

CHEM 1412. Chapter 17. Acid-Base Equilibria (Homework) Ky

1. In which one of the following solutions will acetic acid have the greatest percent ionization?

- A. 0.1 M CH_3COOH
- B. 0.1 M CH_3COOH dissolved in 1.0 M HCl
- C. 0.1 M CH_3COOH plus 0.1 M CH_3COONa
- D. 0.1 M CH_3COOH plus 0.2 M CH_3COONa

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

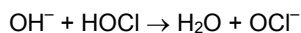
3. Which of the following yields a buffer solution when equal volumes of the two solutions are mixed?

- A. 0.10M H_2CO_3 and 0.050M HCl
- B. 0.10M H_2CO_3 and 0.10M KOH
- C. 0.10M H_2CO_3 and 0.10M HCl
- D. 0.10M H_2CO_3 and 0.050M KOH
- E. 0.10M K_2CO_3 and 0.050M KOH

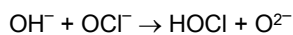
4. Calculate the pH of a buffer solution that contains 0.25 M benzoic acid ($\text{C}_6\text{H}_5\text{CO}_2\text{H}$) and 0.15M sodium benzoate ($\text{C}_6\text{H}_5\text{COONa}$). [$K_a = 6.5 \times 10^{-5}$ for benzoic acid]
- A. 3.97
 - B. 4.83
 - C. 4.19
 - D. 3.40
 - E. 4.41
5. A solution is prepared by mixing 500. mL of 0.10 M NaOCl and 500. mL of 0.20 M HOCl. What is the pH of this solution? [$K_a(\text{HOCl}) = 3.2 \times 10^{-8}$]
- A. 4.10
 - B. 7.00
 - C. 7.19
 - D. 7.49
 - E. 7.80
6. 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

7. Consider a buffer solution prepared from HOCl and NaOCl. Which is the net ionic equation for the reaction that occurs when NaOH is added to this buffer?

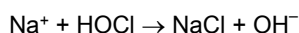
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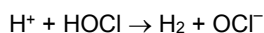
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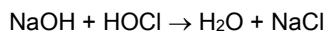
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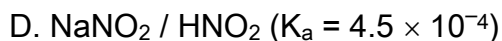
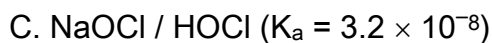
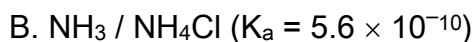
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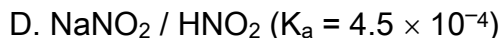
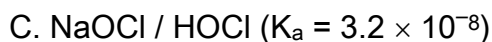
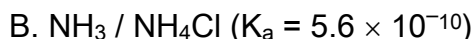
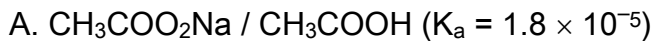
E.



8. 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?



9. 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 4.6–4.8?



10. Starting with 0.750L of a buffer solution containing 0.30 M benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) and 0.35 M sodium benzoate ($\text{C}_6\text{H}_5\text{COONa}$), what will the pH of the solution be after the addition of 340.0 mL of 0.350M HCl? (K_a ($\text{C}_6\text{H}_5\text{COOH}$) = 6.5×10^{-5})

A. 4.19

B. 4.25

C. 3.81

D. 0.45

E. 6.54

11. Calculate the percent ionization of cyanic acid, $K_a = 2.0 \times 10^{-4}$, in a buffer solution that is 0.50 M HCNO and 0.10 M NaCNO.

A. 0.02%

B. 0.10%

C. 0.20%

D. 2.0%

E. 20%

12. 25.0 mL of a 0.100 M solution of NH_3 is titrated with 0.150M HCl. After 10.0 mL of the HCl has been added, the resultant solution is:

- A. Basic and before the equivalence point
- B. Basic and after the equivalence point
- C. Acidic and before the equivalence point
- D. Acidic and after the equivalence point
- E. Neutral and at the equivalence point

13. 25.0 mL of a 0.100 M solution of NH_3 is titrated with 0.250M HCl. After 10.0 mL of the HCl has been added, the resultant solution is:

- A. Basic and before the equivalence point
- B. Basic and after the equivalence point
- C. Acidic and before the equivalence point
- D. Basic and at the equivalence point
- E. Acidic and at the equivalence point

14. 25.0 mL of a 0.100 M solution of NH_3 is titrated with 0.250M HCl. After 25.0 mL of the HCl has been added, the resultant solution is:

- A. Basic and before the equivalence point
- B. Basic and after the equivalence point
- C. Acidic and before the equivalence point
- D. Acidic and after the equivalence point
- E. Neutral and at the equivalence point

15. 40.0 mL of a 0.65 M solution of HF is titrated with 0.100 M NaOH. After 0.400 L of the NaOH solution has been added, the resultant solution is:

- A. Basic and before the equivalence point
- B. Basic and after the equivalence point
- C. Acidic and before the equivalence point
- D. Acidic and after the equivalence point
- E. Neutral and at the equivalence point

16. 35.00 mL of a 0.30 M HCl solution is titrated with 0.35 M NaOH. What is the pH of the solution after 40.00 mL of the NaOH has been added?

- A. 2.46
- B. 11.54
- C. 7.00
- D. 12.72
- E. 12.67

17. 50.00 mL of 0.10 M HNO₂ (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.

18. What is the pH at the equivalence point in the titration of 100 mL of 0.10 M HCl with 0.10 M NaOH?

- A. 1.0
- B. 6.0
- C. 7.0
- D. 8.0
- E. 13.0

19. What is the pH at the equivalence point in the titration of 100 mL of 0.10 M HCN ($K_a = 4.9 \times 10^{-10}$) with 0.10 M NaOH?

- A. 3.0
- B. 6.0
- C. 7.0
- D. 11.0
- E. 12.0

20. Calculate the pH of the solution resulting from the addition of 10.0 mL of 0.10 M NaOH to 50.0 mL of 0.10 M HCN ($K_a = 4.9 \times 10^{-10}$) solution.

- A. 5.15
- B. 8.71
- C. 5.85
- D. 9.91
- E. 13.0

21. Calculate the pH of the solution resulting from the addition of 25.0 mL of 0.20 M HCl to 50.0 mL of 0.10 M aniline ($\text{C}_6\text{H}_5\text{NH}_2$). $K_b(\text{C}_6\text{H}_5\text{NH}_2) = 3.8 \times 10^{-10}$

- A. 9.42
- B. 9.12
- C. 7.00
- D. 2.30
- E. 2.88

22. Calculate the pH of the solution resulting from the addition of 85.0 mL of 0.35 M HCl to 30.0 mL of 0.40 M aniline ($\text{C}_6\text{H}_5\text{NH}_2$). $K_b(\text{C}_6\text{H}_5\text{NH}_2) = 3.8 \times 10^{-10}$

- A. 1.75
- B. 0.81
- C. 4.64
- D. 4.19
- E. 9.09

23. 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 $\text{Pb}(\text{NO}_3)_2$ 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 $Q < K_{sp}$.

24. The molar solubility of magnesium carbonate is 1.8×10^{-4} mol/L. What is K_{sp} for this compound?
- A. 1.8×10^{-4}
 - B. 3.6×10^{-4}
 - C. 1.3×10^{-7}
 - D. 3.2×10^{-8}
 - E. 2.8×10^{-14}
25. The molar solubility of lead(II) iodate in water is 4.0×10^{-5} mol/L. Calculate K_{sp} for lead(II) iodate.
- A. 1.6×10^{-9}
 - B. 6.4×10^{-14}
 - C. 2.6×10^{-13}
 - D. 4.0×10^{-5}
 - E. 4.0×10^{-15}
26. 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

27. Calculate the concentration of chloride ions in a saturated lead(II) chloride ($K_{sp} = 2.4 \times 10^{-4}$) solution.

- A. 2.4×10^{-4} M
- B. 4.8×10^{-4} M
- C. 3.9×10^{-2} M
- D. 1.2×10^{-1} M
- E. 7.8×10^{-2} M

28. Will a precipitate of magnesium fluoride form when 300. mL of 1.1×10^{-3} M $MgCl_2$ are added to 500. mL of 1.2×10^{-3} M NaF? [$K_{sp}(MgF_2) = 6.9 \times 10^{-9}$]

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

29. Will a precipitate (ppt) form when 300. mL of 2.0×10^{-5} M $AgNO_3$ are added to 200. mL of 2.5×10^{-9} M NaI? Answer yes or no, and identify the precipitate if there is one.

- A. Yes, the ppt is $AgNO_3(s)$
- B. Yes, the ppt is $NaNO_3(s)$
- C. Yes, the ppt is $NaI(s)$
- D. Yes, the ppt is $AgI(s)$
- E. No, a precipitate will not form

30. Which response has both answers correct? Will a precipitate form when 250 mL of 0.33 M Na_2CrO_4 are added to 250 mL of 0.12 M AgNO_3 ? [$K_{\text{sp}}(\text{Ag}_2\text{CrO}_4) = 1.1 \times 10^{-12}$] What is the concentration of the silver ion remaining in solution?

- A. Yes, $[\text{Ag}^+] = 2.9 \times 10^{-6} \text{ M}$
- B. Yes, $[\text{Ag}^+] = 0.060 \text{ M}$
- C. Yes, $[\text{Ag}^+] = 1.3 \times 10^{-4} \text{ M}$
- D. No, $[\text{Ag}^+] = 0.060 \text{ M}$
- E. No, $[\text{Ag}^+] = 0.105 \text{ M}$

31. To 1.00 L of a 0.100 M aqueous solution of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) is added 1.00 mL of 12.0 M HCl. What is the percentage ionization of the benzoic acid in the resulting solution? [$K_{\text{a}}(\text{C}_6\text{H}_5\text{COOH}) = 6.5 \times 10^{-5}$]

- A. 3.3%
- B. 12%
- C. 1.3%
- D. 0.52%
- E. 0.065%

32. Calculate the molar solubility of AgCl in a 0.15 M solution of $\text{NH}_3(\text{aq})$.

($K_{\text{sp}}(\text{AgCl}) = 1.6 \times 10^{-10}$; $K_{\text{f}}(\text{Ag}(\text{NH}_3)_2^+) = 1.5 \times 10^7$)

- A. $6.7 \times 10^{-3} \text{ M}$
- B. $1.3 \times 10^{-5} \text{ M}$
- C. $3.9 \times 10^3 \text{ M}$
- D. $7.5 \times 10^{-2} \text{ M}$
- E. $3.3 \times 10^{-5} \text{ M}$

33. Calculate the molar solubility of AgBr in a 0.25M solution of $\text{NH}_3(\text{aq})$ ($K_{\text{sp}}(\text{AgBr}) = 7.7 \times 10^{-13}$; $K_{\text{f}}(\text{Ag}(\text{NH}_3)_2^+) = 1.5 \times 10^7$).

- A. 8.8×10^{-7} M
- B. 3.4×10^{-3} M
- C. 8.4×10^{-4} M
- D. 2.5×10^{-1} M
- E. 9.7×10^2 M

34. Find the concentration of Pb^{2+} ions in a solution made by adding 5.00 g of lead(II) iodide to 500. mL of 0.150 M KI. [For PbI_2 , $K_{\text{sp}} = 1.39 \times 10^{-8}$.]

- A. 3.04×10^{-4} M
- B. 1.54×10^{-7} M
- C. 6.18×10^{-7} M
- D. 1.52×10^{-4} M
- E. 9.27×10^{-8} M

35. 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? [$K_{\text{a}}(\text{HCOOH}) = 1.7 \times 10^{-4}$]

- A. 540 mL
- B. 420 mL
- C. 80. mL
- D. 340 mL
- E. 500. mL

36. 500. mL of a solution containing 1.5 M $\text{NH}_3(\text{aq})$ is mixed with 500. mL of a solution containing 0.50M of $\text{HCl}(\text{aq})$. What is the pH of the final solution?

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

- A. 9.16
- B. 9.36
- C. 9.56
- D. 9.76
- E. None of the Above

37. Calculate the percent ionization of formic acid in a 0.010 M HCOOH solution.

($K_a = 1.7 \times 10^{-4}$)

- A. 11%
- B. 13%
- C. 15%
- D. 17%
- E. None of the Above

38. Calculate the percent ionization of formic acid in a solution that is 0.010 M HCOOH and 0.005 M HCOONa . ($K_a = 1.7 \times 10^{-4}$)

- A. 1.4%
- B. 2.4%
- C. 3.4%
- D. 4.4%
- E. None of the Above

39. Calculate the percent ionization of formic acid in a solution that is 0.010 M HCOOH and 0.050 M HCOONa. ($K_a = 1.7 \times 10^{-4}$)

- A. 0.34%
- B. 0.44%
- C. 0.54%
- D. 0.64%
- E. None of the Above

40. Calculate the pH at the equivalence point for the titration of 0.22 M HCN with 0.22 M NaOH. ($K_a = 4.9 \times 10^{-10}$ for HCN)

- A. 10.58
- B. 10.78
- C. 10.98
- D. 11.18
- E. None of the above

41.

340. mL of a 0.150M solution of $\text{NH}_3(\text{aq})$ is titrated with 0.100 M HCl. Calculate the pH of the solution after 750. mL of the HCl has been added. ($K_a(\text{NH}_4^+) = 5.6 \times 10^{-10}$)

- A. 1.46
- B. 1.66
- C. 1.86
- D. 2.06
- E. None of the above

42. Calculate the molar solubility of silver carbonate. ($K_{sp}(\text{Ag}_2\text{CO}_3) = 8.1 \times 10^{-12}$)

- A. 1.1×10^{-4} M
- B. 1.3×10^{-4} M
- C. 1.5×10^{-4} M
- D. 1.7×10^{-4} M
- E. None of the above

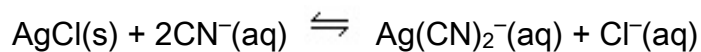
43. The K_{sp} of CaF_2 is 4×10^{-11} . What is the maximum concentration of Ca^{2+} possible in a 0.10 M NaF solution?

- A. 4×10^{-7} M
- B. 4×10^{-8} M
- C. 4×10^{-9} M
- D. 4×10^{-10} M
- E. None of the above

44. 5.0 mL of 12 M NH_3 is added to 500. mL of 0.050 M AgNO_3 . What concentration of silver ion will exist after equilibrium is established? [K_f for $\text{Ag}(\text{NH}_3)_2^+$ is 1.5×10^7 .]

- A. 8.2×10^{-6} M
- B. 8.4×10^{-6} M
- C. 8.6×10^{-6} M
- D. 8.8×10^{-6} M
- E. None of the above

45. Calculate the equilibrium constant K_c for the following overall reaction:



For AgCl , $K_{\text{sp}} = 1.6 \times 10^{-10}$; for $\text{Ag(CN)}_2^{\text{-}}$, $K_f = 1.0 \times 10^{21}$.

- A. 1.2×10^{11}
- B. 1.4×10^{11}
- C. 1.6×10^{11}
- D. 1.8×10^{11}
- E. None of the above

46. The solubility of $\text{Ba(NO}_3)_2$ is 130.5 g/L at 0°C . How many moles of dissolved salt are present in 4.0 L of a saturated solution of $\text{Ba(NO}_3)_2$ at 0°C ?

- A. 1.0 moles
- B. 2.0 moles
- C. 3.0 moles
- D. 4.0 moles
- E. None of the above

47. NaCl is added slowly to a solution that is 0.010 M each in Cu^+ , Ag^+ , and Au^+ . The K_{sp} 's for CuCl , AgCl , and AuCl are 1.9×10^{-7} , 1.8×10^{-10} , and 2.0×10^{-13} , respectively. Which compound will precipitate first?

- A. CuCl
- B. AgCl
- C. AuCl
- D. Au and Ag will precipitate at the same time
- E. None will precipitate

48. How many moles of NaF must be dissolved in 1.00 liter of a saturated solution of PbF_2 at 25°C to reduce the $[\text{Pb}^{2+}]$ to $1.0 \times 10^{-6} \text{ M}$? The K_{sp} for PbF_2 at 25°C is 4.0×10^{-8} .

- A. 0.20 mol
- B. 0.30 mol
- C. 0.40 mol
- D. 0.50 mol
- E. None of the above

49. At 25°C , the base ionization constant for NH_3 is 1.8×10^{-5} . Determine the hydroxide ion concentration in a 0.150 M solution of ammonia at 25°C .

- A. $1.6 \times 10^{-2} \text{ M}$
- B. $3.2 \times 10^{-2} \text{ M}$
- C. $1.6 \times 10^{-3} \text{ M}$
- D. $3.2 \times 10^{-3} \text{ M}$
- E. None of the above

50. At 25°C , the base ionization constant for NH_3 is 1.8×10^{-5} . Determine the pH of a solution prepared by adding 0.0500 mol of solid ammonium chloride to 100. mL of 0.150 M ammonia.

- A. 3.47
- B. 8.73
- C. 10.4
- D. 12.3
- E. None of the above

CHEM 1412. Chapter 17. Acid-Base Equilibria (Homework) Ky

Key

1. A
2. C
3. D
4. A
5. C
6. D
7. A
8. B
9. A
10. C
11. C
12. A
13. E
14. D
15. B
16. E
17. B
18. C

19. D

20. B

21. E

22. B

23. B

24. D

25. C

26. B

27. E

28. B

29. D

30. A

31. D

32. A

33. C

34. C

35. B

36. C

37. B

38. C

39. A

40. D

41. B

42. B

43. C

44. B

45. C

46. B

47. C

48. A

49. C

50. B