Exam: Ch 13 – 17	Name:	Name:										
AP Chem (70 pts, 60 min)	I have not giv	I have not given, received, nor will give any aid on this exam.										
Version I	Period: 5	6	7	March 21 & 22, 2005								

MC:	( / 4)(3 pts each) =	FR:	Overall:

SECTION I: Multiple Choice (3 pts each): Choose the option that is the best answer or completes each question or statement. Write your answers in the blanks provided and erase mistakes completely. In this section, as a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.

- 1. An unsaturated solution is one that: a. Contains more dissolved solute than the solubility allows b. Contains the maximum concentration of solute particles c. Has a concentration lower than the solubility d. Has the dissolved solute in equilibrium with the un-dissolved solute e. Not enough information given or none of the above Ans: 2. Which one of the following is most soluble in water? a. CH<sub>3</sub>OH b. CH<sub>3</sub>CH<sub>2</sub>OH c. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH d. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH e. Not enough information given or none of the above Ans: 3. Of the units below, \_\_\_\_\_\_ are appropriate for a first-order reaction rate constant. a.  $M s^{-1}$ b.  $s^{-1}$ c. L/mol d. M<sup>-1</sup> s<sup>-1</sup> e. Not enough information given or none of the above Ans: Consider the following reaction for Questions 4 – 5:  $2 \text{ NO}(g) \leftrightarrow N_2(g) + O_2(g)$ The equilibrium constant for the reaction above is  $K_{eq} = 230$  at 100°C. At equilibrium, 4. a. Products predominate b. Reactants predominate c. Approximately equal quantities of products and reactants are present d. Only products are present e. Only reactants are present Ans: 5. In an experiment, 0.35 mol of N<sub>2</sub> and 0.40 mol of O<sub>2</sub> are placed in a 1.00 L vessel at 25°C. At equilibrium,
  - it is determined that 0.19 mol of  $O_2$  remain.  $K_p$  at this temperature is:
    - a. 0.063
    - b. 0.15
    - c. 3.7
    - d. 550
    - e. Not enough information given or none of the above

Ans: \_\_\_\_\_

6.	<ul> <li>Which one of the following statements about K<sub>w</sub> is false?</li> <li>a. K<sub>w</sub> is the chemical equilibrium expression of: OH<sup>-</sup> (aq) + H<sup>+</sup> (aq) ↔ H<sub>2</sub></li> <li>b. K<sub>w</sub> is known as the ion-product constant for water.</li> <li>c. K<sub>w</sub> changes with temperature.</li> <li>d. The value of K<sub>w</sub> show that water is a weak base.</li> <li>e. None of the above</li> </ul>	20 (l) Ans:
7.	<ul> <li>ZOH is a weak base. An aqueous solution of ZOH is prepared by dissolving 0.</li> <li>sufficient water to yield 2.00 L of solution. The pOH of the solution was 9.07 a. 3.5 x 10<sup>-9</sup></li> <li>b. 6.9 x 10<sup>-9</sup></li> <li>c. 1.8 x 10<sup>-17</sup></li> <li>d. 3.6 x 10<sup>-17</sup></li> <li>e. Not enough information given</li> </ul>	040 mol of ZOH in at 25°C. The K <sub>b</sub> of ZOH is: Ans:
8.	Of the following, which is most likely to be the strongest base? a. H <sub>3</sub> PO <sub>4</sub> b. H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> c. HPO <sub>4</sub> <sup>2-</sup> d. PO <sub>4</sub> <sup>3-</sup> e. AsO <sub>4</sub> <sup>3-</sup>	Ans:
9.	<ul> <li>Which of the following cannot act as a Lewis acid?</li> <li>a. HCl</li> <li>b. BF<sub>3</sub></li> <li>c. H<sub>3</sub>O<sup>+</sup></li> <li>d. CO<sub>2</sub></li> <li>e. All of these can be Lewis acids</li> </ul>	Ans:
10.	<ul> <li>Determine the K<sub>sp</sub> for manganese (II) hydroxide, where the solubility is 2.2 x 10 a. 1.1 x 10<sup>-14</sup></li> <li>b. 4.3 x 10<sup>-14</sup></li> <li>c. 2.1 x 10<sup>-14</sup></li> <li>d. 4.8 x 10<sup>-10</sup></li> <li>e. Not enough information given or none of the above</li> </ul>	0 <sup>-5</sup> M. Ans:
11.	<ul> <li>Which of the following could be added to a solution of sodium acetate to produ         <ol> <li>Acetic acid</li> <li>Hydrochloric acid</li> <li>Potassium acetate</li> <li>Sodium chloride</li> </ol> </li> </ul>	ice an effective buffer?
	<ul> <li>a. I only</li> <li>b. III only</li> <li>c. IV only</li> <li>d. I or II</li> <li>e. I, II, III, or IV</li> </ul>	Ans:

## **SECTION II: Free Response**

12. (13 pts) Silver chromate is a dense, reddish-brown, slightly soluble solid.

- a. (3 pts) At 25°C, the solid dissolves slightly in water. Write the balanced chemical equilibrium equation for this dissolution.
- b. (3 pts) Write the appropriate chemical equilibrium expression for this dissolution.
- c. (4 pts) If the  $\Delta H_{reaction} = -20 \text{ kJ/mol}$ , and if the temperature of the system were increased from 25°C to 100°C, what would be the effect on the value of K<sub>sp</sub>? Briefly explain in 1-2 sentences.
- d. (4 pts) If solid silver nitrate added to the system at equilibrium at 25°C, what would be the effect on the concentration of chromate in the solution? Briefly explain in 1-2 sentences.
- 13. (12 pts) A sample of an ionic compound,  $NaC_6H_5O$ , where  $C_6H_5O^-$  is the conjugate ion of phenolic acid, was dissolved in water to make 100.0 mL of solution. It was then titrated with 0.100 M HCl. After the addition of 500.0 mL HCl, the pH was found to be 5.00. After the addition of another 500.0 mL of HCl, it was discovered that the equivalence point was reached.
  - a. (6 pts) Calculate the  $K_a$  of  $HC_6H_5O$ .

b. (6 pts) Calculate the pOH of the solution at the equivalence point of the titration.

14. (12 pts) Consider the titration of 50.00 mL of 0.250 M hydrazine,  $H_2NNH_2$  ( $K_b = 1.3 \times 10^{-2}$ ) with 0.500 M hydrochloric acid. Using the axes below, make a sketch of the titration curve, calculating <u>only</u> the initial pH, the pH at the equivalence point, and the final pH. Sketch in the rest of the curve appropriately. Be sure to label the axes and include units.

Use this space for your work:

• Initial pH

• The pH at the equivalence point

• The final pH

15. (3 pts) Describe how to increase the buffer capacity of a buffer, and how this would affect the function of a buffer.

Exam: Ch 13 – 17 AP Chem (72 pts, 60 min)	Name: I have not given, received, nor will give any aid on this exam.										
Version J	Period:	5	6	7	March 21 & 22, 2005						
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MC:	$(\ \ / 4)(3 \text{ pts each}) = \$	FR:	Overall:	

SECTION I: Multiple Choice (3 pts each): Choose the option that is the best answer or completes each question or statement. Write your answers in the blanks provided and erase mistakes completely. In this section, as a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.

1. In a saturated solution of a salt in water: a. The rate of crystallization > the rate of dissolution b. The rate of dissolution > the rate of crystallization c. The rate of crystallization = the rate of dissolution d. The addition of additional salt causes massive crystallization e. Not enough information given or none of the above Ans: 2. Which one of the following is most soluble in hexane  $(C_6H_{14})$ ? a. CH<sub>3</sub>OH b. CH<sub>3</sub>CH<sub>2</sub>OH c. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH d. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH e. Not enough information given or none of the above Ans: 3. Of the units below, \_\_\_\_\_\_ are appropriate for a second-order reaction rate constant. a.  $M s^{-1}$  $s^{-1}$ b. L/mol c. d. M<sup>-1</sup> s<sup>-1</sup> Not enough information given or none of the above e. Ans: 4. Of the following, which is most likely to be the strongest base? a. ClO b. ClO<sub>2</sub> c. ClO<sub>3</sub> d. ClO<sub>4</sub>e. IO Ans: 5. Which of the following cannot act as a Lewis base? Cl a. b. NH<sub>3</sub> c. CN<sup>-</sup> d. CH<sub>4</sub> e. All of these can be Lewis bases Ans:

Consid	ler the f	Collowing reaction for Questions 6 – 7: $2 \text{ NO}(g) \leftrightarrow N_2(g) + O_2(g)$	
6.	The eq	uilibrium constant for this reaction is $K_{eq} = 10$ at 50°C. The equilibrium constant	t for the following
	reactio	n is therefore:	
	$N_{2}(g)$	$+ O_2(g) \leftrightarrow 2 \text{ NO}(g)$	
	a.	0.1	
	b.	1	
	с.	-10	
	d.	100 Nationauch information aisen annona af tha about	<b>A</b>
	e.	Not enough information given of none of the above	Ans:
7.	At 200	$^{\circ}$ C, the equilibrium constant for the reaction is 2.40 x 10 <sup>3</sup> . 36.1 atm of NO are a	dded to a vessel that
	is then	sealed. At equilibrium, the partial pressure of $O_2$ is atm	
	a.	294	
	b.	35.7	
	c.	18.1	
	d.	6.00	
	e.	Not enough information given or none of the above	Ans:
8.	Which	one of the following statements about K <sub>w</sub> is false?	
	a.	pK <sub>w</sub> is 14.00 at 25°C	
	b.	The value of $K_w$ is always 1.0 x 10 <sup>-14</sup> .	
	c.	K <sub>w</sub> changes with temperature.	
	d.	The value of $K_w$ show that water is a weak acid.	
	e.	Not enough information given or none of the above	Ans:
9.	HZ is a	a weak acid. An aqueous solution of HZ is prepared by dissolving 0.040 mol of I	HZ in sufficient
	water t	to yield 2.00 L of solution. The pH of the solution was 4.93 at 25°C. The $K_a$ of I	HZ is:
	a.	1.2 x 10 <sup>-5</sup>	
	b.	$6.9 \times 10^{-9}$	
	с.	$1.4 \times 10^{-10}$	
	d.	9.9 x 10 <sup>-2</sup>	
	e.	Not enough information given or none of the above	Ans:
10.	Determ	nine the $K_{sp}$ for magnesium hydroxide, where the solubility is 1.4 x 10 <sup>-4</sup> M.	
	a.	$2.7 \times 10^{-12}$	
	b.	$1.1 \times 10^{-11}$	
	c.	$2.0 \times 10^{-8}$	
	d.	3.9 x 10 <sup>-6</sup>	
	e.	Not enough information given or none of the above	Ans:
11.	Which	of the following could be added to a solution of ammonium bromide to produce	an effective buffer?
		I. Ammonia	
		II. Ammonium iodide	
		III. Hydrobromic acid	
		IV. Soaium nyaroxiae	
	a.	I only	
	b.	II only	

- c. III onlyd. I or IVe. II or IV

Ans: \_\_\_\_\_

## **SECTION II: Free Response**

12. (12 pts) Plumbous iodide is a dense, golden yellow, slightly soluble solid.

- a. (3 pts) At 25°C, the solid dissolves slightly in water. Write the balanced chemical equilibrium equation for this dissolution.
- b. (3 pts) Write the appropriate chemical equilibrium expression for this dissolution.
- c. (3 pts) If the  $\Delta H_{reaction} = 46 \text{ kJ/mol}$ , and if the temperature of the system were lowered from 25°C to 15°C, what would be the effect on the value of K<sub>sp</sub>? Briefly explain in 1-2 sentences.
- d. (3 pts) If additional solid plumbous iodide were added to the system at equilibrium, what would be the effect on the concentration of iodide in the solution? Briefly explain in 1-2 sentences.
- 13. (12 pts) A sample of an ionic compound NH<sub>3</sub>CH<sub>3</sub>Cl, where NH<sub>3</sub>CH<sub>3</sub><sup>+</sup> is the conjugate ion of a weak base, was dissolved in water to make 200.0 mL of solution. It was then titrated with 0.200 M NaOH. After the addition of 500.0 mL NaOH, the pH was found to be 8.50. After the addition of another 500.0 mL of NaOH, it was discovered that the equivalence point had been reached.
  - a. (6 pts) Calculate the  $K_b$  of  $NH_2CH_3$ .

b. (6 pts) Calculate the pH of the solution at the equivalence point of the titration.

14. (12 pts) Consider the titration of 50.00 mL of 0.125 M chlorous acid ( $K_a = 1.1 \times 10^{-2}$ ) with 0.250 M sodium hydroxide. Using the axes below, make a sketch of the titration curve, calculating <u>only</u> the initial pH, the pH at the equivalence point, and the final pH. Sketch in the rest of the curve appropriately. Be sure to label the axes and include units.

Use this space for your work:

• Initial pH

• The pH at the equivalence point

• The final pH

15. (3 pts) Compare and contrast the equivalence point and endpoint of a titration.