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 ($C_6H_5CO_2H$) and 0.15M 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

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(HOCl) = 3.2×10^{-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 $\pm$ 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?

A.

$OH^- + HOCl \rightarrow H_2O + OCl^-$

B.

$OH^- + OCl^- \rightarrow HOCl + O^{2-}$

C.

$Na^+ + HOCl \rightarrow NaCl + OH^-$

D.

$H^+ + HOCl \rightarrow H_2 + OCl^-$

E.

$NaOH + HOCl \rightarrow H_2O + NaCl$

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?

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

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?

A. CH_3COO_2Na / 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

10. Starting with 0.750L of a buffer solution containing 0.30 M benzoic acid (C_6H_5COOH) and 0.35 M sodium benzoate (C_6H_5COONa), what will the pH of the solution be after the addition of 340.0 mL of 0.350M HCl? (K_a (C_6H_5COOH) = 6.5 x 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 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.

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 ($C_6H_5NH_2$). K_b ($C_6H_5NH_2$) = 3.8 x 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 ($C_6H_5NH_2$). K_b ($C_6H_5NH_2$) = 3.8 x 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 $\times$ 10^{-2} M $Pb(NO_3)_2$ is added to 400 mL of 9.0 $\times$ 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) = 6.9×10^{-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 $AgNO_3$? [$K_{sp}(Ag_2CrO_4) = 1.1 \times 10^{-12}$] What is the concentration of the silver ion remaining in solution?

A. Yes, $[Ag^+] = 2.9 \times 10^{-6}$ M

B. Yes, $[Ag^+] = 0.060$ M

C. Yes, $[Ag^+] = 1.3 \times 10^{-4}$ M

D. No, $[Ag^+] = 0.060$ M

E. No, $[Ag^+] = 0.105$ M

31. To 1.00 L of a 0.100 M aqueous solution of benzoic acid (C_6H_5COOH) is added 1.00 mL of 12.0 M HCl. What is the percentage ionization of the benzoic acid in the resulting solution? [$K_a(C_6H_5COOH) = 6.5 \times 10^{-5}$]

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 $NH_3(aq)$.
(K_{sp} (AgCl) = 1.6 x 10^{-10}; K_f ($Ag(NH_3)_2^+$) = 1.5 x 10^7)

A. 6.7 x 10^{-3} M

B. 1.3 x 10^{-5} M

C. 3.9 x 10^3 M

D. 7.5 x 10^{-2} M

E. 3.3 x 10^{-5} M

33. Calculate the molar solubility of AgBr in a 0.25M solution of $NH_3(aq)$ (K_{sp} (AgBr) = 7.7 x 10^{-13} ; K_f ($Ag(NH_3)_2^+$) = 1.5 x 10^7.

A. 8.8 x 10^{-7} M

B. 3.4 x 10^{-3} M

C. 8.4 x 10^{-4} M

D. 2.5 x 10^{-1} M

E. 9.7 x 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, $K_{sp} = 1.39 \times 10^{-8}$.]

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_a(HCOOH) = 1.7×10^{-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 $NH_3(aq)$ is mixed with 500. mL of a solution containing 0.50M of HCl(aq). What is the pH of the final solution?

($K_b(NH_3) = 1.8 \times 10^{-5}$)

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 $NH_3(aq)$ is titrated with 0.100 M HCl. Calculate the pH of the solution after 750. mL of the HCl has been added. ($K_a(NH_4^+) = 5.6 \times 10^{-10}$)

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} (Ag_2CO_3 = 8.1 x 10^{-12}))

A. 1.1 x 10^{-4} M

B. 1.3 x 10^{-4} M

C. 1.5 x 10^{-4} M

D. 1.7 x 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 $Ag(NH_3)_2^+$ 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:

$AgCl(s) + 2CN^-(aq) \rightleftharpoons Ag(CN)_2^-(aq) + Cl^-(aq)$

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

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 $Ba(NO_3)_2$ is 130.5 g/L at 0ºC. How many moles of dissolved salt are present in 4.0 L of a saturated solution of $Ba(NO_3)_2$ at 0ºC?

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 $[Pb^{2+}]$ to 1.0×10^{-6} 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. 1.6×10^{-2} M

B. 3.2×10^{-2} M

C. 1.6×10^{-3} M

D. 3.2×10^{-3}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

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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