

CHEMISTRY 16
EXAM III-Version 1

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July 23, 1998

An optical scoring machine will grade this examination. The machine is not programmed to accept the correct one of two sensed answers and will not sense answers which are lightly marked. Mark your answer sheet carefully with a No. 2 soft lead pencil and erase any undesired marks COMPLETELY. Avoid making any extraneous marks on the answer sheet other than the information requested below.

On the answer sheet:

1. Print your name in the space for NAME (last name first, circle your last name).
2. In the space marked SUBJECT print your student number.
3. In the space marked HOUR print Summer II '98.

Check to see that you have 20 examination questions, periodic table and scratch paper when the exam begins.

HAND IN ONLY THE ANSWER SHEET.

Useful Equations and Constants:

$$K_w = 1.0 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

$$x = \frac{-b \pm (b^2 - 4ac)^{1/2}}{2a}$$

CHEMISTRY 16
HOUR EXAM III

Summer 1998

CHOOSE THE ONE BEST ANSWER.

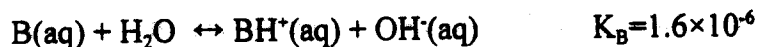
✓ 1. The pH of 0.075 M HOBr is:
($K_A(\text{HOBr}) = 2.06 \times 10^{-9}$)

- Calc to find pH*
- A. 4.91
 - B. 7.50
 - C. 4.15
 - D. 9.09
 - E. 1.24

✓ 2. Calculate K_B for the conjugate base of formic acid HCOOH.
($K_A(\text{HCOOH}) = 1.77 \times 10^{-4}$)

- A. 5.6×10^{-11}
- B. 1.8×10^{10}
- C. 5.6×10^{-3}
- D. 1.8×10^{-18}
- E. 3.1×10^{-8}

✓ 3. Strychnine is a weak base with $K_B = 1.6 \times 10^{-6}$. The equilibrium for K_B can be represented as below (where B stands for neutral molecules of strychnine). The concentration of OH^- in 0.090 M strychnine is:

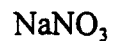


- A. 2.4×10^{-11} M
- B. 9.0×10^{-12} M
- C. 1.4×10^{-7} M
- D. 3.8×10^{-4} M
- E. 0.090 M

✓ 4. The pH of 0.025 M NaOCl is:
($K_A(\text{HOCl}) = 2.95 \times 10^{-5}$)

- A. 3.00
- B. 8.46
- C. 9.47
- D. 12.40
- E. 5.49

5. Which of the salts below will give an **acidic solution** when dissolved in water?



- A. All will give an acidic solution.
- B. NaNO_3 , $\text{Al}(\text{NO}_3)_3$ and NH_4Br
- C. $\text{Al}(\text{NO}_3)_3$ and NH_4Br
- D. $\text{KC}_2\text{H}_3\text{O}_2$
- E. NH_4Br

6. The pH of a buffer that contains 0.100 M $\text{HC}_3\text{H}_5\text{O}_2$ (propionic acid) and 0.400 M $\text{KC}_3\text{H}_5\text{O}_2$ (potassium propionate) is:
($K_a(\text{HC}_3\text{H}_5\text{O}_2) = 1.34 \times 10^{-5}$)

- A. 2.94
- B. 9.56
- C. 4.21
- D. 5.47
- E. 4.87

7. Which of the following systems constitutes a buffer when 1 L of each solution is mixed?

- A. 0.2 M HCl /0.1 M NaOH
- B. 0.1 M KOH /0.5 M KCl
- C. 0.5 M NH_4Cl /0.2 M HCl
- D. 0.5 M NH_3 /0.25 M NaOH
- E. 0.5 M NH_3 /0.25 M HCl

8. When KOH is added to a $\text{HNO}_2/\text{NaNO}_2$ buffer system, the OH^- will react _____ with the _____.

- A. 100% ; HNO_2
- B. incompletely; Na^+
- C. 100%; NO_2^-
- D. 50%; H_2O
- E. incompletely; HNO_2

9. Hydroxylamine (NH_2OH) is a weak base. The equilibrium established by NH_2OH in water is shown below.



As solid NaNH_3OH is added the $[\text{OH}^-]$ _____ while the pH _____.

- A. decreases; increases
- B. increases; increases
- C. increases; decreases
- D. decreases; decreases
- E. remains the same; remains the same

10. A pH buffered at 4.00 is needed to standardize a pH meter. A buffer system made out of which of the following acids will work best?

- A. Acrylic acid ($K_A=5.6 \times 10^{-5}$)
- B. Barbituric acid ($K_A=9.8 \times 10^{-5}$)
- C. Oxalic acid ($K_A=5.9 \times 10^{-2}$)
- D. Uric acid ($K_A=1.3 \times 10^{-4}$)
- E. Arsenious acid ($K_A=6 \times 10^{-10}$)

11. A 15.0 mL sample of 0.15 M NH_3 is to be titrated with 0.25 M HCl. The volume of HCl needed to reach the equivalence point will be _____ and the pH at the equivalence point will be _____.

- A. 5.6 mL; neutral
- B. 2.5 mL; basic
- C. 9.0 mL; acidic
- D. 17 mL; acidic
- E. 9.0 mL; basic

12. A 20. mL sample of 0.10 M HCl is to be titrated with 0.20 M NaOH. What will be the pH of the solution after the addition of 7.5 mL of NaOH?

- A. 1.00
- B. 12.19
- C. 1.74
- D. 6.21
- E. 7.00

13. A 10. mL sample of 0.10 M uric acid (a weak acid $K_A=1.3\times 10^{-4}$) is titrated with 0.20 M NaOH. If 5.0 mL of NaOH are needed to reach the equivalence point, what is the pH of the solution half-way to the equivalence point (after addition of 2.5 mL of NaOH)?

- A. 10.00
- B. 5.35
- C. 8.71
- D. 3.89
- E. 4.57

✓ 14. Which of the ions below will react with water (hydrolyze) to give either an acidic or basic solution?

- A. K^+
- B. Br^-
- C. NO_3^-
- D. ClO_4^-
- E. F^-

15. Which of the following statements is **TRUE** about buffers?

- A. A buffer works best when the concentration of acid and base are nearly equal.
- B. Dilution alters the pH of a buffer.
- C. Addition of a small amount of strong acid to a buffer solution causes a sharp decrease in the pH of the buffer solution.
- D. The pH of a buffer solution is always equal to pK_A independent of the concentrations of weak acid and conjugate base present.
- E. Addition of a small amount of strong base to a buffer solution causes a sharp increase in the pH of the buffer solution.

16. Which of the following statements is **TRUE** about the indicator methyl red ($K_{A,In}=5\times 10^{-6}$)? (HINT: Calculate $pK_{A,In}$)

- A. Methyl red is a basic indicator.
- B. Methyl red can be used to accurately determine the end point for any titration.
- C. Methyl red changes color at $pH=7.00$.
- D. Methyl red can be used to determine the end point when titrating a weak base with a strong acid.
- E. Methyl red has the same color in both acidic and basic solutions.

17. The molar solubility of BaSO_4 in water is:
 $K_{sp}(\text{BaSO}_4)=1.0\times 10^{-10}$
- A. 3.2×10^{-3} M
 - B. 5.3×10^{-8} M
 - C. 1.0×10^{-5} M
 - D. 6.7×10^{-4} M
 - E. 2.3×10^{-3} M
18. The concentration of Hg^{+2} in a saturated solution of HgI_2 is 1.93×10^{-10} M. The numerical value of K_{sp} for HgI_2 is:
- A. 7.28×10^{-30}
 - B. 2.88×10^{-29}
 - C. 7.72×10^{-10}
 - D. 5.53×10^{-15}
 - E. 3.72×10^{-20}
19. Which condition characterizes the equivalence point in the titration of an acid with a base?
- A. Stoichiometric amounts of acid and base have reacted.
 - B. A slight excess of titrant is present.
 - C. The point where the indicator changes color.
 - D. The pH is exactly 7.0.
 - E. The pH remains constant with addition of excess base.
20. Which one of the following sulfides is **LEAST** soluble in water (ie. has the lowest molar solubility)?
- | | | |
|----|-----|----------------------------------|
| A. | FeS | K_{sp}
6.3×10^{-18} |
| B. | MnS | 2.5×10^{-13} |
| C. | NiS | 1.0×10^{-24} |
| D. | CdS | 8.0×10^{-27} |
| E. | HgS | 1.6×10^{-52} |