

⌚ : 1 hr 30 min

Chem. 102
Final Exam

Feb. 2, 2000
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Family Name: _____

First Name: _____

I.D. #: _____

Score:

I. _____ / 22

II. _____ / 32

III. _____ / 32

IV. _____ / 14

Grade: _____ / 100

Useful constants:

$R = 8.314 \text{ J/K. mol}$

$F = 96500 \text{ J/V. mol}$

☺ GOOD LUCK

I.A(15%) Fill in the balnks:

Concerning a cell reaction, if ε is positive, then ΔG is _____ and the cell reaction is _____; while if ε is equal to zero, then ΔG is _____ and the reaction is _____.

All electrochemical reactions involve the transfer of electrons and are therefore _____ reactions.

In the electrolysis of water, gas bubbles appear at both electrodes. Evolution of _____ gas occurs at the anode, and _____ gas is evolved at the cathode.

There are three isotopes of hydrogen: _____, _____, and _____. Heavy water contains _____.

In the nuclear equation, ${}_{84}^{212}Po \rightarrow {}_{82}^{208}Pb + \times$, \times is _____ and it is called _____, while in ${}_{92}^{235}U + {}_0^1n \rightarrow {}_{40}^{99}Sn + {}_{52}^{135}Te + 2 \times$, \times is _____ and it is called _____.

B(7%) Circle T for True statements and F for false ones:

- T F Electrolysis of water occurs readily in 0.10M H_2SO_4 solution because there are sufficient number of ions to conduct electricity.
- T F Sulfuric acid is the cornerstone of the chemical industry. It is produced from sulfur via sulfur dioxide and sulfur trioxide.
- T F Nuclear fusion is the splitting of a large nucleus into two smaller nuclei.
- T F The reactivity, toxicity, and oxidizing ability of the halogens decrease from fluorine to iodine.
- T F Radioactive decay and nuclear transmutation are considered as nuclear or chemical reactions.
- T F The relationship between K_p and K_c for a given equilibrium system is given by $K_c = K_p (RT)^{\Delta n}$ where Δn is the number of moles of gaseous products - number of moles of gaseous reactants.
- T F Rates of nuclear reactions normally are not affected by temperature, pressure, and catalysts.

II.(32%) Answer the following independent questions:

1-(6%) Find the percent by mass of each element in sucrose or table sugar ($C_{12}H_{22}O_{11}$).

2-(4%) Chalcopyrite ($CuFeS_2$) is a principal ore of copper. Calculate the mass of Cu (in kg) contained in 3.71×10^3 kg chalcopyrite.

3-(5%) (SF_4) reacts with (I_2O_5) to produce the interhalogen compound IF_5 and sulfur dioxide.

a- Write the equation of the reaction.

b- Calculate the weight of IF_5 that can be obtained from 10.0g of I_2O_5 .

4-(8%) Consider the β -decay of ^{90}Sr (89.908a.m.u) with a half-life of 28.1 years.

a- Write the nuclear reaction equation.

b- Starting with one mole of ^{90}Sr , calculate the number of moles of ^{90}Sr that will decay in 112.4 years.

5-(9%) Benzene C_6H_6 burns in air to produce carbon dioxide and liquid water.

a- Calculate the heat released (in kilojoules) per gram of the compound reacted with oxygen.

b- Calculate the standard free-energy of the above reaction at 25°C .

Given that:

	$\Delta H^\circ_f(\text{KJ/mol})$	$S^\circ(\text{J/K.mol})$
Carbon dioxide(g)	-393.5	213.6
Water (l)	-285.8	69.9
Benzene (l)	49.04	172.8

III(32%) Circle the letter preceding the best answer:

Concerning Raoult's Law:

- a. It states that the partial pressure of a solvent over a solution is given by the vapor pressure of the pure solvent times the mole fraction of the solvent in the solution.
- b. All solutions that obey Raoult's Law are ideal solutions.
- c. It can be stated mathematically by $P_1 = X_1P_1^\circ$.
- d. Benzene-Toluene is an example of a solution that obeys Raoult's Law.
- e. All of the above statements are true.
- f. (a), (b) and (c).

The freezing point of a solution containing 478g of ethylene glycol (Mwt = 62.01) in 3202g water ($K_f = 1.86^\circ\text{C/molal}$) is equal to:

- a. 4.48°C
- b. -1.25°C
- c. -2.41°C
- d. 2.41°C
- e. -4.48°C

What is true about ozone:

- a. More stable than oxygen.
- b. An allotrope of oxygen.
- c. For the reaction $3\text{O}_2(\text{g}) \rightarrow 2\text{O}_3(\text{g})$, ΔG° is positive.
- d. A light-blue gas and a powerful oxidizing agent.
- e. All of the above.
- f. (b), (c) and (d).
- g. (a) and (d).

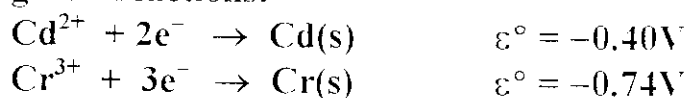
The number of moles NaOH that should be added to 333mls of water to produce a solution of $\text{pH} = 12.67$ is equal to:

- a. 12.7×10^{-3}
- b. 712×10^{-3}
- c. 7.12×10^{-3}
- d. 15.6×10^{-3}
- e. 443×10^{-3}

The volume of potassium permanganate KMnO_4 0.200M needed to oxidize 25.00ml of sodium oxalate 0.400M in acidic medium (into Mn^{2+} and CO_2) is equal to:

- a- 25.0ml
- b- 50.0 ml
- c- 125 ml
- d- 20.0 ml
- e- None of the above, my answer is _____.

Given the following half-reactions:



The standard Emf of the galvanic cell made of chromium and cadmium electrodes in 1.0M of their nitrate solutions is equal to:

- a- -0.34V
- b- -0.34V
- c- +0.28V
- d- -0.28V
- e- None of the above, my answer is _____.

In calculating K_{sp} of a sparingly soluble salt, which of the following statements is/are reasonable:

- a- K_{sp} is the same as molar solubility and depends on temperature.
- b- To calculate K_{sp} , use solubility in g/l.
- c- K_{sp} is the same in a solution containing a common ion as in pure water.
- d- All of the above.
- e- None of the above.

The primary ionization constant for H_2CO_3 is 4.0×10^{-7} . The percent ionization for a 0.10M solution of this acid is equal to:

- a- 0.20
- b- 0.0020
- c- 0.10
- d- 0.040
- e- 0.40

IV(14%) Given:



A piece of copper is dipped into a beaker (A) containing dilute nitric acid, and another piece of copper is dipped into a beaker (B) containing hot and concentrated nitric acid.

- a- What do you observe in each beaker?
- b- Write the equation of the chemical reaction where applicable.
- c- Determine ε° , ΔG° and K_{eq} for the overall reaction in beaker (B) at 25°C .