CHE 107 EXAMINATION III April 4, 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 test 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 Hour Examination III).
SPECIAL CODES:	Use for course and section number; in positions K-P write in one of the following: Dr. Allison Soult 107001 and 107002 Dr. Lisa Blue 107003 and 107006 Dr. H. Ades 107005
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. Soon after the examination is finished, an examination key will be posted on Blackboard.

Grading and Reporting:

The examination scores will be posted in Blackboard within 96 hours after the examination. If an error has been made in scoring your answers, tell 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 and pagers are to be turned off and out of sight during the exams.

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

A. NH_4Cl, pH = 7
B. Na_2CO_3, pH < 7
C. $HC_7H_5O_2$, pH > 7
D. $KClO_2$, pH > 7

2. What is the pH of a 0.25 M NaF, sodium fluoride, solution? K_a for HF, hydrofluoric acid, is 3.5×10^{-4}.

A. 8.43
B. 5.87
C. 9.71
D. 9.28

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

A. H_2O, H_2S, H_2Se, H_2Te
B. HBr, HCl, H_2S, H_2O
C. HCl, HBr, HI, HF
D. HI, H_2Te, HBr, H_2Se

4. Identify the Lewis acids in the following reactions.

$$Cu^{2+}(aq) + 4H_2O(l) \rightarrow Cu(H_2O)_4^{2+}(aq)$$
$$NH_3(g) + BF_3(g) \rightarrow H_3NBF_3(s)$$

A. Cu^{2+}, NH_3
B. Cu^{2+}, BF_3
C. H_2O, NH_3
D. H_2O, BF_3

5. Which of the following will <u>not</u> act as a buffer?

A. 1.0 M CH_3NH_3Cl and 1.5 M CH_3NH_2
B. 1.0 M Na_2HPO_4 and 1.0 M $Ca(H_2PO_4)_2$
C. 0.50 M $HCHO_2$ and 0.25M $NaCHO_2$
D. 1.0 M CH_3NH_3Cl and 1.5 M NH_4Br

6. What is the ratio of base to acid in a buffer prepared from combining $HClO_2$ and $NaClO_2$ with a pH of 2.2? K_a of $HClO_2 = 1.1 \times 10^{-2}$

A. 0.23 : 1
C. 0.53 : 1
B. 1.74 : 1
D. 4.0 : 1

7. A 1.00 L buffer solution contains 0.150 mol $HC_7H_5O_2$ and 0.150 mol $KC_7H_5O_2$ (K_a for $HC_7H_5O_2$ is 6.5×10^{-5}). What is the pH of the solution after 0.050 mol of solid KOH is added? Assume no change in volume.

A. 5.23
C. 4.49
B. 3.79
D. 2.36

8. What is the pH of a solution containing 0.75 M aniline, $C_6H_5NH_2$, and 0.25 M anilinium chloride, $C_6H_5NH_3Cl$? K_b for aniline is 3.9×10^{-10}.

A. 4.21
C. 5.07
B. 7.00
D. 5.60

9. What is the pH of the resulting solution when 25 mL of 0.25 M NaOH is added to 25 mL of 0.15 M HCl?

A. 7
C. 13.49
B. 12.70
D. 13.01

10. A 20.0 mL sample of 0.175 M CH_3NH_2 is titrated with 0.220 M HCl. What is the pH of the solution after adding 16.90 mL of HCl to the CH_3NH_2 solution? K_b for CH_3NH_2 is 4.4×10^{-4}

A. 1.94
C. 3.55
B. 2.22
D. 10.25

11. A handbook lists the following information for some indicators:

Indicator	K_{HIn}
bromocresol green	2.0×10^{-5}
phenolphthalein	4.0×10^{-10}
thymol blue	2.0×10^{-2}
phenol red	1.3×10^{-8}

Which indicator would be <u>best</u> to use in the titration of 0.50 M NH_3 with 0.50 M HCl? K_b for $NH_3 = 1.76 \times 10^{-5}$.

A. bromocresol green
C. thymol blue
B. phenolphthalein
D. phenol red

12. Which one of the following salts is the least soluble in water?

A. $PbBr_2$, $K_{sp} = 4.67 \times 10^{-6}$
C. $MgCO_3$, $K_{sp} = 6.82 \times 10^{-6}$
B. $BaSO_4$, $K_{sp} = 1.07 \times 10^{-10}$
D. AgCl, $K_{sp} = 1.77 \times 10^{-10}$

13. Calculate the molar solubility of $Ca(OH)_2$ in pure water. The K_{sp} of $Ca(OH)_2$ is 4.68×10^{-6} M.

A. 4.05×10^{-3} M
C. 2.05×10^{-4} M
B. 3.05×10^{-1} M
D. 1.05×10^{-2} M

14. What is the solubility of CaF_2 in 0.150 M NaF? K_{sp} for $CaF_2 = 1.46 \times 10^{-10}$.

A. 1.20×10^{-5} M
B. 6.49×10^{-9} M
C. 9.37×10^{-10} M
D. 4.88×10^{-6} M

15. Which of the following solutions will see an increase in solubility with an increase in pH?

A. BaF_2
B. $PbBr_2$
C. NaBr
D. $Fe(OH)_3$

16. A solution is mixed that is 0.0200 M in $Ba(NO_3)_2$, 0.0200 M in $Ca(NO_3)_2$, and 0.0200 M in $Cd(NO_3)_2$. The pH is adjusted until $[OH^-] = 0.00100$ M. What precipitate, if any, will form?

K_{sp} of $Ba(OH)_2$ is 5.0×10^{-3} M
K_{sp} of $Ca(OH)_2$ is 4.68×10^{-6} M
K_{sp} of $Cd(OH)_2$ is 7.2×10^{-15} M

A. $Ba(OH)_2$
B. $Ca(OH)_2$
C. $Cd(OH)_2$
D. No precipitate will form.

17. An aqueous solution is 0.020 M in Ag^+ and 0.020 M in Ca^{2+}. When sufficient CO_3^{2-} is added to the solution, both Ag_2CO_3 ($K_{sp} = 8.46 \times 10^{-12}$) and $CaCO_3$ ($K_{sp} = 4.96 \times 10^{-9}$) will precipitate from the solution. What minimum concentration of CO_3^{2-} is needed to begin precipitation of the salt that precipitates first?

A. 2.5×10^{-9} M
B. 2.1×10^{-8}M
C. 5.2×10^{-7} M
D. 4.4×10^{-9} M

18. What concentration of Zn^{2+} will remain when 100.0 mL of 2.5×10^{-3} M $Zn(NO_3)_2$ is combined with 100.0 mL of 0.35 M NaOH? K_f of $Zn(OH)_4^{2-} = 2.0 \times 10^{15}$

A. 0 M
C. 3.6×10^{-18} M
B. 7.5×10^{-16} M
D. 9.2×10^{-17} M

19. The solubility of CoS is greater in concentrated $NH_3(aq)$ than in pure water because

A. NH_3 lowers the pH of the solution.
B. NH_3 forms a complex with S^{2-}
C. CoS is more soluble at higher pH.
D. NH_3 forms a complex with Co^{2+}.

20. Which of the following statements is <u>true</u>?

A. A nonspontaneous process can never occur.
B. Processes that are spontaneous always occur rapidly.
C. A process that is spontaneous in one direction is also spontaneous in the reverse direction.
D. Both spontaneous and nonspontaneous processes can occur, but only spontaneous ones occur without outside intervention.

21. Which one of the following statements is <u>false</u>?

A. Spontaneous reactions can be endothermic.
B. All reactions are spontaneous.
C. Spontaneous reactions can be exothermic.
D. Nonspontaneous reactions can be endothermic or exothermic.

22. Which of the following statements is true?

A. When ice is added to water, heat flows from the water to the ice in a spontaneous process.

B. Water evaporates spontaneously, decreasing the entropy of the system.

C. A gas under constant temperature and pressure will spontaneously condense into a smaller volume.

D. NaCl dissolving in water is non-spontaneous because the process increases entropy for the system.

23. Which of the following has a positive entropy change?

A. $CO_2(l) \rightarrow CO_2(s)$

B. $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$

C. $2\ N_2(g) + 3\ O_2(g) \rightarrow 2\ N_2O_3(g)$

D. $H_2O(g) \rightarrow H_2O(s)$

24. For a spontaneous process which has $\Delta S_{sys} = -250$ J, what is true about the value of ΔS_{surr}?

A. $\Delta S_{surr} = 250$ J

B. $\Delta S_{surr} < 250$ J

C. $\Delta S_{surr} > 250$ J

D. ΔS_{surr} can be < or > 250 J

25. What is the change in the entropy of the surroundings at 45.0°C for a reaction whose enthalpy is −715 kJ/mol?

A. 2.25 kJ/mol·K

B. 0.155 kJ/mol·K

C. 1.75 kJ/mol·K

D. 3.74 kJ/mol·K

CHE 107 SPRING 2013 Exam 3 Key

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