) \left(\frac{461.01\text{gPbI}_2}{1} \right) = 1.92\text{gPbI}_2$$

- d. The mass of precipitate actually recovered is 1.03
Calculate the percent yield.

$$\frac{1.03}{1.92}(100) = 53.6\%$$

- e. What are the spectator ions? Na^+ and NO_3^- (must always have the charge)

17. A compound is found to have 9.74% H, 51.6% O and 38.7% C by mass.

- a. What is the empirical formula of the compound assume 100g sample

$$9.74\text{gH} \left(\frac{1\text{m}}{1.01\text{g}} \right) = 9.64\text{molH} \div 3.23 = 3$$

$$51.6\text{gO} \left(\frac{1\text{m}}{16.00\text{g}} \right) = 3.23\text{molO} \div 3.23 = 1$$

$$38.7\text{gC} \left(\frac{1\text{m}}{12.0\text{g}} \right) = 3.23\text{molC} \div 3.23 = 1 \quad \text{CH}_3\text{O}$$

- b. If the molar mass of the compound is between 120 and 140 g/mol, what is the probable molecular formula?

$$12 + 3 + 16 = 31x = 120\text{ish}$$

$$x = 4 \quad \text{C}_4\text{H}_{12}\text{O}_4$$

18. For the reaction: $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$

- a. Find the oxidation states (number) for each element

$\text{Al}=0$, $\text{O}_2=0$, O in any compound but $\text{H}_2\text{O}_2 = -2$, so $\text{Al}=+3$

- b. Identify the reduction reaction and the reducing agent

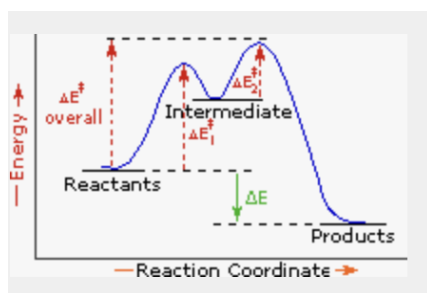
O goes down in number $0 \rightarrow -2$ so reduction reaction is $\text{O}_2 + 4e^- \rightarrow 2\text{O}^{2-}$, Al is the reducing agent

- c. Balance the reaction by electrons.



19. Know the following polyatomic ions: formula and charge: nitrate, permanganate, hydroxide, chlorate, cyanide, carbonate, sulfate, chromate, dichromate, phosphate, ammonium

20. Sketch the reaction diagram of a reaction that is exothermic and has two steps.



Unit 2

- List five ways that the rate of a reaction can be measured? **Evolution of a gas, creation of a precipitate, change in color, change in temp. Loss of reactant, change in pH**
- List four ways to increase the rate of a reaction and explain how it works. **Increase in reaction rate always occurs because of increase in the number of effective collisions per second. Increase in temp, increases velocity so more collisions overall occur per second. Increase in concentration of reactants, increases the rate of collisions because it is more crowded. Decrease in volume increases the concentration of reactants.**
- Explain what a catalyst is and how it works **something that is not used up in a reaction but speeds up the rate by lowering the activation energy**

Unit 3: $c_{\text{ice}} = 2.09 \text{ J/g}^\circ\text{C} = c_{\text{steam}}$ $c_{\text{water}} = 4.18 \text{ J/g}^\circ\text{C}$ heat of fusion_{water} = 334 J/g, heat of vaporization_{water} = 2,260 J/g

- A 30.0 g piece of metal is heated to 95°C and placed in 200.0 g of H₂O at an initial temperature of 25°C. If the final temperature of the system is 28°C, what is the specific heat of the metal?
(30)(x)(95-28)=(200)(4.18)(28-25) x = 1.25 J/g°C (proper sig figs and units in answer)
- 45.0 g of a substance is combusted in a calorimeter that contains 200.0 g of H₂O at an initial temperature of 20°C. If the substance has a heat of combustion of 22 J/g, what will the final temperature of the system be?
(45)(22)=(200)(4.18)(x) x=1.18°C= ΔT so final temp is 21.2°C

- Sketch the heating curve for water and calculate the amount of energy required to raise 25.0 g of water from -5°C to 125°C (be sure to include state changes).

Ice: (25)(2.09)(5) = 261.25 J

Melting: (25)(334) = 8,350 J

Water: (25)(4.18)(100)=10,450 J

Vaporization: (25)(2,260)=56,500 J

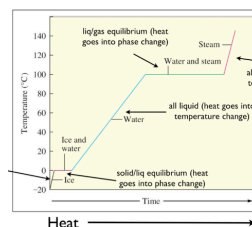
Steam: (25)(2.09)(25)= 1,306.25 J

Total = 76.9 kJ

- Why is the heat of vaporization so much higher than the heat of fusion? **Melting only has to overcome a few IMFs to get particles moving, vaporization has to overcome all remaining, more IMFs means more energy required**
- Rank the following in terms of increasing boiling point and justify your answer by identifying the types of IMFs in each compound. CO₂, MgO, NaI, NH₃, PCl₃
CO₂ (low mass dispersion) < PCl₃ (dipole/dipole small diff in Z_{eff}) < NH₃ (hydrogen "bond") < NaI (ionic low charge) < MgO (ionic high charge)

Unit 4

- Sketch the graph of the following:
 - Reaction that goes to completion **reactants go to zero% products to 100%**
 - Reaction that goes to equilibrium that favors the products **left**
 - Reaction that goes to equilibrium that favors the reactants **right**



5. For the reaction: $2\text{NH}_{3(g)} \rightleftharpoons \text{N}_{2(g)} + 3\text{H}_{2(g)}$

a. Write the K_c expression

$$K_c = \frac{[\text{N}_2][\text{H}_2]^3}{[\text{NH}_3]^2}$$

b. If 5 moles of $\text{NH}_{3(g)}$ are placed in a 0.5 L container, calculate the initial concentration of $\text{NH}_{3(g)}$. $5/0.5 = 10\text{ M}$

c. No other gases were present when the $\text{NH}_{3(g)}$ was added and the reaction was allowed to reach equilibrium. At equilibrium, the concentration of $\text{NH}_{3(g)}$ was 4M. What were the equilibrium concentrations of $\text{N}_{2(g)}$ and $\text{H}_{2(g)}$?
 $4=10-6$ NH_3 lost 6 M, so according to stoich, N_2 gained and H_2 gained 9M

d. Sketch the graph of the reaction making sure to add the appropriate y-axis values.

NH_3 starts at 10 goes down to 4, N_2 starts at 0 goes to 3, H_2 starts at 0 goes to 9, levels off at the same time for all

$$K_c = \frac{[3][9]^3}{[4]^2} = 137$$

e. Calculate the K_c for the reaction.

6. For the reaction: $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)}$

$$K_c = 3 \times 10^{-4}$$

a. Write the K_c expression

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]}$$

b. If 2 moles of N_2O_4 and 1×10^{-2} moles of NO_2 are both placed in a 2 L container

i. Calculate the molarity of each compound divide all by 2L, so
 $[\text{N}_2\text{O}_4] = 1\text{ M}$, $[\text{NO}_2] = 5 \times 10^{-3}\text{ M}$

ii. Calculate the Q/K_i

iii. Which way will the reaction shift to reach equilibrium? Justify your answer

$$K_i = \frac{[5 \times 10^{-3}]^2}{[1]} = 5 \times 10^{-6}$$

$Q \ll K_c$ so the system will shift right to increase products and decrease reactants and bring the $Q=K_c$

Unit 5

8. List the six strong acids **HCl, HI, HBr, HNO₃, H₂SO₄, HClO₄**
9. List the six strong bases **LiOH, NaOH, KOH, Ca(OH)₂, Ba(OH)₂, Sr(OH)₂**
10. Give the conjugates of the following
 - a. Conjugate acids of SO_4^{2-} **HSO_4^{2-}**
 - b. Conjugate acid of NH_3 **NH_4^+**
 - c. Conjugate base of H_2SO_4 **HSO_4^{2-}**
 - d. Conjugate base of H_2O **OH^-**
11. Calculate the pH and pOH
 - a. 3×10^{-4} M solution of HCl **$-\log(3 \times 10^{-4}) = 3.5$**
 - b. 4×10^{-3} M solution of LiOH **$-\log(4 \times 10^{-3}) = \text{pOH} = 2.4$ $\text{pH} = 14 - 2.4 = 11.6$**
12. Which will have a lower pH?
 - a. A 3 M solution of HF, or a 3 M solution of HI. Explain. **HI because it is a strong acid and will dissociate completely $3 \text{ M HI} = 3 \text{ M H}^+$, $3 \text{ M HF} < 3 \text{ M H}^+$
lower $[\text{H}^+] = \text{higher pH}$**
 - b. A 3 M solution of HBr, or a 3 M solution of H_2SO_4 . Explain **H_2SO_4 is diprotic and creates 2x concentration of H^+ higher concentration = lower pH**
 - c. A 3 M solution of NaOH, or a 3 M solution of AgOH. Explain. **AgOH is a weak base, will not make as concentrated $[\text{OH}^-]$ so less basic, lower pH**
13. How many mL of a 0.4 M solution of HCl is required to completely titrate 60 mL of a 0.5 M solution of NaOH? **$M_a V_a = M_b V_b$ $(0.4)(V_a) = (0.5)(60)$ $V_a = 75 \text{ mL}$**
14. For the titration of H_2SO_4 and LiOH
 - a. Write the balanced equation **$\text{H}_2\text{SO}_{4(\text{aq})} + 2 \text{LiOH}_{(\text{aq})} \rightarrow 2 \text{H}_2\text{O} + \text{Li}_2\text{SO}_{4(\text{aq})}$**
 - b. Write the net ionic equation **$2 \text{H}^+ + 2 \text{OH}^- \rightarrow 2 \text{H}_2\text{O}$**
 - c. Identify the spectator ions **Li^+ and SO_4^{2-} need charges, not coefficients**

Unit 6

3. Determine the correct oxidation state (number) of
 - a. N in NH_3 **H is less electronegative so it will be +1, so N = -3**
 - b. N in N_2O_4 **O is always -2 unless H_2O_2 so N = +4**
 - c. Cr in $\text{Cr}_2\text{O}_7^{2-}$ **overall charge = -2 so $-2 = 2x + 7(-2)$ $\text{Cr} = x = +6$**
4. Given the following reduction potentials
$$\text{Sn}^{2+} + 2\text{e}^- \rightarrow \text{Sn} \quad -0.14 \text{ V}$$
$$\text{Au}^{3+} + 3\text{e}^- \rightarrow \text{Au} \quad +1.50 \text{ V}$$
 - a. Which reaction will be the reduction reaction? **$\text{Au}^{3+} + 3 \text{e}^- \rightarrow \text{Au}$ because higher reduction potential**
 - b. Write the oxidation reaction. **$\text{Sn} \rightarrow \text{Sn}^{2+} + 2\text{e}^- + 0.14 \text{ V}$**
 - c. Calculate the E°_{cell} potential for the reaction **$0.14 + 1.50 = 1.64$**
 - d. Balance the reaction **total of 6e^- exchanged so $2\text{Au}^{3+} + 3 \text{Sn} \rightarrow 2 \text{Au} + 3 \text{Sn}^{2+}$**

Unit 7 atomic structures and basic electron configuration

3. Complete the following table

particle	location	charge	mass
proton	nucleus	positive	1 amu
neutron	nucleus	neutral	1 amu
electron	Flying around	negative	1/1000 amu

4. Write the ground state electron configuration of

- F (long hand) $1s^2 2s^2 2p^5$
- Br (short hand) $[Ar]4s^2 3d^{10} 4p^5$
- S^{2-} (short hand) $[Ne] 3s^2 3p^6$
- Zn^{2+} (short hand) $[Ar] 4s^2 3d^{10}$

Unit 8 distinguishing molecular vs ionic compounds, basic lewis structure

2. Identify the following compounds as either molecular or ionic

- $FeCl_2$ ionic
- C_3H_8 molecular
- $Ni(NO_3)_2$ ionic
- NH_3 molecular

2. Draw the Lewis structure for

k. Na_2O draw the before and after

l. MgF_2 draw the before and after

m. CCl_4

n. PCl_3

o. CO_2

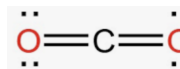
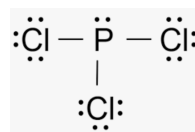
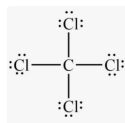
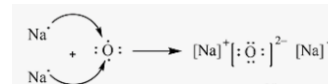
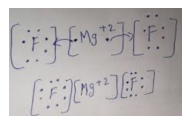
p. N_2 $:N \equiv N:$

q. HCN $H-C \equiv N:$

r. C_3H_8 all single bonds

s. C_3H_6 one double bond

t. C_3H_4 one triple bond



Unit 9

4. Calculate the number of moles of gas required to fill a 3.5 L balloon at a pressure of 1.2 atm and a temperature of $17^\circ C$.

$$PV = nRT \quad (1.2)(3.5) = n(0.08221)(17+273) \quad n = 0.18 \text{ moles}$$

5. A 2.6 L balloon at a pressure of 1.5 atm and a temperature of $27^\circ C$ rises to an altitude where the pressure drops to 0.7 atm and a temperature of $-5^\circ C$. What is the new volume of the balloon?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{(1.5)(2.6)(-5 + 273)}{(27 + 273)(0.7)} = 5.0L$$

6. A container holds 2.5 moles of $N_{2(g)}$ 1.5 moles of $O_{2(g)}$ and 2 moles of $CO_{2(g)}$. If the total pressure of the container is 2.4 atm, calculate the partial pressures of each gas.

$$\frac{n_i}{n_{tot}} = \frac{P_i}{P_{tot}} \quad \frac{2.5}{(1.5+2.5+2)} = \frac{P_{N_2}}{2.4} \quad P_{N_2} = 1 \text{ atm}$$

$$\frac{2}{6} = \frac{P_{CO_2}}{2.4} \quad P_{CO_2} = 0.8 \text{ atm} \quad P_{O_2} = 2.4 - (1 + 0.8) = 0.6 \text{ atm}$$