CHM 106
Quiz I

The reaction $2\ NO + Cl_2 \rightarrow 2\ NOCl$ was studied at -10 °C. The following results were obtained:

[NO] (mol / L)	[Cl_2] (mol / L)	Rate (mol / L · min)
0.10	0.10	0.18
0.10	0.20	0.36
0.20	0.20	1.45

a) What is the rate law for this reaction?

b) What is the value of the rate constant?

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Quiz II

Nitrogen dioxide reacts with carbon monoxide in an equilibrium to form nitrogen oxide and carbon dioxide:

$$NO_2(g) + CO(g) \rightleftharpoons NO(g) + CO_2(g)$$

For this reaction under a particular set of conditions, a plot of $1 / [NO_2]$ vs. time was linear with a slope of 0.0287.

1. If a flask starts with 0.0050 M NO_2, How long does it take for 90% of the NO_2 to be consumed?

2. How long does it take for 100% of the NO_2 to be consumed? Explain.

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Quiz III

Ethene and water are in equilibrium with ethanol in the gas phase:

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

At 400 K, the equilibrium constant for this reaction is $K_p = 0.254$. If a reaction vessel is charged with 5.0 atm of $C_2H_4(g)$ and 5.0 atm of $H_2O(g)$, what are the partial pressures of all species at equilibrium?

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Quiz IV

Benzoic acid (C_6H_5COOH) has a $K_a = 9.46x10^{-5}$. What is the pH of a 0.25 M benzoic acid solution?

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Quiz V

Phenol (HOC_6H_5) has a $K_a = 1.00x10^{-10}$. What is the pH of a 0.20 M solution of sodium phenoxide ($NaOC_6H_5$)?

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Quiz VI

Hydrofluoric acid has a $K_a = 6.31 \times 10^{-4}$. What is the pH of a solution that is 2.0 M in hydrofluoric acid and 5.0 M in potassium fluoride?

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Quiz VII

A 10.00 mL aliquot of 0.150 M acetic acid ($K_a = 1.75 \times 10^{-5}$) is titrated with standard 0.0950 M NaOH.

1. What volume of base must be added in order to reach the equivalence point?

2. What is the pH at the equivalence point?

3. Of the indicators methyl red ($pK_a = 4.95$), bromothymol blue ($pK_a = 7.1$), and phenolphthalein ($pK_a = 9.4$), which is most appropriate for this titration? Explain.

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Quiz VIII

Consider the sublimation of carbon dioxide, which occurs at -78.4 °C:

$$CO_2(s) \rightarrow CO_2(g)$$

1. For this process, is ΔS_{system} positive or negative? Explain.

2. This process requires 25.23 kJ of energy as heat per mol of CO_2. Is $\Delta S_{surroundings}$ positive or negative? Explain.

3. In order for this process to be spontaneous, what must the sum of ΔS_{system} and $\Delta S_{surroundings}$ be?

4. What is ΔS^0 for this process? Be sure to include units in your answer.

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Quiz IX

Ethylene reacts with oxygen to form ethylene oxide:

$$2\ C_2H_4(g) + O_2(g) \rightarrow 2\ C_2H_4O(g)$$

Substance	ΔH_f^0 (kJ / mol)	S^0 (J / mol · K)
$C_2H_4(g)$	52.5	219.6
$O_2(g)$	0	205.2
$C_2H_4O(g)$	-52.6	242.5

a) What is the value for ΔH^0 for this reaction?

b) What is the value for ΔS^0 for this reaction?

c) This reaction is run at 700 °C. Assuming that ΔH^0 and ΔS^0 do not depend on temperature, what is ΔG^0 for this reaction?

d) What is the value of the equilibrium constant at 700 °C?

e) Are the high temperatures for this reaction necessary for thermodynamic or kinetic reasons?

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Quiz X

In the zinc-air battery, oxygen gas reacts with zinc metal under acidic conditions to produce water and zinc (II) ions.

1. Using the method of half-reactions, balance this equation. Show your work.

2. Sketch an electrochemical cell for this process. In your sketch label the anode, the cathode, the direction of electron flow, which half-cell contains the oxidation reaction, and which half-cell contains the reduction reaction.

3. What is $\mathscr{E}^0$ for this reaction? A table of standard reduction potentials is on the back side of this quiz.

4. What is the line notation for this cell?

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Quiz XI

Francium is one of the rarest naturally occurring elements due to its instability and short half-life.

1. Francium-223 undergoes alpha decay. Write a balanced nuclear equation for this process.

2. The half-life for this process is 22 minutes. How long does it take for 99.9% of a sample of Francium-223 to decay?

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Quiz XII

Write balanced equations that show the reaction of sodium metal with:

1. Water

2. Phosphorus

3. Bromine

4. Hydrogen gas

5. Oxygen gas (to form the peroxide)

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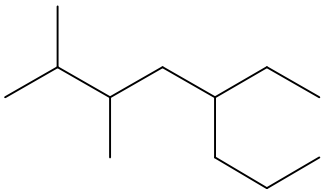
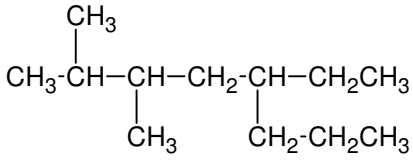
Quiz XIII

1. Provide an unambiguous, systematic name for the following molecule, shown as both a line-angle drawing and a structural formula.





2. Draw the structure of the molecule 2,2,4-trimethylpentane.

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Quiz XIV

For each problem, draw the structure and provide an unambiguous, systematic name for a compound containing the named functional group with *exactly* four carbon atoms.

1. Aldehyde

2. Alkyne

3. Alcohol

4. Ester

5. Ether