

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 <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 <b>VERY IMPORTANT!</b> Under IDENTIFICATION NUMBER, put in your <b>8 DIGIT STUDENT ID NUMBER (do not use the 9 at the beginning of your number)</b> 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:  <div style="text-align: center;">           Dr. K. Woodrum      107001, 107002            Dr. F. Bramwell     107003, 107004            Dr. S. Newman        107401         </div>
SIGNATURE:	You <b>MUST</b> 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. The day after the examination is finished, 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 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.

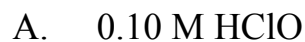
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1. Which of the following will have the largest **first** ionization constant?



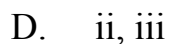
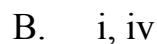
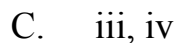
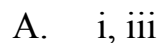
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2. Which of these oxoacids would have the **lowest pH**?



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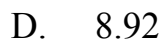
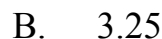
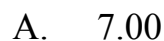
3. Which of the following are salts that produce basic solutions?



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4. What is the pH of 0.35 M ethylammonium bromide ( $\text{C}_2\text{H}_5\text{NH}_3\text{Br}$ )?

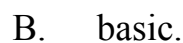
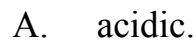
$$K_b(\text{CH}_2\text{H}_5\text{NH}_2) = 5.6 \times 10^{-4}$$



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5. A 0.25 M  $\text{NH}_4\text{CN}$  aqueous solution is

$$K_a(\text{HCN}) = 4.9 \times 10^{-10} \text{ and } K_b(\text{NH}_3) = 1.8 \times 10^{-5}$$



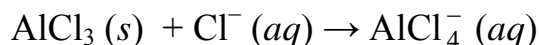
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6. Which of the following is the most acidic oxide?



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7. Which of the following statements is **true**?
- A. A Lewis acid is a substance that can accept a pair of electrons in an acid-base reaction yielding a new bond.
  - B. A Lewis acid is a substance that can donate a pair of electrons in an acid-base reaction yielding a salt and water.
  - C. A Lewis base is a substance that can donate a proton in an acid-base reaction yielding a new bond.
  - D. A Lewis base is a substance that can accept a proton in an acid-base reaction yielding a salt and water.
- 

8. What is the Lewis acid and Lewis base in the following reaction?



- A. Acid:  $\text{AlCl}_3$ , Base:  $\text{AlCl}_4^-$
  - B. Acid:  $\text{AlCl}_4^-$ , Base:  $\text{AlCl}_3$
  - C. Acid:  $\text{AlCl}_3$ , Base:  $\text{Cl}^-$
  - D. Acid:  $\text{Cl}^-$ , Base:  $\text{AlCl}_3$
- 

9. Which of the following substances will decrease the ionization of 0.10 M  $\text{HNO}_2$ ?

- A.  $\text{NaOH}$
  - B.  $\text{NaNO}_3$
  - C.  $\text{NaNO}_2$
  - D.  $\text{Cl}_2$
- 

10. What is the acetate ion concentration in a solution that is 0.050 M in acetic acid, and  $8.8 \times 10^{-6}$  M in  $\text{H}_3\text{O}^+$ ?  $K_a(\text{acetic acid}) = 1.76 \times 10^{-5}$

- A.  $2.0 \times 10^{-3}$  M
  - B. 1.5 M
  - C. 0.050 M
  - D. 0.10 M
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11. Which of these statements **best** describe a buffer?
- A. A neutral solution with a pH of 7, balanced by equal amounts of acid and base.
  - B. A solution composed of an acid and a base.
  - C. A solution with a steady pH that does not change with any addition of acid or base.
  - D. A solution containing a weak acid and its conjugate base, and is able to neutralize small additions of acids or bases.
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12. How many moles of NaF must be added to 100.0 mL of 0.15 M HF to prepare a buffer with pH = 3.30?  $K_a(\text{HF}) = 7.1 \times 10^{-4}$
- A. 0.021 mol
  - B. 0.25 mol
  - C. 0.71 mol
  - D. 190 mol
- 
13. What is the pH of a solution formed after titrating 25.0 mL of 0.150 M acetic acid with 15.0 mL of 0.150 M sodium hydroxide?  $K_a(\text{acetic acid}) = 1.76 \times 10^{-5}$
- A. 4.22
  - B. 4.93
  - C. 9.82
  - D. 7.03
- 
14. Which one of these statements is **true** when a weak base is titrated with a strong acid?
- A. During the titration, the  $\text{H}^+$  concentration in solutions is always the same as the concentration of the added strong acid.
  - B. The pH of the mixture, at all points of the titration, is greater than 7.
  - C. The pH of the solution is always determined by the amount of strong acid, since the base is weak.
  - D. The pH of the equivalence point is less than 7.
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15. The acid form of the indicator *cresol red* is yellow. The base form of the indicator is red. The  $K_a$  value is approximately  $1 \times 10^{-8}$ . A solution with pH = \_\_\_\_\_ will be red.
- A. 2.0
  - B. 7.0
  - C. 8.0
  - D. 10.0
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16. Which of the following conditions best describes when the ion product ( $Q$ ) is less than the solubility product ( $K_{sp}$ )?
- A. There is a saturated solution with no precipitation.
  - B. There is a supersaturated solution with no precipitation.
  - C. There is a supersaturated solution with precipitation.
  - D. There is an unsaturated solution with no precipitation.
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17. The  $K_{sp}$  of strontium chromate is  $1.17 \times 10^{-12}$ . What is the molar solubility of  $\text{SrCrO}_4$ ?
- A.  $2.20 \times 10^{-4} \text{ M}$
  - B.  $6.64 \times 10^{-5} \text{ M}$
  - C.  $1.08 \times 10^{-6} \text{ M}$
  - D.  $5.85 \times 10^{-13} \text{ M}$
- 
18. Which statement is **true** concerning the addition of  $\text{CuNO}_3$  to  $0.010 \text{ M NaI}$ .  
 $K_{sp}(\text{CuI}) = 5.1 \times 10^{-12}$ .
- A.  $\text{CuI}$  will precipitate from solution upon the addition of *any* amount of  $\text{CuNO}_3$ .
  - B.  $\text{CuI}$  will precipitate if  $[\text{Cu}^+] \times 0.010 < 5.1 \times 10^{-12}$ .
  - C.  $\text{CuI}$  will precipitate if  $[\text{Cu}^+] \times 0.010 = 5.1 \times 10^{-12}$ .
  - D.  $\text{CuI}$  will precipitate if  $[\text{Cu}^+] \times 0.010 > 5.1 \times 10^{-12}$ .
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19. In a test tube,  $10 \text{ mL}$  of  $0.100 \text{ M KI}$  and  $10 \text{ mL}$  of  $0.100 \text{ M Na}_2\text{CO}_3$  are mixed. Next,  $0.10 \text{ M}$  lead nitrate is added drop wise. What will be the concentration of  $\text{CO}_3^{2-}$  when  $\text{PbI}_2$  first starts to precipitate?  $K_{sp}(\text{PbCO}_3) = 1.5 \times 10^{-13}$   $K_{sp}(\text{PbI}_2) = 8.7 \times 10^{-9}$ .
- A.  $8.7 \times 10^{-7}$
  - B.  $1.5 \times 10^{-11}$
  - C.  $4.3 \times 10^{-8}$
  - D.  $5.8 \times 10^{-8}$
- 
20. What is the molar solubility of  $\text{AgCl}$  in  $2.0 \times 10^{-3} \text{ M AgNO}_3$ .  $K_{sp}(\text{AgCl}) = 1.6 \times 10^{-10}$ ?
- A.  $8.0 \times 10^{-8} \text{ M}$
  - B.  $0.0020 \text{ M}$
  - C.  $1.3 \times 10^{-5} \text{ M}$
  - D.  $3.2 \times 10^{-13} \text{ M}$
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21. Which statement is **true**?

- A. The solubility of NaF is not affected by the pH of the solution.
- B. The solubility of  $\text{Fe}(\text{OH})_3$  increases with the addition of an acid.
- C. The solubility of KBr increases with decreasing pH.
- D. The solubility of  $\text{LiNO}_3$  increases with increasing pH.

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22. Which of the following statements about spontaneous processes is **true**?

- A. Exothermic reactions are always spontaneous.
- B. Endothermic reactions are always spontaneous.
- C. Spontaneous reactions may occur when  $\Delta H = 0$ .
- D. Spontaneous reactions are always pressure dependent.

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23. Which of these is an example of an increase in entropy?

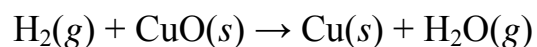
- A. Liquifying nitrogen gas from air
- B. Spraying perfume
- C. Freezing water
- D. Cooling the air in a room

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24. Which statement is **true** about the second law of thermodynamics?

- A. The entropy of a perfect crystalline substance is zero at absolute zero.
  - B. The entropy of the universe increases in a spontaneous process and remains unchanged in an equilibrium process.
  - C. Mass and energy of a reaction are conserved.
  - D. The mass of a reaction is conserved.
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25. Given the standard entropy values in the table below, determine the standard entropy change of the oxidation-reduction reaction which produces **10.0 grams** of metallic copper according to the reaction:



<u>Substance</u>	<u><math>S^\circ</math> (J/K·mol)</u>
$\text{H}_2(g)$	131.0
$\text{H}_2\text{O}(g)$	188.7
$\text{Cu}(s)$	33.3
$\text{CuO}(s)$	43.5

- A. 7.47 J  
B. 49.0 J

- C. 134.5 J  
D. 23.4 J

