General Chemistry 2 Exam 2 Summer 2008

Kingsborough Community College Dept. of Physical Sciences

Each question is worth 4 points. Mark your answers on the exam and on the scantron form.

$[H_3O^+][OH^-] = K_W = K_aK_b = 10^{-14}$
$pH + pOH = 14.00$
$pH = -\log [H_3O^+]$
$pOH = -\log[OH^-]$
$pK_a = -\log K_a$

$p = 10^{-12}$
$n = 10^{-9}$
$u = 10^{-6}$
$m = 10^{-3}$
$c = 10^{-2}$
$k = 10^{3}$
$M = 10^{6}$
$G = 10^{9}$

K_a	
HF	7.1×10^{-4}
HNO_2	4.5×10^{-4}
$HC_2H_3O_2$	1.8×10^{-5}
HOCl	3.2×10^{-8}
HCN	4.9×10^{-10}

1. Which one of the following is a buffer solution?
   A. 0.40 M HCN and 0.10 KCN
   B. 0.20 M CH_3COOH
   C. 1.0 M HNO_3 and 1.0 M $NaNO_3$
   D. 0.10 M KCN
   E. 0.50 M HCl and 0.10 NaCl

2. Which of the following is the most acidic solution?
   A. 0.10 M CH_3COOH and 0.10 M CH_3COONa
   B. 0.10 M CH_3COOH
   C. 0.10 M HNO_2
   D. 0.10 M HNO_2 and 0.10 M $NaNO_2$
   E. 0.10 M CH_3COONa

3. Calculate the pH of a buffer solution that contains 0.25 M benzoic acid ($C_6H_5CO_2H$) and 0.15 M sodium benzoate (C_6H_5COONa). [$K_a = 6.5 \times 10^{-5}$ for benzoic acid]
   A. 3.97
   B. 4.83
   C. 4.19
   D. 3.40
   E. 4.41

4. You are asked to go into the lab and prepare an acetic acid - sodium acetate buffer solution with a pH of 4.00 ± 0.02. What molar ratio of CH_3COOH to CH_3COONa should be used?
   A. 0.18
   B. 0.84
   C. 1.19
   D. 5.50
   E. 0.10

5. What is the *net ionic equation* for the reaction that occurs when small amounts of hydrochloric acid are added to a HOCl/NaOCl buffer solution?
   A. $H^+ + H_2O \rightarrow H_3O^+$
   B. $H^+ + OCl^- \rightarrow HOCl$
   C. $HOCl \rightarrow H^+ + OCl^-$
   D. $H^+ + HOCl \rightarrow H_2OCl^+$
   E. $HCl + HOCl \rightarrow H_2O + Cl_2$

6. Over what range of pH is a HOCl - NaOCl buffer effective?
   A. pH 2.0 - pH 4.0
   B. pH 7.5 - pH 9.5
   C. pH 6.5 - pH 8.5
   D. pH 6.5 - pH 9.5
   E. pH 1.0 - pH 14.0

7. Assuming equal concentrations of conjugate base and acid, which one of the following mixtures is suitable for making a buffer solution with an optimum pH of 9.2-9.3?
   A. CH_3COONa/CH_3COOH ($K_a = 1.8 \times 10^{-5}$)
   B. NH_3/NH_4Cl ($K_a = 5.6 \times 10^{-10}$)
   C. $NaOCl/HOCl$ ($K_a = 3.2 \times 10^{-8}$)
   D. $NaNO_2/HNO_2$ ($K_a = 4.5 \times 10^{-4}$)
   E. NaCl/HCl

8. You have 500.0 mL of a buffer solution containing 0.20 M acetic acid (CH_3COOH) and 0.30 M sodium acetate (CH_3COONa). What will the pH of this solution be after the addition of 20.0 mL of 1.00 M NaOH solution? [$K_a = 1.8 \times 10^{-5}$]
   A. 4.41
   B. 4.74
   C. 4.56
   D. 4.92
   E. 5.07

9. For which type of titration will the pH be basic at the equivalence point?
   A. Strong acid vs. strong base.
   B. Strong acid vs. weak base.
   C. Weak acid vs. strong base.
   D. all of the these
   E. none of these

10. 50.00 mL of 0.10 M HNO_2 (nitrous acid, $K_a = 4.5 \times 10^{-4}$) is titrated with a 0.10 M KOH solution. After 25.00 mL of the KOH solution is added, the pH in the titration flask will be
   A. 2.17
   B. 3.35
   C. 2.41
   D. 1.48
   E. 7.00

11. A titration of an acid and base to the equivalence point results in a noticeably acidic solution. It is likely this titration involves
    A. a strong acid and a weak base.
    B. a weak acid and a strong base.
    C. a weak acid and a weak base (where K_a equals K_b).
    D. a strong acid and a strong base.

12. Methyl red is a common acid-base indicator. It has a K_a equal to 6.3×10^{-6}. Its unionized form is red and its anionic form is yellow. What color would a methyl red solution have at pH = 7.8?
    A. green
    B. red
    C. blue
    D. yellow
    E. violet

13. What mass of sodium fluoride must be added to 250. mL of a 0.100 M HF solution to give a buffer solution having a pH of 3.50? (K_a(HF) = 7.1×10^{-4})

A. 0.49 g
B. 1.5g
C. 3.4g
D. 2.3g
E. 0.75 g

14. 25.0 mL of a hydrofluoric acid solution of unknown concentration is titrated with 0.200 M NaOH. After 20.0 mL of the base solution has been added, the pH in the titration flask is 3.00. What was the concentration of the original hydrofluoric acid solution. (K_a(HF) = 7.1×10^{-4})

A. 0.39 M
B. 0.27 M
C. 0.16 M
D. 2.4M
E. 0.23 M

15. For $PbCl_2$ ($K_{sp} = 2.4 \times 10^{-4}$), will a precipitate of $PbCl_2$ form when 0.10 L of 3.0×10^{-2} M $Pb(NO_3)_2$ is added to 400 mL of 9.0×10^{-2} M NaCl?

A. Yes, because $Q > K_{sp.}$
B. No, because $Q < K_{sp.}$
C. No, because $Q = K_{sp.}$
D. Yes, because $Q < K_{sp.}$

16. The solubility of lead(II) iodide is 0.064 g/100 mL at 20°C. What is the solubility product for lead(II) iodide?

A. 1.1×10^{-8}
B. 3.9×10^{-6}
C. 1.1×10^{-11}
D. 2.7×10^{-12}
E. 1.4×10^{-3}

17. The solubility product for chromium(III) fluoride is $K_{sp} = 6.6 \times 10^{-11}$. What is the molar solubility of chromium(III) fluoride?

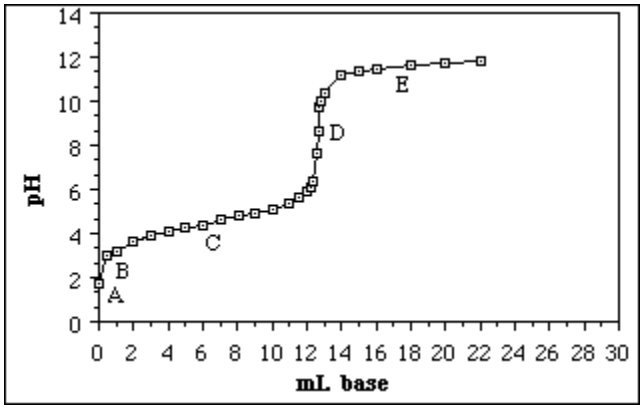
A. 1.6×10^{-3} M
B. 1.2×10^{-3} M
C. 6.6×10^{-11} M
D. 2.2×10^{-3} M
E. 1.6×10^{-6} M

18. Which of the following would decrease the K_{sp} for PbI_2?
    A. Lowering the pH of the solution
    B. Adding a solution of $Pb(NO_3)_2$
    C. Adding a solution of KI
    D. None of these—the K_{sp} of a compound is constant at constant temperature.

19. A saturated sodium carbonate solution at 0°C contains 7.1 g of dissolved sodium carbonate per 100. mL of solution. The solubility product constant for sodium carbonate at this temperature is
    A. 1.2.
    B. 0.30.
    C. 3.0×10^{-4}.
    D. 0.90.
    E. 1.2×10^{-3}.

20. What volume of 0.0500 M sodium hydroxide should be added to 250. mL of 0.100 M HCOOH to obtain a solution with a pH of 4.50? [$K_a(HCOOH) = 1.7 \times 10^{-4}$]
    A. 540 mL
    B. 420 mL
    C. 80. mL
    D. 340 mL
    E. 500. mL

Use the titration curve below to answer questions 21-23.



21. Which point indicates the region where the solution behaves as a buffer?
A. A
B. B
C. C
D. D
E. E

22. Which point indicates the equivalence point of the titration?
A. A
B. B
C. C
D. D
E. E

23. The titration curve best describes a titration between
A. a strong acid and a strong base
B. a strong acid and a weak base
C. a weak acid and a strong base
D. a weak acid and a weak base

24. Calculate the molar solubility of cupric hydroxide, $Cu(OH)_2$, in a solution buffered at pH 9.00. For the cupric hydroxide, $K_{sp} = 2.2 \times 10^{-20}$.
A. 2.2×10^{-20} M
B. 2.2×10^{-15} M
C. 2.2×10^{-10} M
D. 1.7×10^{-7} M
E. 1.5×10^{-10} M

25. 65 mL of 0.145 M HCl is titrated with 45 mL of 0.183 M KOH. The pH of the HCl solution before and after the addition of KOH would be:

	pH before addition of KOH	pH after addition of KOH
A.	2.76	2.76
B.	0.84	1.97
C.	1.13	1.97
D.	2.76	12.03
E.	0.84	12.03

Answers

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