

Time: 2hrs.

Chem. 102
Final Examination

Feb. 5th, 1999

S. Sadek

Name: _____

I.D. #: _____

Score:

I. _____ / 12

II. _____ / 24

III. _____ / 20

IV. _____ / 20

V. _____ / 12

VI. _____ / 12

Grade _____ / 100

$K_b(\text{water}) = 0.520 \text{ }^\circ\text{C/m}$

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

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

Good Luck

I (12%) Circle T for True statements and F for False ones:

T F - The terms strong acid and strong base refer to ionization and not concentration.

T F - A solution prepared by dissolving 12.8g of naphthalene $C_{10}H_8$ in 1.00 L water is 0.100 m.

T F - The atomic bomb is a nuclear fusion device.

T F - ϵ° changes sign whenever a half-cell reaction is reversed, and changes value when changing stoichiometric coefficients.

T F - A solution of pH 4 is 100 times more acidic than a solution of pH 7.

T F - In an insulator the gap between the valence band and the conduction band is greater than that in a metal.

T F - Heavy water contains tritium, an isotope of hydrogen.

T F - Dipole-dipole forces and ion-dipole forces attract molecules with dipole moments to other polar molecules or ions.

II (24%) Circle the letter preceding the best answer:

A solution of diethylene glycol (M.wt.106.1) contains 7.5% benzene (M.wt.78.11) by mass. The mole fractions of diethylene glycol and benzene are respectively:

- a- 0.872 and 0.096
- b- 0.943 and 0.057
- c- 0.057 and 0.943
- d- 0.90 and 0.099
- e- None of the above; my answer is _____

Arrange the following salts in increasing order of molar solubility in pure water:

AgCl ($K_{sp} = 1.7 \times 10^{-10}$); BaCrO_4 ($K_{sp} = 8.5 \times 10^{-11}$);
 $\text{Fe}(\text{OH})_3$ ($K_{sp} = 6.0 \times 10^{-38}$); $\text{Mn}(\text{OH})_2$ ($K_{sp} = 2.0 \times 10^{-13}$):

- a- $\text{Fe}(\text{OH})_3$, BaCrO_4 , AgCl , $\text{Mn}(\text{OH})_2$
- b- $\text{Fe}(\text{OH})_3$, $\text{Mn}(\text{OH})_2$, BaCrO_4 , AgCl
- c- AgCl , $\text{Mn}(\text{OH})_2$, $\text{Fe}(\text{OH})_3$, BaCrO_4
- d- $\text{Mn}(\text{OH})_2$, AgCl , BaCrO_4 , $\text{Fe}(\text{OH})_3$
- e- AgCl , BaCrO_4 , $\text{Mn}(\text{OH})_2$, $\text{Fe}(\text{OH})_3$

The equilibrium molar concentrations of H^+ and NO_2^- at 25°C for a 1.0 M HNO_2 solution ($K_a = 4.5 \times 10^{-4}$) are respectively:

- a- 2.1×10^{-2} and 2.1×10^{-2}
- b- 2.1×10^{-2} and 9.8×10^{-1}
- c- 6.7×10^{-3} and 6.7×10^{-3}
- d- 6.7×10^{-3} and 9.9×10^{-1}
- e- 2.1×10^{-3} and 6.7×10^{-3}

Which of the following metals is most easily oxidized ?

	<u>Metal</u>	<u>$\varepsilon^\circ(\text{M}^{2+}/\text{M})$</u>
a-	Ni	-0.236 V
b-	Pb	-0.127 V
c-	Fe	-0.409 V
d-	Cu	+0.339 V
e-	Zn	-0.762 V

Given the following ΔH_f° values (in KJ/mole), calculate the heat obtained from the complete combustion of 1.8373 g of Glucose, $C_6H_{12}O_6$ to carbon dioxide and water at constant pressure:

<u>Species</u>	<u>ΔH_f° (KJ/mole)</u>
$C_6H_{12}O_6(s)$	-1274
$CO_2(g)$	-393
$H_2O(L)$	-286

- a- 5348 KJ
- b- 28.56 KJ
- c- 2800 KJ
- d- 595 KJ
- e- None of the above, may answer is _____

Which of the following is not true about spontaneous processes:

- a- The reaction of hydrogen with oxygen to form water after being ignited with a spark is a spontaneous process.
- b- Spontaneous processes occur without outside interferences.
- c- Heat flowing from a cold object to a hot object is a spontaneous process.
- d- (a) and (c).
- e- All of the above are not true.

Calculate the change in entropy of the universe for the conversion of two moles of benzene to vapor at a pressure of 1 atm and a temperature of 353°K, its normal boiling point. The ΔH_{vap} for benzene is $3.08 \times 10^4 \text{ J mole}^{-1}$

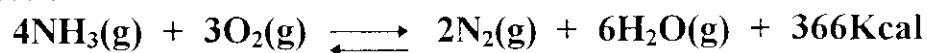
- a- 87.2 JK^{-1}
- b- $3.08 \times 10^4 \text{ JK}^{-1}$
- c- -87.2 JK^{-1}
- d- 0
- e- $-3.08 \times 10^4 \text{ JK}^{-1}$

Which one of the following reactions should result in the greatest increase in entropy:

- a- $2NO_2(g) \longrightarrow N_2O_4(g)$
- b- $BaS(s) + 2NaNO_3(s) \longrightarrow Ba(NO_3)_2(s) + Na_2S(s)$
- c- $4NO_2(g) + 6H_2O(g) \longrightarrow 4NH_3(g) + 7O_2(g)$
- d- $C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$
- e- Can not be determined

III (20%) Answer the following short questions:

Predict the direction in which the equilibrium will shift when heat is added to the reaction:

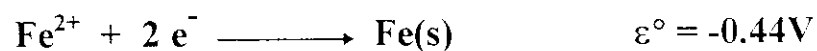


Justify your answer.

Draw a structural isomer of the formula $\text{C}_4\text{H}_8\text{Cl}_2$ that has two chiral centers and give a systematic name.

Calculate the boiling point of a solution prepared by dissolving 100.0g of ethylene glycol $\text{C}_2\text{H}_6\text{O}_2$ in 500.0g water.

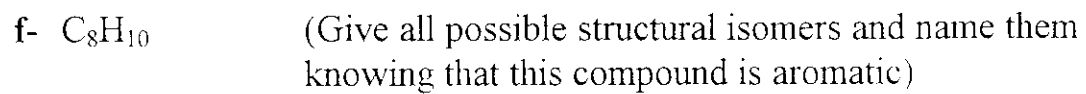
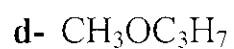
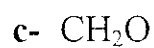
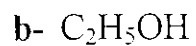
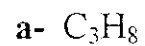
Given the following half-reactions:



calculate the equilibrium constant and ΔG° for the reaction of silver in a ferrous nitrate solution at 25°C .

Determine the half-life of carbon-14 knowing that a piece of wood that originally contained 4g of carbon-14 is today 23080 years-old and it contains only 0.25g of carbon-14.

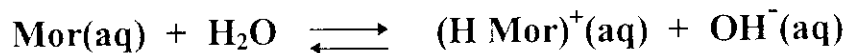
IV (20%) Draw a structural formula and give the name for each of the following molecules:



V1 (15%) A patient is injected with the radioisotope ^{99}Tc in order to diagnose a possible malfunction of the liver or gall bladder. The radioisotope ^{99}Tc is a gamma ray emitter with a half-life of 6 hours. The path of the isotope is traced with a gamma ray camera and projected on a monitor.

- a- Write the nuclear equation.
- b- What is the order of this reaction.
- c- How many hours must pass for only one-fourth of the original dosage to remain in the body.
- d- Determine the rate constant for this reaction.

V (15%) Morphine $C_{17}H_{19}NO_3$, a naturally occurring base, is administered medically to relieve pain. The ionization constant K_b for morphine is 1.60×10^{-6} at 25°C . We can represent the ionization of morphine (Mor) in water by the following equation:



Calculate the initial concentration of Mor if the pH of the solution at equilibrium is 10.60.