CHE 107 EXAMINATION III July 19, 2013

University of Kentucky Department of Chemistry

READ THESE DIRECTIONS CAREFULLY BEFORE STARTING THE EXAMINATION!

It is *extremely* important that you fill in the answer sheet EXACTLY 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); fill in the circles completely and firmly. Erasures must be complete. 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 correct 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 "3" blank in the J column under IDENTIFICATION NUMBER (to indicate Examination III).
SPECIAL CODES:	Use for course and section number; in positions K-P write in the following: Dr.Blue 107-020 107-021
SIGNATURE:	You **MUST** sign the examination answer sheet (bubble sheet) on the line directly above your printed name. Use your legal signature.

Answering Questions:

Starting with answer "1" on SIDE 1, fill in the circle indicating the one best answer for each of the **25 questions** in this examination. Your score is the sum of the appropriate credit for each response. On the day following the examination, an examination key will be posted on Blackboard.

Grading and Reporting:

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.

BE SURE THAT YOUR TEST HAS 25 QUESTIONS, A PERIODIC TABLE, AND ONE SHEET OF SCRATCH PAPER. You may NOT use your own scratch paper during this examination. Cell phones, computers, and pagers are to be turned off and out of sight during the exam.

1. Which balanced chemical equation correctly identifies the bolded reactant as an Arrhenius acid or base and properly demonstrates how the acid or base behaves?

A. base $\mathbf{KOH(}\boldsymbol{aq}\mathbf{)} \rightarrow K^+(aq) + OH^-(aq)$

B. base $\mathbf{CH_3NH_3^+(}\boldsymbol{aq}\mathbf{)} + H_2O(l) \rightleftharpoons CH_3NH_2(aq) + H_3O^+(aq)$

C. acid $\mathbf{H_3AsO_4(}\boldsymbol{aq}\mathbf{)} \rightarrow 3\ H^+(aq) + AsO_4^{3-}(aq)$

D. acid $\mathbf{NH_3(}\boldsymbol{aq}\mathbf{)} + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

2. Select the reactants from each balanced chemical equation below that function as Brønsted-Lowry **bases**.

(1) $H_2Se(aq) + CO_3^{2-}(aq) \rightarrow HSe^-(aq) + HCO_3^-(aq)$
(2) $C_3H_7NH_2(aq) + H_2O(l) \rightarrow C_3H_7NH_3^+(aq) + OH^-(aq)$

A. (1) H_2Se; (2) $C_3H_7NH_2$

B. (1) CO_3^{2-}; (2) $C_3H_7NH_2$

C. (1) H_2Se; (2) H_2O

D. (1) CO_3^{2-}; (2) H_2O

3. Which one of the following 0.250 M acids has the **highest** percent ionization?

A. HCN, $K_a = 4.9 \times 10^{-10}$

B. H_3BO_3, $K_a = 5.4 \times 10^{-10}$

C. $HC_9H_7O_4$, $K_a = 3.3 \times 10^{-4}$

D. HNO_2, $K_a = 4.6 \times 10^{-4}$

4. K_w for water is 5.48×10^{-14} at 50°C. Which of the following statements about water at 50°C is **false**?

A. $pK_w = 13.261$ for water at 50°C.

B. pH = 6.631 for pure water at 50°C.

C. $[H^+] = 1.00 \times 10^{-7}$ M for pure water at 50°C.

D. $[OH^-] = 2.34 \times 10^{-7}$ M for pure water at 50°C.

5. Find the pH of a solution formed by mixing 50.0 mL of 0.100 *M* HI and 150.0 mL of 0.050 *M* HIO. K_a for HIO is 2.3×10^{-11}.

A. 1.10
C. 2.78
B. 1.60
D. 1.39

6. A 0.200 *M* solution of acetylsalicylic acid ($HC_9H_7O_4$) is 4.06% percent ionized. What is K_a for acetylsalicylic acid?

A. 5.29×10^{-3}
C. 3.44×10^{-4}
B. 4.28×10^{-7}
D. 2.31×10^{-6}

7. An acidic solution contains 0.050 *M* $HClO_4$, 0.050 *M* $HClO_2$, 0.050 *M* HClO, and 0.050 *M* HCl. In calculating the pH, which acidic species contribute significantly to the pH and must be considered?

A. $HClO_2$ and HClO
C. $HClO_4$ and $HClO_2$
B. HClO and HCl
D. $HClO_4$ and HCl

8. What is the pH of a 0.0200 *M* solution of codeine ($C_{18}H_{21}NO_3$, K_b 2.31×10^{-6})?

A. 10.332
C. 8.659
B. 11.281
D. 7.305

9. If $HONH_3Cl$ is added to water, what is the correct value of *K* needed to calculate the pH of the resulting solution given that K_b of $HONH_2$ is 1.1×10^{-8}?

A. 1.1×10^{-5}
C. 1.0×10^{-7}
B. 9.1×10^{-7}
D. 9.3×10^{-8}

10. Which of the following cations is acidic?

A. Ca^{2+}
C. Mn^{7+}
B. Na^{+}
D. Rb^{+}

11. Which one of the following salts dissolves in water to give a solution in the indicated pH range?

A. NaCN, pH < 7
C. Na_2CO_3, pH = 7
B. NH_4Cl, pH > 7
D. $MgCl_2$, pH = 7

12. Which of the following lists acids in order of **increasing** acid strength?

A. $HIO < HIO_2 < HClO_3 < HClO_4$
B. $HClO_4 < HClO_3 < HIO_2 < HIO$
C. $HClO_3 < HClO_4 < HIO < HIO_2$
D. $HIO < HClO_3 < HIO_2 < HClO_4$

13. Which of the following lists acids in order of **decreasing** acid strength?

A. $H_2Te > HBr > H_2Se > H_2S$
C. $H_2S > H_2Se > H_2Te > HBr$
B. $HBr > H_2Te > H_2Se > H_2S$
D. $HBr > H_2S > H_2Se > H_2Te$

14. Identify the Lewis **bases** in the following reactions.

$$Mn^{2+}(aq) + 6\ H_2O(l) \rightarrow Mn(H_2O)_6^{2+}(aq)$$
$$PCl_3(l) + BBr_3(g) \rightarrow Br_3B^{-}\text{—}^{+}PCl_3(s)$$

A. Mn^{2+}, PCl_3
C. H_2O, PCl_3
B. Mn^{2+}, BBr_3
D. H_2O, BBr_3

15. Which one of the following mixtures will act as a buffer?

A. 20.0 mmol HCl and 15.0 mmol NaOH in 350.0 mL of solution

B. 25.0 mmol HNO_3 and 25.0 mmol HCl in 50.0 mL of solution

C. 10.0 mmol NaH_2PO_4 and 10.0 mmol Na_3PO_4 in 100.0 mL of solution

D. 25.0 mmol $HC_2H_3O_2$ and 12.5 mmol NaOH in 50.0 mL of solution

16. What is the ratio of conjugate base to weak acid in a $HC_4H_7O_2/KC_4H_7O_2$ buffer with a pH of 5.12? The pK_a of $HC_4H_7O_2$ is 4.82.

A. 1.3:1

B. 2.0:1

C. 0.27:1

D. 0.78:1

17. A 1.00 L buffer solution contains 0.100 mol HNO_2 and 0.075 mol $NaNO_2$ (pK_a for HNO_2 is 3.34). What is the pH of the solution **after** 0.025 mol of solid HCl is added? Assume no change in volume.

A. 1.78

B. 4.29

C. 2.94

D. 3.67

18. Which of the following is **not** a characteristic of an effective buffer?

A. Buffers are most effective when [base]:[acid] = 1.

B. A buffer will be effective as long as the ratio of [base]:[acid] remains between 0.1 and 10.

C. Buffers are most effective when polyprotic acids are used.

D. Buffers are most effective when the [acid] and [base] are large.

19. What is the pH of the resulting solution when 50.0 mL of 0.25 *M* KOH is added to 50.0 mL of 0.15 *M* HBr?

A. 12.70
C. 2.75
B. 13.35
D. 1.10

20. A 25.0 mL sample of 0.400 *M* ethylamine ($C_2H_5NH_2$, K_b 5.6×10^{-4}) is titrated with 0.500 *M* HCl. What is the pH after adding 8.00 mL of HCl to the $C_2H_5NH_2$ solution?

A. 10.92
C. 4.65
B. 11.36
D. 8.74

21. A handbook lists the following information:

Indicator	pK_{HIn}
Thymol blue	1.65
Chlorophenol red	6.25
Metacresol purple	8.32
Alizarin yellow	11.00

Which indicator would be **best** to use in the titration of 0.100 M pyruvic acid ($HC_3H_3O_3$, K_a 4.1×10^{-3}) with 0.075 M NaOH?

A. Alizarin yellow
C. Chlorophenol red
B. Metacresol purple
D. Thymol blue

22. Which one of the following salts is the **most** soluble in water?

A. CaC_2O_4, $K_{sp} = 2.32 \times 10^{-9}$
C. BaC_2O_4, $K_{sp} = 1.60 \times 10^{-6}$
B. ZnC_2O_4, $K_{sp} = 2.70 \times 10^{-8}$
D. MgC_2O_4, $K_{sp} = 4.83 \times 10^{-6}$

23. Calculate the molar solubility of LaF_3 in pure water. The K_{sp} of LaF_3 is 2.0×10^{-19}.

A. $9.3 \times 10^{-6}\ M$
C. $7.6 \times 10^{-20}\ M$
B. $8.7 \times 10^{-10}\ M$
D. $5.9 \times 10^{-2}\ M$

24. What is the solubility of AgI in 0.65 M KI? K_{sp} for AgI = 8.51×10^{-17}.

A. $9.2 \times 10^{-20}\ M$
C. $1.3 \times 10^{-16}\ M$
B. $6.2 \times 10^{-6}\ M$
D. $2.5\times 10^{-12}\ M$

25. Which of the following solutions will see an **increase** in solubility with a **decrease** in pH?

A. $PbBr_2$
C. AgCl
B. $Cd(OH)_2$
D. KNO_3

Answer Key:

1. A
2. B
3. D
4. C
5. B
6. C
7. D
8. A
9. B
10. C
11. D
12. A
13. B
14. C
15. D
16. B
17. C
18. C
19. A
20. A
21. B
22. D
23. A
24. C
25. B