CHE 113   FINAL EXAMINATION   May 3, 2012

University of Kentucky   Department of Chemistry

<u>READ THESE DIRECTIONS CAREFULLY BEFORE STARTING THE EXAMINATION!</u>

It is *extremely* important that you fill in the answer sheet <u>EXACTLY</u> as indicated, otherwise your answer sheet may not be processed; ALL entries are to be made on SIDE 1 of the answer sheet. Use a #2 pencil (or softer); <u>fill in the circles completely and firmly. Erasures must be complete</u>. Use only the following categories:

NAME:	Print your name starting at the first space, LAST NAME first, then a space, followed by your FIRST NAME, then another space, followed by your MIDDLE INITIAL. Fill in the <u>correct</u> circles below your printed name corresponding to the letters of your name; for the spaces, fill in the top blank circle.
STUDENT NUMBER:	This is **VERY IMPORTANT!** Under IDENTIFICATION NUMBER, put in your **8 DIGIT STUDENT ID NUMBER** (**do not use the 9 at the beginning of your number**) beginning in column A and continuing through column H, column I will be blank, (do NOT use column J at this time); be sure to fill in the correct circles (a common error to be avoided is mistaking "0" for "1").
TEST FORM:	Fill in the "2" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination II).
SPECIAL CODES:	Use for course and section number; in positions K-P write in your course and section: Dr. April French 113-xxx
SIGNATURE:	You **MUST** sign the examination answer sheet (bubble sheet) on the line directly above your printed name. Use your legal signature.

<u>Answering Questions</u>:
Starting with answer "1" on SIDE 1, fill in the circle indicating the <u>one best answer</u> for each of the **35 questions** in this examination. Your score is the sum of the appropriate credit for each response.

<u>Grading and Reporting</u>:
The examination scores will be posted in Blackboard as soon as possible after the examination. If an error has occurred in scoring your answers, inform your instructor within 48 hours of the posting of your score.

<u>BE SURE THAT YOUR TEST HAS 35 QUESTIONS, A PERIODIC TABLE, AND ONE SHEET OF SCRATCH PAPER</u>. You may <u>NOT</u> use your own scratch paper during this examination. Cell phones, computer, and pagers are to be turned off and out of sight during the exam. **All** exam paper, scratch paper, and scantrons must be handed in at the end of the exam. You may **not** take any exam materials away from the exam room.

1. It is a sunny 80°F day in Lexington and four students are on their way to lab. Which of the following students is correctly dressed for lab?

    Student 1: Capri pants, UK t-shirt, ballet flats with no socks
    Student 2: Knee-length sun dress, sandals
    Student 3: Denim jeans, Old-Navy t-shirt, Nike tennis shoes
    Student 4: Board shorts, muscle shirt, flip-flops

    A. Student 1   C. Student 3
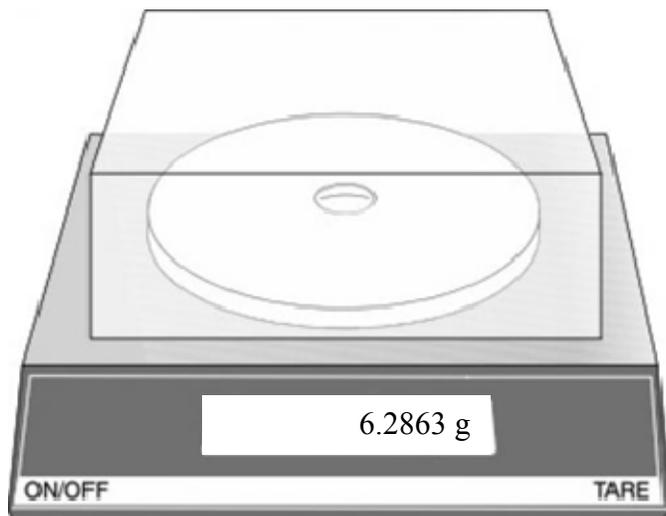   B. Student 2   D. Student 4

2. The safety equipment pictured here is:

    A. Eye wash bath   C. Safety shower
    B. Fire doors   D. Nothing

3. On the balance shown below, which of the digits is estimated?

A. 6   C. 2

B. 8   D. 3

4. A chemist must determine the density of a mineral sample. After conducting four trials, the chemist found the following densities: 4.68 g/cm³, 4.67 g/cm³, 4.67 g/cm³, and 4.68 g/cm³. Independent studies found that correct density to be 4.95 g/cm³. Which of the following statements represents the best analysis of the data?

A. The chemist's results have much greater accuracy than precision.

B. The chemist's results have much greater precision than accuracy.

C. The chemist's results have high accuracy and high precision.

D. The chemist's results have low accuracy and low precision.

5. How many mL of a 2.00 M $CuSO_4$ stock solution are needed to prepare 0.250 L of a 0.400 M $CuSO_4$?

A. 50.0 mL   C.   100.0 mL

B. 0.050mL   D.   25.0 mL

6. If 2.95 mL of acetic anhydride reacts with 4.59 g salicylic to form aspirin and acetic acid, what is the limiting reagent?

Acetic anhydride	+	Salicylic acid	→	aspirin	+	Acetic acid
$(CH_3CO)_2O$		HOC_6H_4COOH		$CH_3CO_2C_6H_4CO_2H$		CH_3COOH
Density = 1.082g/mL						

A. Acetic anhydride
B. Salicylic acid
C. Aspirin
D. Acetic acid

7. How many lone pairs of electrons are on the P atom in PCl_5?

A. 0
B. 1
C. 2
D. 3

8. An aqueous KNO_3 solution is cooled from 75°C to 15°C. Which statement from the following list is true?

A. The molarity of the solution does not change.
B. The molality of the solution does not change.
C. The molality of the solution decreases.
D. The density of the solution does not change.

9. The freezing point of ethanol (C_2H_5OH) is –114.6°C. The molal freezing point depression constant for ethanol is 2.00°C/m. What is the freezing point (°C) of a solution prepare by dissolving 50.0 g of glycerin ($C_3H_8O_3$, a nonelectrolyte) in 200 g of ethanol?

A. –120.°C
B. –5.42°C
C. –132°C
D. –115°C

10. Jeff prepared a sugar solution containing 2.94 g of sugar ($C_{12}H_{22}O_{11}$) in 25.00 mL of water and produced the following freezing point data:

Freezing point of Pure Water

Freezing point of Sugar Solution
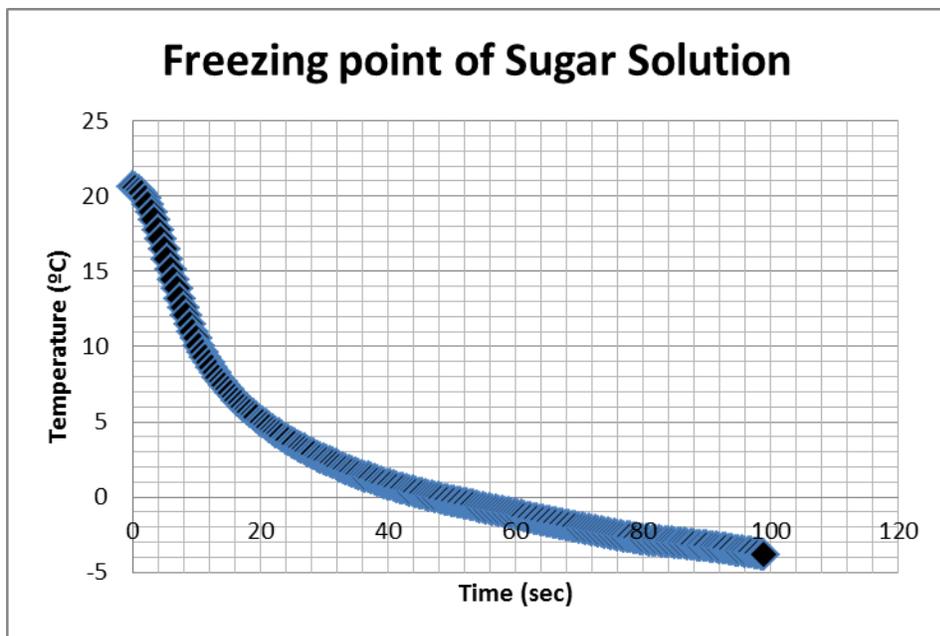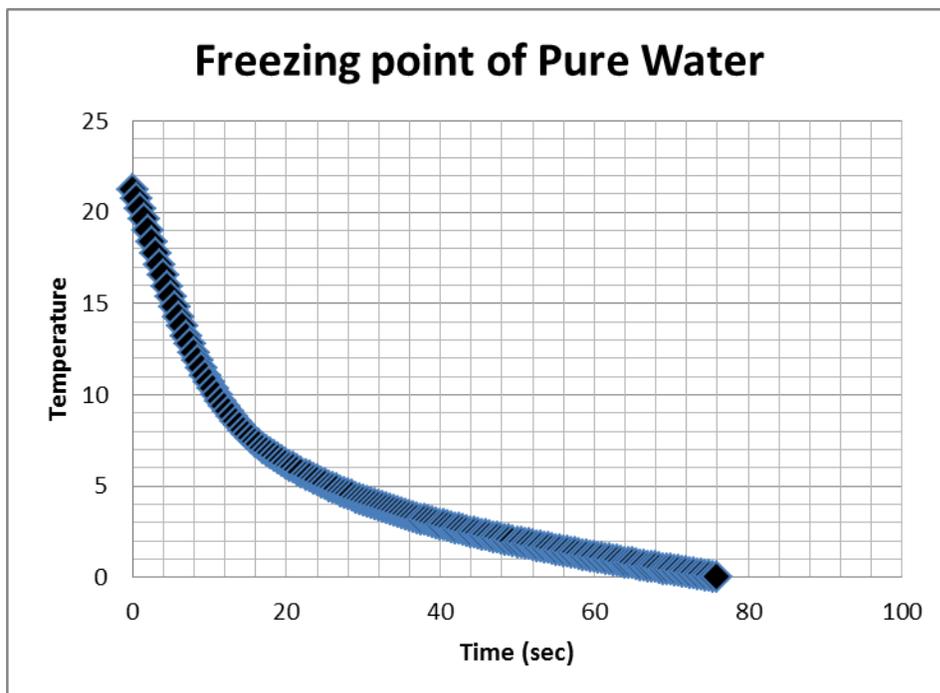
What is the K_f of water based on Jeff's data?

A. 15.3 °C/m

B. 0.367 °C/m

C. 8.44 °C/m

D. 1.86 °C/m

11. A hard water sample contains 0.0085% calcium by mass in the form of Ca^{+2} ions. How much water (in grams) contains 1.2 grams of Ca? 1.2 g of Ca is the recommended daily allowance of calcium for those between 19 and 24 years old.

A. $7.1 \times 10^{-5}g$

C. 1.4×10^4 g

B. 0 g

D. 100 g

12. Consider the following reaction:

$$3A \rightarrow 2B$$
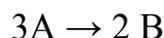
The average rate of appearance of B is given by $\frac{\Delta[B]}{\Delta t}$. Comparing the rate of appearance of B and the rate of disappearance of A, we get $\frac{\Delta[B]}{\Delta t} = \underline{\quad} \times \left(-\frac{\Delta[A]}{\Delta t}\right)$.

A. + 2/3

C. –2/3

B. –3/2

D. +3/2

13. If the rate law for the reaction

$$2A + 3B \rightarrow products$$
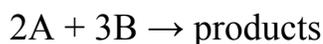
is first order in A and second order in B, what is the rate law?

A. Rate = $k[A]^2[B]$

C. Rate = $k[A]^2[B]^2$

B. Rate = $k[A][B]$

D. Rate = $k[A][B]^2$

14. Consider the following reaction at equilibrium in a closed container

$$4 NH_3(g) + 3 O_2(g) \rightleftharpoons 2 N_2(g) + 6 H_2O(g) \quad \Delta H = -64.5 \text{ kJ/mol}$$
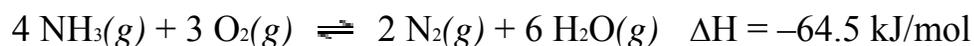
Increasing the O_2 partial pressure will _____ the NH_3 partial pressure.

A. Increase

C. Not change

B. Decrease

D.

15. Consider the reaction

$$Fe^{+3}(aq) + SCN^-(aq) \rightleftharpoons FeSCN^{+2}(aq)$$
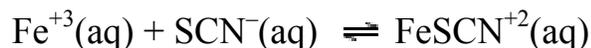
A reaction mixture at 25°C initially contains 9.722×10^{-4} M Fe^{+3} and 4.325×10^{-4} M SCN^-. At equilibrium, the reaction vessel contained 5.847×10^{-5} M $FeSCN^{+2}$. What is the K_c of this reaction?
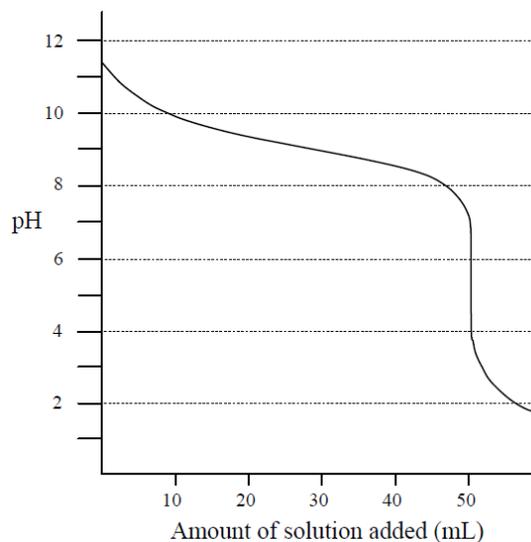
A. 5.845×10^{-3} C. 7.191×10^{-3}

B. 139.1   D. 171.08

**Questions 16 – 35 cover material after the Midterm Exam**

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16. Consider the following titration curve.

Which one of the following combinations does the titration curve represent?

A. Addition of a strong acid to a weak base
B. Addition of a strong base to a weak acid
C. Addition of a weak base to a strong acid
D. Addition of a strong acid to a strong base

17. In lab, you used a standardized 0.1976 M NaOH solution to titrate an acetic acid solution of unknown concentration. The following titration curve was produced after titrating 25.00 mL of the unknown acetic acid solution:

Titration of Acetic Acid with NaOH

2nd Derivative of Acetic Acid Titration with NaOH
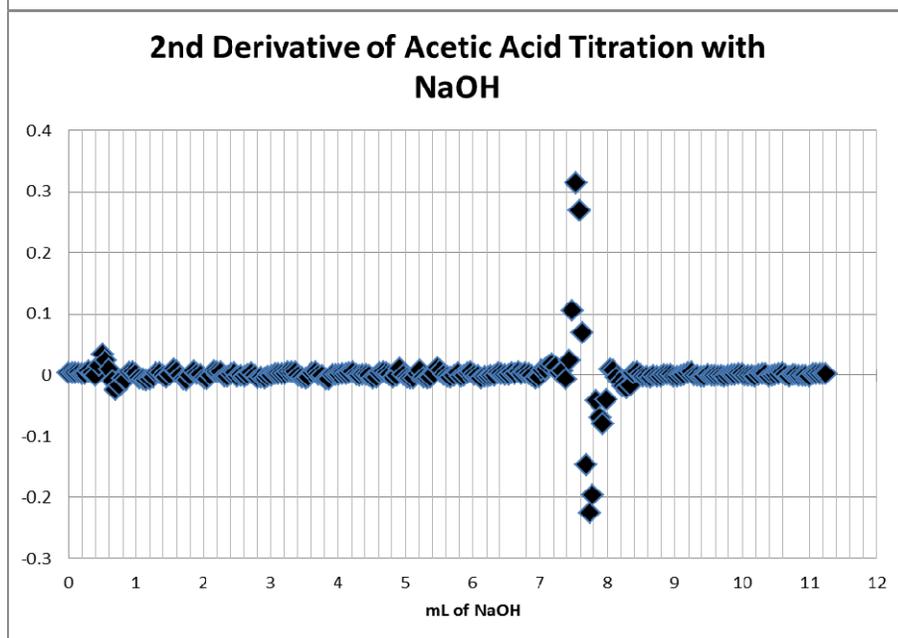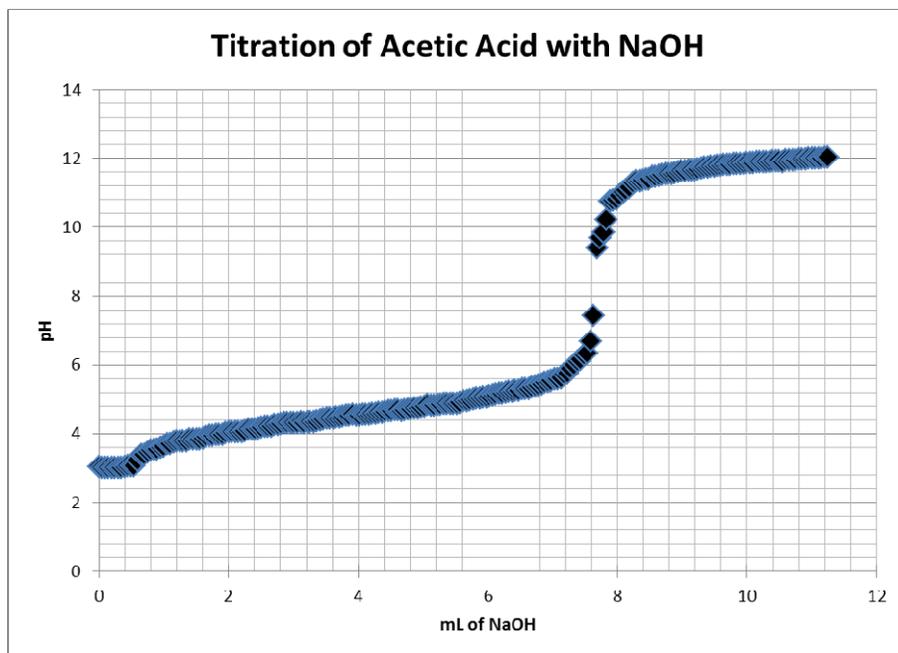
What is the concentration of the acetic acid solution?

A. 0.0474 M   C. 0.0632 M

B. 0.0553 M   D. 0.0601 M

18. In lab, you completed three titrations to standardize a sodium hydroxide solution and determined the following molarities: 0.180 M, 0.213 M, and 0.200 M. What is the standard deviation associated with these data points?

$$\text{Std. dev.} = \sqrt{\frac{\Sigma(X_i - \bar{X})^2}{(n-1)}}$$

A. 0.05   C. 0.02

B. 0.002   D. 0

19. 25.0 mL of a 0.100 M Ba(OH)$_2$ solution was used to titrate 50 mL of HCl. What is the concentration of the HCl solution?

A. 0.05 M   C. .001 M

B. 10 M   D. 0.100 M

20. Acid rain over the Great Lakes has a pH of about 4.5, while the rain over Kentucky has a pH of 7.4. How many times more concentrated is the acid in rain over the Great Lakes?

A. 10 times   C. 2 times

B. 800 times   D. 7000 times

21. Potassium hydrogen phthalate (KHP) is used as a primary standard in titrations. Why do you need to standardize sodium hydroxide prior to using it in a titration?

A. The mass of sodium hydroxide was not recorded prior to preparing the solution.

B. The concentration of sodium hydroxide is not known.

C. You have to titrate an acid with another acid.

D. Sodium hydroxide is hygroscopic and so its concentration may have changed.

22. What is the conjugate base of HCO_3^-?

    A. OH^- C. CO_3^{-2}

    B. H_2CO_3 D. HCO_3^+

23. The K_a of acetic acid is 1.7×10^{-5}. What is the pH of a buffer prepared by combining 50.0 mL of 1.00 M potassium acetate and 50.0 mL of 1.00 M acetic acid?

    A. 1.00   C.   4.77

    B. 0.00   D.   6.58

24. Which of the following conjugate acid/base pairs would you choose to create a buffer solution with a pH of 5.00?

    A. Formic acid / sodium formate
        $K_a = 1.77 \times 10^{-4}$
    B. Propionic acid / sodium propionate
        $K_a = 1.34 \times 10^{-5}$
    C. Phosphoric acid / sodium dihydrogen phosphate monohydrate
        $K_a = 7.52 \times 10^{-3}$
    D. Sodium bisulfate monohydrate / sodium sulfate decahydrate
        $K_a = 1.20 \times 10^{-2}$

25. Consider a solution that is 0.25M $HC_2H_3O_2$ / $NaC_2H_3O_2$. Which response contains all false statements?

    I. If LiOH is added, sodium ions will react with hydroxide ions.
    II. If a small amount of LiOH is added, the pH increases very slightly.
    III. If more $NaC_2H_3O_2$ is added, the pH decreases.
    IV. If HNO_3 is added, hydrogen ions react with acetate ions.

    A. I and III   C.   I and IV

    B. II and IV   D.   II and III

26. Which of the following is the correct equilibrium expression for the addition of solid calcium sulfate to water?

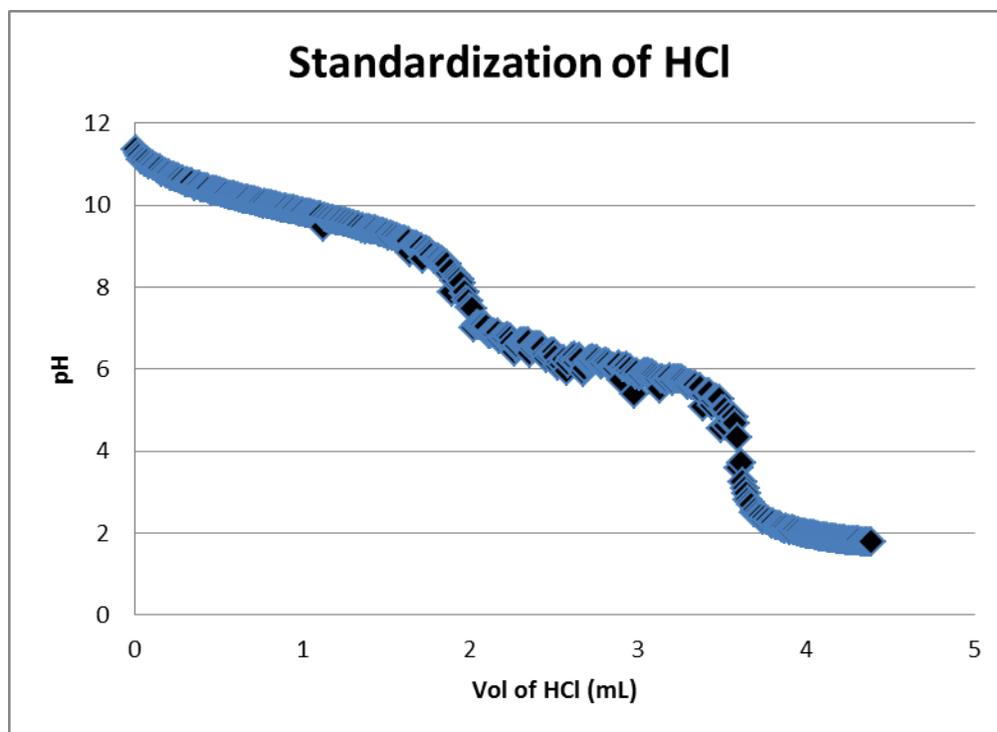A. $K_{sp} = \dfrac{[Ca^{+2}][SO_4^{-2}]}{[CaSO_4]}$

C. $K_{sp} = [Ca^{+2}][SO_4^{-2}]$

B. $K_{sp} = \dfrac{[CaSO_4]}{[Ca^{+2}][SO_4^{-2}]}$

D. $K_{sp} = [CaSO_4]$

27. The following data was obtained during the standardization of HCl with Na_2CO_3.

Why are two equivalence points seen in this titration?

A. The acid used contains two hydrogens.
B. The base used can accept two hydrogens.
C. The base breaks into two pieces.
D. The acid breaks into two pieces.

28. Which of the following shows the correct K_{sp} expression for the dissolution of barium hydroxide in water?

A. $BaOH(s) \rightleftharpoons Ba^+(aq) + OH^-(aq)$ C. $BaOH_2(aq) \rightleftharpoons Ba^{+2}(s) + 2OH^-(aq)$

B. $Ba(OH)_2(s) \rightleftharpoons Ba^{+2}(aq) + OH^-(aq)$ D. $Ba(OH)_2(s) \rightleftharpoons Ba^{+2}(aq) + 2OH^-(aq)$

29. What is the concentration of strontium ion in a saturated solution of $SrCrO_4(s)$ in pure water? The K_{sp} for $SrCrO_4(s)$ is 3.6×10^{-5}.

A. 0.0060 M C. 4.2×10^{-3} M

B. 3.6×10^{-5} M D. 1.8×10^{-5} M

30. If solid NaCl is added to an aqueous solution which is 0.0200 M in BOTH $Pb(NO_3)_2$ and $AgNO_3$ until the $[Cl^-]$ is 0.02 M, what will happen? Assume no volume change. K_{sp} for $PbCl_2$ is 1.6×10^{-5} and K_{sp} for $AgCl$ is 1.6×10^{-10}.

A. A precipitate of $PbCl_2$ but not of AgCl will form.

B. A precipitate of AgCl but not of $PbCl_2$ will form.

C. Precipitates of both AgCl and $PbCl_2$ will form.

D. No precipitate will form.

31. What is the solubility product, K_{sp}, for the dissolution of lead (II) hydroxide if the solubility of $Pb(OH)_2$ in water is 1.53×10^{-7} mol/L?

A. 3.58×10^{-21} C. 1.43×10^{-20}

B. 2.34×10^{-14} D. 7.16×10^{-21}

32. Which of the following contains only compounds that are soluble?

    A. $NaOH$, $CaCO_3$, Na_2CO_3 C. NH_4Cl, MgS, $PbNO_3$

    B. $NaCl$, $NaHCO_3$, $MgSO_4$ D. $BaCO_3$, $Ca(NO_3)_2$, CaS

33. Various qualitative tests were performed on an unknown sample and the following results were obtained:

    1. The unknown was insoluble in water.
    2. When iodine was added, the solution did not change color.
    3. When mixed with vinegar, the solid bubbled.

    Based on this information, what is the identity of the unknown?

    A. Cornstarch   C. Sodium carbonate

    B. Calcium carbonate   D. Sodium chloride

34. In lab, you conducted a sodium hydroxide test by adding 5 to 10 drops of 2M NaOH to your unknown solutions. What were you testing for in this reaction?

    A. The presence of sodium hydroxide.
    B. The presence of acid.
    C. The presence of starch.
    D. The formation of an insoluble hydroxide.

35. A student performed an iodine test on an unknown sample and the solution turned deep blue in color. What is the unknown?

    A. Sodium bicarbonate   C. Sodium borate

    B. Cornstarch   D. Sodium chloride

CHE 113 Final Exam Key SP 12

1. C
2. C
3. D
4. B
5. A
6. A
7. A
8. B
9. A
10. C
11. C
12. A
13. D
14. B
15. D
16. A
17. D
18. C
19. D
20. B
21. D
22. C
23. C
24. B
25. A
26. C
27. B
28. D
29. A
30. B
31. C
32. B
33. B
34. D
35. B