

## 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 <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="display: flex; justify-content: space-around;"> <div style="text-align: center;">Dr. Ades</div> <div style="text-align: center;">107-001 (MWF), put 107001 107-002 (TR), put 107002</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">Dr. Selegue</div> <div style="text-align: center;">107003</div> </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 **28 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 28 QUESTIONS, A PERIODIC TABLE, AND ONE SHEET OF SCRATCH PAPER.** You may NOT 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.

---

1. What is the pH of an aqueous  $5.48 \times 10^{-4}$  M hydroiodic acid (HI) solution?

- A. 5.484  
B. 7.509  
C. 3.261  
D. 3.311

---

2. Which statement about propanoic acid,  $\text{HC}_3\text{H}_5\text{O}_2$ , is **true**?  $K_a$  for propanoic acid is  $1.6 \times 10^{-6}$

- A. The percent ionization of propanoic acid is greater at 0.0010 M concentration than at 1.0 M concentration.  
B. Propanoic acid is a strong acid.  
C. Propanoic acid dissociates into  $\text{C}_3\text{H}_5\text{O}^+$  and  $\text{OH}^-$  ions in aqueous solution.  
D. The pH of a 1.0 M propanoic acid equals the  $\text{p}K_a$  of the acid.

---

3. What is the pH of a mixture that is 0.050 M in nitric acid,  $\text{HNO}_3$ , and 0.050 M in hypochlorous acid,  $\text{HClO}$ ?  $K_a$  for  $\text{HClO}$  is  $2.9 \times 10^{-8}$ .

- A. 1.00  
B. 1.30  
C. 2.26  
D. 2.60

---

4. Which statement is false?

- A. The pH of 0.05 M  $\text{Ba}(\text{OH})_2$  is 13.0.  
B. Alkali metal hydroxides are strong electrolytes.  
C. For a strong base,  $\text{pOH} = -\log[\text{OH}^-]$   
D. The conjugate acid of a strong base is a strong acid.

---

5. What is the pH of a 0.125 M aqueous solution of the weak base codeine,  $(\text{C}_{18}\text{H}_{21}\text{NO}_3)$ ?  $K_b$  for codeine is  $1.6 \times 10^{-6}$ .

- A. 8.20  
B. 13.10  
C. 8.98  
D. 10.65
-



---

12. When 0.20 mol NaF (sodium fluoride) is added to 100 mL of 0.20 M HF (hydrofluoric acid), the pH of the resulting solution

- A. decreases.
- B. increases by a factor of 0.20 and then decreases.
- C. increases.
- D. remains unchanged.

---

13. Choose the effective pH range of a pyridine-pyridinium chloride ( $\text{C}_5\text{H}_5\text{N}/\text{C}_5\text{H}_5\text{NHCl}$ )<sup>-</sup> buffer.  $K_b$  for pyridine is  $1.7 \times 10^{-9}$

- A. 1.4–3.4
- B. 4.2–6.2
- C. 7.7–9.7
- D. 9.1–11.1

---

14. Calculate the pH of 1.00 L of a buffer that contains 1.00 mol of formic acid ( $\text{HCHO}_2$ ) and 1.00 mol of sodium formate ( $\text{NaCHO}_2$ ) after 0.100 mol of NaOH is added to the buffer.  $K_a$  for formic acid is  $1.8 \times 10^{-4}$ .

- A. 3.70
- B. 4.26
- C. 3.83
- D. 2.87

---

15. Which of these is a buffer solution?

- A. 1.0 L of 0.50 M propanoic acid ( $\text{HC}_3\text{H}_5\text{O}_2$ ) + 1.0 L of 0.25 M potassium hydroxide (KOH)
- B. 1.0 L of 0.50 M propanoic acid ( $\text{HC}_3\text{H}_5\text{O}_2$ ) + 1.0 L of 0.25 M hydrofluoric acid (HF)
- C. 1.0 L of 0.50 M propanoic acid ( $\text{HC}_3\text{H}_5\text{O}_2$ ) + 1.0 L of 0.25 M hydrochloric acid (HCl)
- D. 1.0 L of 0.75 M potassium propanoate ( $\text{KC}_3\text{H}_5\text{O}_2$ )

---

16. What is the pH of an aqueous solution that is 0.400 M in hydrofluoric acid (HF) and 0.100 M in potassium fluoride (KF)?  $K_a$  for HF is  $3.5 \times 10^{-4}$ .

- A. 2.85
  - B. 4.35
  - C. 1.73
  - D. 5.34
-

---

17. A 1.00 L buffer solution is 0.10 M in  $\text{NH}_3$  and 0.20 M in  $\text{NH}_4\text{Cl}$ . Which action produces a solution that is no longer a buffer?

- A. adding 0.10 mol  $\text{NH}_3$                       C. adding 0.050 mol  $\text{NH}_4\text{Cl}$   
B. adding 0.11 mol  $\text{HCl}$                       D. adding 0.15 mol  $\text{NaOH}$

---

18. What is the pH of the solution that results when 20.0 mL of 0.100 M  $\text{NaOH}$  is titrated with 12.5 mL of 0.200 M  $\text{HC}_2\text{H}_5\text{O}_2$ ?  $K_a$  for  $\text{HC}_2\text{H}_5\text{O}_2$  is  $1.8 \times 10^{-5}$ .

- A. 4.84    C. 5.35  
B. 2.36    D. 6.72

---

19. What is the pH of the solution that results when 25.0 mL of 0.100 M  $\text{KOH}$  is titrated with 12.5 mL of 0.200 M  $\text{HNO}_2$ ?  $K_a$  for  $\text{HNO}_2$  is  $4.6 \times 10^{-4}$ .

- A. 8.08    C. 9.56  
B. 4.32    D. 7.47

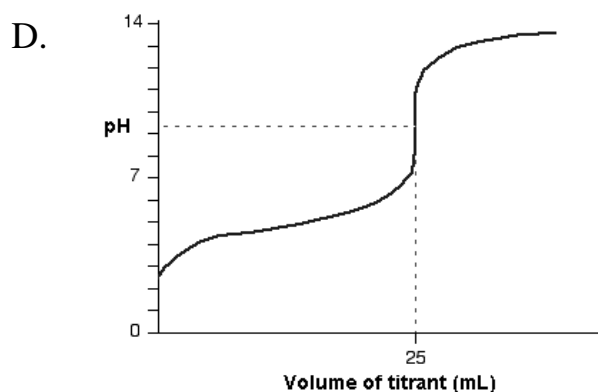
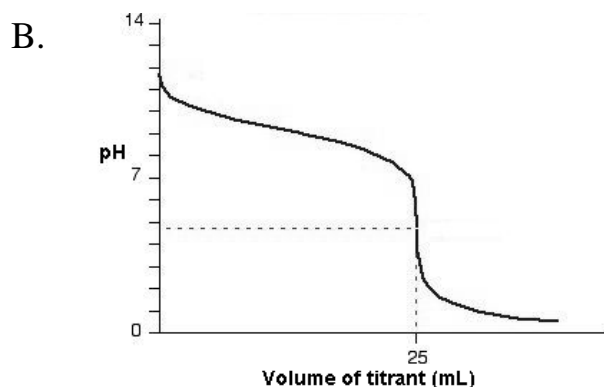
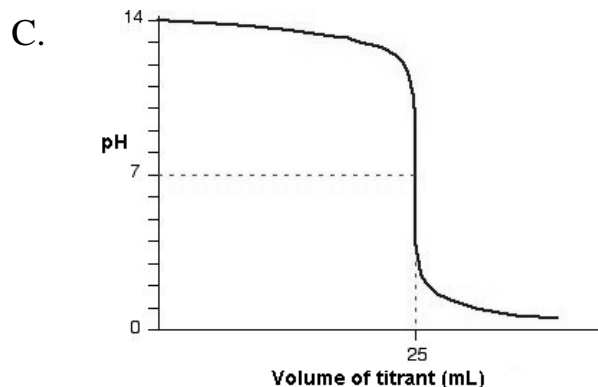
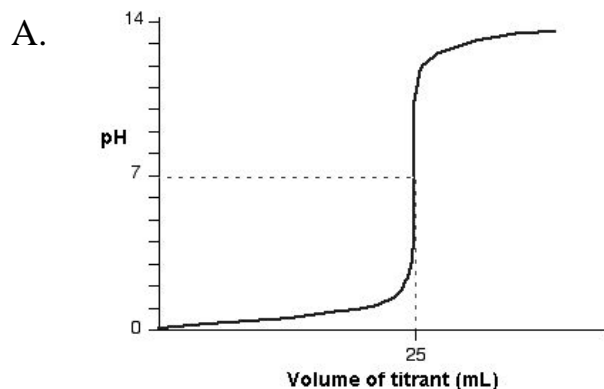
---

20. Which of these titrations has  $\text{pH} < 7.0$  at the equivalence point?

- A. 0.50 M  $\text{NaOH}$  titrated with 0.50 M  $\text{HCl}$   
B. 0.50 M  $\text{CH}_3\text{NH}_2$  titrated with 0.50 M  $\text{HCl}$   
C. 0.50 M  $\text{H}_2\text{SO}_4$  titrated with 0.50 M  $\text{Ba}(\text{OH})_2$   
D. 0.50 M  $\text{HNO}_2$  titrated with 0.50 M  $\text{KOH}$
-

---

21. Which plot shows the titration of a weak base with a strong acid?



---

22. Methyl red has  $pK_a = 5.0$ . It is red in its acid form and yellow in its basic form. When methyl red is added to a solution of unknown pH, the solution turns yellow. What is the approximate pH of the solution?

- A. less than 3  
B. exactly 5

- C. greater than 7  
D. between 4 and 5

---

23. The solubility product constant of  $MgF_2$  is  $K_{sp} = 7.4 \times 10^{-11}$ .  $S$  = the molar solubility of  $MgF_2$ . Which expression is correct?

- A.  $[Mg^{2+}] = 4S^3$   
B.  $K_{sp} = 27S$

- C.  $K_{sp} = [Mg^{2+}][F^-]^2$   
D.  $S = 7.4 \times 10^{-11}$
-

---

24. The molar solubility of  $\text{Co}(\text{OH})_2$  in pure water is  $1.14 \times 10^{-5} \text{ M}$ ? What is  $K_{\text{sp}}$  for  $\text{Co}(\text{OH})_2$ ?

- A.  $3.42 \times 10^{-5} \text{ M}$                       C.  $1.14 \times 10^{-15} \text{ M}$   
B.  $5.20 \times 10^{-10} \text{ M}$                       D.  $5.93 \times 10^{-15} \text{ M}$
- 

25. What is the molar solubility of calcium fluoride ( $\text{CaF}_2$ ) in  $0.100 \text{ M NaF}$ ?  $K_{\text{sp}}$  for  $\text{CaF}_2$  is  $1.46 \times 10^{-10}$ .

- A.  $1.46 \times 10^{-12} \text{ M}$                       C.  $1.46 \times 10^{-7} \text{ M}$   
B.  $1.46 \times 10^{-11} \text{ M}$                       D.  $1.46 \times 10^{-8} \text{ M}$
- 

26. Which one of the following compounds is **not** more soluble in acid solution than in pure water?

- A.  $\text{Mg}(\text{OH})_2$                               C.  $\text{PbBr}_2$   
B.  $\text{CoS}$                                       D.  $\text{CaF}_2$
- 

27. What minimum concentration of  $\text{NaCl}$  will cause  $\text{AgCl}$  to precipitate from a  $0.0500 \text{ M AgNO}_3$  solution?  $K_{\text{sp}}$  for  $\text{AgCl}$  is  $1.77 \times 10^{-10}$ .

- A.  $8.88 \times 10^{-11} \text{ M}$                       C.  $3.54 \times 10^{-9} \text{ M}$   
B.  $1.46 \times 10^{-11} \text{ M}$                       D.  $1.33 \times 10^{-5} \text{ M}$
- 

28. The solubility of  $\text{Cu}(\text{OH})_2$  is greater in concentrated  $\text{NH}_3(\text{aq})$  than in pure water because

- A.  $\text{Cu}^{2+}$  forms a complex with  $\text{NH}_3$   
B.  $\text{Cu}(\text{OH})_2$  is more soluble at high pH than at neutral pH  
C.  $\text{NH}_3$  lowers the pH of the solution  
D.  $\text{OH}^-$  forms a complex with  $\text{NH}_3$
-

CHE 107 FALL 2012 Exam 3 Key

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