Name_____

CHEMISTRY 4A
Professor Richard Mathies

November 15, 1993

THIRD MIDTERM

Name:_____

TA:_____

Begin by writing your name on all pages. You must **show all your work** in the space provided for each question. Look over all the problems and do the ones that you know first. Then go back to work on the more difficult ones in the time remaining. Relevant tables, constants and some equations will be found in the appendix. Good Luck!

(1) _____ /23

(2) _____ /20

(3) _____ /20

(4) _____ /20

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1. Answer the following short questions.

(a) What is a complex ion? Give an example.

(b) Why is ΔS for the universe always greater than or equal to zero?

(c) A gas spontaneously expands into an evacuated container. Indicate whether ΔT, ΔE, ΔH, ΔS, q, w and ΔG are positive, negative or zero.

(d) What is the third law of thermodynamics?

(e) An ice cube melts. Indicate whether ΔT, ΔE, ΔH, ΔS, q, w and ΔG are positive, negative or zero.

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2. (a) One mole of an ideal gas at 200 K and 1 atm pressure slowly and isothermally doubles in volume. Calculate ΔE, ΔH, ΔS, q, w and ΔG.

(b) One mole of ice at 0° C is converted to one mole of water vapor at 200° C. Calculate ΔS for this entire process. The pressure is constant at1 atm.

C_p (ice) = 38 J/mole K
C_p (water) = 75 J/mol K
C_p (water vapor) = 36 J/mol K
ΔH_{fus} = 6,007 J/mol
ΔH_{vap} = 40,680 J/mol

(c) The equilibrium constant of a reaction is found to increase from 2.64 to 5.28 when the temperature is increased from 50° C to 60° C. Calculate ΔH^o for this reaction.

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3. Consider the reaction CaF_2 (s) $\Rightarrow$ Ca^{2+} (aq) + $2F^-$ (aq)

(a) What is ΔG° for this reaction?

(b) What is the equilibrium constant for this reaction at 298 K?

(c) Calculate the solubility of CaF_2 in an aqueous solution.

(d) Calculate the solubility of CaF_2 in an 0.1 M solution of NaF.

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4. An unknown mixture of K_2CO_3 (MW = 138.2) and Na_2CO_3 (MW = 106.0) weighing 0.150 gram is dissolved in water and titrated with standard 0.100 M HCl to the bromocresol green endpoint. This titration requires 25 ml of the HCl solution. What is the percent K_2CO_3 in the unknown?

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