

Exam Five
CHM 205 (Dr. Mattson)
8 April 2005

Academic Integrity Pledge:

In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

Signature:

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. **BOX YOUR ANSWERS!**

1. (6 pts) Write the equilibrium expression along with the appropriate arrows for each of the following sparingly soluble salts and then write the K_{sp} expression for the equilibrium.

(a) CaF_2

(b) $\text{Ca}_3(\text{PO}_4)_2$

(c) CuF

2. (3 pts) Which of the following activities will produce a precipitate? Write either "No ppt" or write the formula of the precipitate predicted.

(a) Adding equal volumes of 1 M NaCl and 1 M AgNO_3 .

(b) Adding equal volumes of 1 M NaCl and 1 M CaBr_2 .

(c) Adding equal volumes of 1 M $(\text{NH}_4)_2\text{SO}_4$ and 1 M $\text{Ba}(\text{NO}_3)_2$.

3. (3 pts) What is the molar solubility of calcium fluoride in pure water?

4. Which member of each pair has the greater molar solubility? As always, whenever a box is provided, explain your reasoning or show your work.

(a) (2 pts) AgI or AgBr

(b) (2 pts) CaSO_4 or $\text{Ca}(\text{OH})_2$

5. (3 pts) What is the $[\text{OH}^-]$ and pH of a saturated solution of magnesium hydroxide?

6. (3 pts) What is the molar solubility of zinc carbonate in a 0.0010 M solution of Na_2CO_3 ?

7. (3 pts) Will a precipitate form if 0.0010 mol solid ammonium sulfate is stirred into a 250 mL solution of 0.050 M lead nitrate?

8. (3 pts) Which of the following is/are spontaneous?

- (a) water freezing at +4 °C
- (b) a puddle of water evaporating
- (c) a glass of soda pop going “flat” (losing its dissolved carbon dioxide) after awhile
- (d) cheese becoming moldy

9. (4 pts) Which of the following activities is/are associated with an increase in entropy?

- (a) a puddle of water evaporating
- (b) sugar dissolving in water
- (c) water freezing
- (d) a glass of soda pop going “flat”
- (e) crystals of sugar forming in a jar of honey

10. Determine ΔH° and ΔS° for the combustion of hydrazine (a rocket fuel) with “nitrous” (an oxidant),

(a) (2 pts) ΔH°



(b) (2 pts) ΔS°



(c) (2 pts) Use the values determined in (a) and (b) to determine ΔG°

(d) (1 pt) Is this reaction exothermic? YES NO

(e) (1 pt) Is it entropy favored? YES NO

11. (3 pts) Matching.

- ___ always spontaneous
- ___ never spontaneous
- ___ spontaneous at low T; non-spontaneous at high T
- ___ spontaneous at high T; non-spontaneous at low T

- A. $\Delta H > 0$ and $\Delta S < 0$
- B. $\Delta H > 0$ and $\Delta S > 0$
- C. $\Delta H < 0$ and $\Delta S < 0$
- D. $\Delta H < 0$ and $\Delta S > 0$

12. Given that $\Delta H^\circ = +57.0 \text{ kJ}$, $\Delta S^\circ = +176 \text{ J/K}$ and $\Delta G^\circ = +4.6 \text{ kJ}$ for the reaction:



(a) (3 pts) Calculate the equilibrium constant for the reaction.

(b) (3 pts) Calculate ΔG at 370 K and $P_{\text{N}_2\text{O}_4} = 0.5 \text{ atm}$ and $P_{\text{NO}_2} = 5.0 \text{ atm}$. Is the forward reaction spontaneous under these conditions?

(c) (1 pt) This particular reaction is expected to be:

- A. spontaneous at all temperatures
- B. never spontaneous at any temperature
- C. spontaneous at low T; non-spontaneous at high T
- D. spontaneous at high T; non-spontaneous at low T

10. (BONUS 1 point) Print your name here:

(For DocM's use)

Your exam score (50 possible): _____

Bonus pts: Max: _____ Earned: _____

Total Score (50 maximum) _____

Determine your grade:

A ≥ 46.5 ; B+ ≥ 43.5 ; B ≥ 41.0 ;

C+ ≥ 37.5 ; C ≥ 34.00 ; D ≥ 30.00

Useful Formulas:

$$\Delta G = \Delta G^\circ + R T \ln Q$$

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

Answers:



$$K_{\text{sp}} = [\text{Ca}^{+2}][\text{F}^-]^2$$



$$K_{\text{sp}} = [\text{Ca}^{+2}]^3[\text{PO}_4^{-3}]^2$$



$$K_{\text{sp}} = [\text{Cu}^+][\text{F}^-]$$

2. (a) AgCl; (b) no rxn; (c) BaSO₄

3. molar solubility = 3.3×10^{-4} mol/L

4. (a) AgBr; (b) Ca(OH)₂

5. $[\text{OH}^-] = 2.2 \times 10^{-4}$ mol/L; pH = 10.34

6. molar solubility = 1.2×10^{-7} mol/L

7. $Q_{\text{sp}} = 2 \times 10^{-4}$ therefore a precipitate will form.

8. B, C, D

9. A, B, D

10. (a) $\Delta H^\circ = -743$ kJ

(b) $\Delta S^\circ = 274$ J/K

(c) $G^\circ -825$ kJ

(d) YES

(e) YES

11. D, A, C, E

12. (a) $K_p = 0.15$

(b) $\Delta G = 17$ kJ; non-spontaneous

(c) D