Acid/Base Homework Booklet #2 Last one!! Name ____________________Period _____

You know the drill.

1. What is true about the transition point of all indicators described by the following equilibrium:

$$HIn + H_2O \leftrightarrows H_3O^+ + In^-$$

   A. $[H_3O^+] = [OH^-]$
   B. pH = pOH
   C. $pH = K_a$
   D. $[HIn] = [In^-]$

2. What color would 1.0 M HCl be in an indicator mixture consisting of phenol red and thymophthalein?
   A. yellow
   B. colorless
   C. red
   D. blue

3. What color would 0.10 M NaOH be in an indicator mixture consisting of phenol red and bromcresol green?
   A. purple
   B. green
   C. yellow
   D. blue

4. What color would 0.10 M NaOH be in an indicator mixture consisting of phenol red and alizarin yellow ?
   A. red
   B. colorless
   C. yellow
   D. orange

5. When the indicator thymol blue is added to 0.10 M solution of an unknown acid, the solution is red. The acid could be
   A. HCN
   B. HF
   C. HNO_3
   D. H_2S

6. When the indicator alazarin yellow is added to 0.010 M solution of an unknown compound, the solution is red. The unknown compound could could be
   A. NaOH
   B. HNO_3
   C. HCN
   D. KIO_3

7. At pH = 4.0 methyl red will be
   A. red and [HInd] > $[Ind^-]$
   B. yellow and [HInd] < $[Ind^-]$
   C. yellow and [HInd] > $[Ind^-]$
   D. red and [HInd] < $[Ind^-]$

8. Methyl red is orange in a 0.10 M solution of an acid. The acid could be
   A. NH_3
   B. C_6H_5OH
   C. HI
   D. NaOH

9. Thymol blue is green in a 0.72 M solution of an unknown solution. The unknown solution could be
   A. HCN
   B. HI
   C. NaHCOO
   D. NaOH

10. Which would produce a yellow solution at pH = 4.0?
    A. indigo carmen
    B. methyl violet
    C. methyl red
    D. chlorophenol red

11. Which would produce an orange solution at pH = 6.0?
    A. phenol red
    B. thymol blue
    C. methyl red
    D. chlorophenol red

12. Which would produce a green solution at pH = 6.8?
    A. thymol blue
    B. indigo carmine
    C. bromcresol green
    D. bromthymol blue

13. The chemical indicator bromthymol blue changes from yellow to blue as a result of the addition of
   A. 1.0 M HNO_2
   B. 1.0 M NH_4Cl
   C. 1.0 M HCl
   D. 1.0 M K_2CO_3

14. The chemical indicator thymol blue changes from yellow to blue as a result of the addition of
   A. 1.0 M HNO_2
   B. 1.0 M NH_4Cl
   C. 1.0 M HCl
   D. 1.0 M K_2CO_3

15. The chemical indicator bromcresol green changes from blue to yellow as a result of the addition of
   A. 1.0 M K_2CO_3
   B. 1.0 M LiCl
   C. 1.0 M $NaNO_2$
   D. 1.0 M HCl

16. The chemical indicator phenol red changes from red to yellow as a result of the addition of
   A. 1.0 M K_2CO_3
   B. 1.0 M LiCl
   C. 1.0 M $NaNO_2$
   D. 1.0 M HI

17. Consider the following equilibrium for the chemical indicator phenol red, HInd, at a pH = 7.3 (orange).

$$\underset{\text{yellow}}{HInd} + H_2O \leftrightharpoons H_3O^+ + \underset{\text{red}}{Ind^-}$$

   When some HCl is added, what stress is imposed on the equilibrium and what colour change occurs?

	Stress	Indicator Colour Change
A.	increased $[H_3O^+]$	turns yellow
B.	decreased $[H_3O^+]$	turns yellow
C.	increased $[H_3O^+]$	turns red
D.	decreased $[H_3O^+]$	turns red

18. The indicator phenol red will be red in which of the following solutions?
   A. 1.0 M NH_4Cl
   B. 1.0 M Na_2CO_3
   C. 1.0 M HF
   D. 1.0 M HBr

19. The indicator phenolphthalein can be described by the following equilibrium equation:

$$\underset{\text{colorless}}{HIn} + H_2O \leftrightarrows H_3O^+ + \underset{\text{pink}}{In^-}$$

HCl is added to a slighly pink sample of this indicator. After equilibrium has been re-established, how do the $[H_3O^+]$ and the colour of the solution compare with the original equilibrium?

	$[H_3O^+]$	Colour of solution
A.	increases	turns more pink
B.	decreases	turns colourless
C.	decreases	turns more pink
D.	increases	turns colourless

20. The indicator phenolphthalein can be described by the following equilibrium equation:

$$\underset{\text{colorless}}{HIn} + H_2O \leftrightarrows H_3O^+ + \underset{\text{pink}}{In^-}$$

NH_4Cl is added to a slighly pink sample of this indicator. After equilibrium has been re-established, how do the $[H_3O^+]$ and the colour of the solution compare with the original equilibrium?

	$[H_3O^+]$	Colour of solution
A.	increases	turns colourless
B.	increases	turns more pink
C.	decreases	turns more pink
D.	decreases	turns colourless

21. Consider the following indicator equilibrium:

$$\underset{\text{(yellow)}}{HIn} + H_2O \leftrightarrows H_3O^+ + \underset{\text{(blue)}}{In^-}$$

What is the result of adding CH_3COOH to this indicator?

	Equilibrium Shift	Colour
A.	right	blue
B.	right	yellow
C.	left	yellow
D.	left	blue

22. Consider the following indicator equilibrium:

$$\underset{\text{(yellow)}}{HIn} + H_2O \leftrightarrows H_3O^+ + \underset{\text{(blue)}}{In^-}$$

What is the result of adding Na_2CO_3 to this indicator?

	Equilibrium Shift	Colour
A.	left	blue
B.	right	yellow
C.	right	blue
D.	left	yellow

23. Consider the equilibirum for the indicator, thymolphthalein (HThy):

$$HThy + H_2O \leftrightarrows H_3O^+ + Thy^-$$

What happens when NaOH is added to a sample of this indicator in water?

	Equilibrium	Colour
A.	shifts left	turns colourless
B.	shifts right	turns blue
C.	shifts left	turns blue
D.	shifts right	turns colourless

24. A chemical indicator has a $K_a = 1.6 \times 10^{-7}$. What is the pH at the transition point and what is the identity of the indicator?

	pH	Indicator
A.	6.8	phenol red
B.	7.2	thymol blue
C.	6.8	bromthymol blue
D.	6.8	chlorophenol red

25. An indicator is blue at pH of 7.8 and yellow at a pH of 5.6. Identify the indicator and determine its K_a.

	Indicator	K_a
A.	thymol blue	2×10^{-9}
B.	bromcresol green	3×10^{-5}
C.	thymol blue	1×10^{-2}
D.	bromthymol blue	2×10^{-7}

26. What is one of the Ka values for thymol blue?

A. 1×10^{-7}

B. 2×10^{-9}

C. 6×10^{-2}

D. 2×10^{-7}

27. An indicator is often used during acid-base titrations.

a. Define the term ***transition point*** for an indicator.

b. Calculate the K_a value for methyl orange.

c. A mixture of indicators is made by combining equal amounts of methyl orange and bromthymol blue. Complete the following table showing the colour of each indicator and the mixture at the pH's indicated.

pH	Colour of methyl orange	Colour of bromthymol blue	Colour of mixture
pH = 5			
pH = 9			

28. An indicator is often used during acid-base titrations.

a. Calculate the K_a value for phenol red.

b. A mixture of indicators is made by combining equal amounts of methyl orange, phenol red and chlorophenol red. Complete the following table showing the colour of each indicator and the mixture at the pH's indicated.

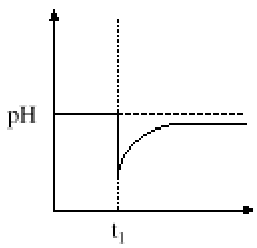
pH	Colour of thymol blue	Colour of phenol red	Colour of mixture
pH = 1.4			
pH = 7.8			
pH = 10.0			

29. A buffer solution can be prepared by dissolving equal moles of
   A. a strong acid and its conjugate base
   B. a strong base and its conjugate acid
   C. a weak acid and its conjugate base
   D. a weak base and a strong acid

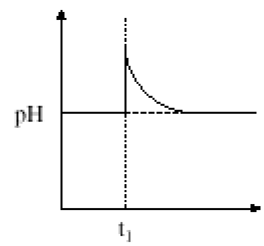
30. Which of the following acids could **not** be present in a buffer solution?
   A. $HClO_4$
   B. H_2SO_3
   C. HF
   D. HNO_2

31. Which of the following graphs best describes the effect on the pH of a buffer solution with a small amount of acid is added at time t_1?

A.



B.



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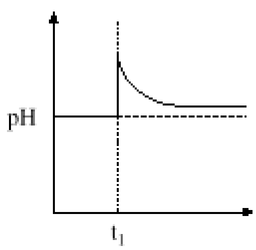
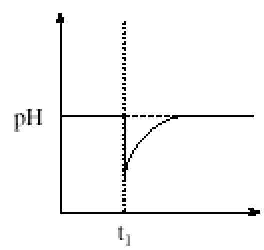
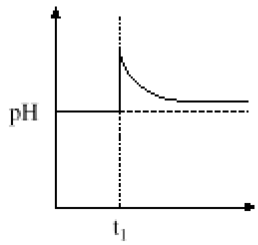


D.

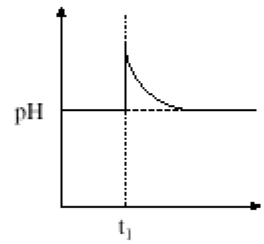


32. Which of the following graphs best describes the effect on the pH of a buffer solution with a small amount of base is added at time t_1?

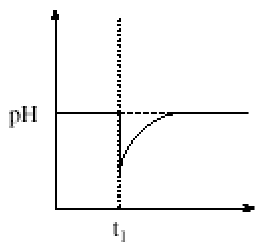
A.



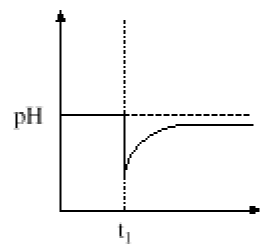
B.



C.



D.



33. Which of the following would form a buffer solution when equal moles are mixed together?
   A. HCl and NaCl
   B. HCN and NaCN
   C. KNO_3 and KOH
   D. Na_2SO_4 and NaOH

34. Equal moles of which of the following chemicals could be used to make a buffer solution that has a pH >7.0?
   A. HCN and NaCN
   B. KBr and $NaNO_3$
   C. HF and NaF
   D. HCl and NaCl

35. Equal moles of which of the following chemicals could be used to make a buffer solution with a pH <7.0?
   A. KBr and $NaNO_3$
   B. HCN and NaCN
   C. HCl and NaCl
   D. HF and NaF

36. Which of the following pairs of chemicals could be used to make a buffer solution?
   A. HCl and NaCl
   B. CH_3COOH and HCl
   C. NH_3 and H_2O
   D. NH_3 and NH_4Cl

37. Which of the following could tpically be used to prepare a buffer solution?
   A. H_2S and NaHS
   B. HNO_2 and $NaNO_3$
   C. HNO_3 and $NaNO_3$
   D. H_2S and ZnS

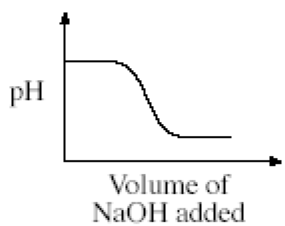
38. Consider the following buffer equilibrium:

$$HCN + H_2O \leftrightarrows CN^- + H_3O^+$$

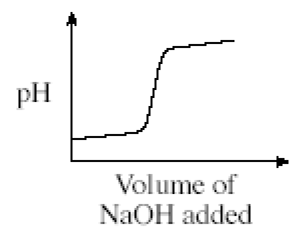
When a few drops of KOH are added the buffer, the equilibrium
   A. shifts left and the $[CN^-]$ increases
   B. shifts right and the $[CN^-]$ increases
   C. shifts left and the $[CN^-]$ decreases
   D. shifts right and the $[CN^-]$ decreases

39. Which of the following graphs describes the relationship between the pH of a buffer and the volume of NaOH added to the buffer?

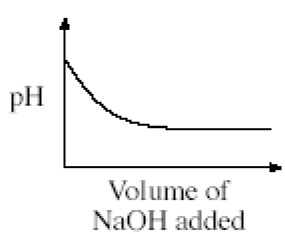
A.



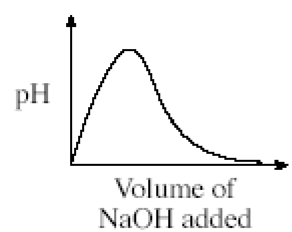
B.



C.

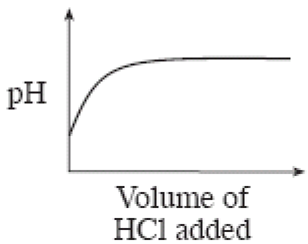


D.

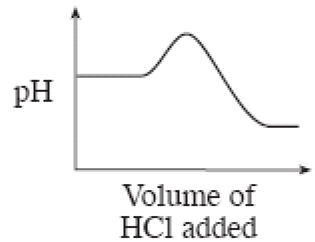


40. Which of the following graphs best describes the changes in pH when HCl is added to a buffer solution?

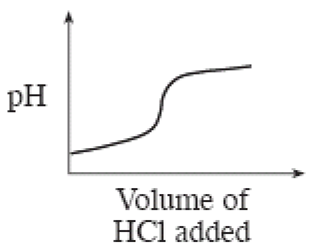
A.



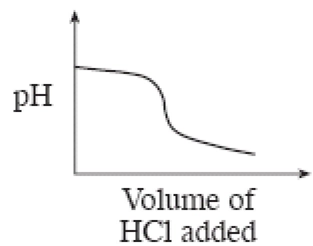
B.



C.



D.



41. Acid is added to a buffer solution. When equilibrium is reestablished the buffering effect has resulted in $[H_3O^+]$

A. increasing slightly
B. decreasing considerably
C. increasing considerably
D. decreasing slightly

42. Consider the buffer equilibrium:

$$HNO_{2\,(aq)} + H_2O_{(l)} \leftrightarrows H_3O^+_{(aq)} + NO_2^-{}_{(aq)}$$

HNO_2	H_3O^+	NO_2^-
high concentration	low concentration	high concentration

What happens when a small amount of $HCl_{(aq)}$ is added to the equilibrium system?

A. the equilibrium shifts to the right
B. the equilibrium does not shift due to the levelling effect
C. the pH increases slightly
D. the pH decreases slightly

43. Consider the buffer equilibrium:

$HNO_{2\,(aq)}$	+ $H_2O_{(l)}$	⇆ $H_3O^+_{(aq)}$	+	$NO_2^-{}_{(aq)}$
high concentration		low concentration		high concentration

What happens when a small amount of $Na_2CO_{3\,(aq)}$ is added to the equilibrium system?

A. the pH increases slightly
B. there will be no shift since Na_2CO_3 is not an acid or a base
C. the $[H_3O^+]$ will increase slightly
D. the pH decreases slightly

44. In the human bloodstream, a buffer exists that is made of H_2CO_3 and $NaHCO_3$.

a. Explain what the purpose for this buffer is:

b. Approximately what pH level would this buffer operate at? Assume that there are equal moles of H_2CO_3 and $NaHCO_3$.

c. When a person exercises strenuously, the muscles produce lactic acid as a waste product. After strenuous exercise, that acid would make its way into the blood stream. What would happen to the pH of the blood?

45. A scientist wants a buffer solution that will work at a pH level of 3.75.

a. Describe what would be required to make a suitable buffer solution.

b. Which weak acid and conjugate base would work? ____________ and its conjugate base _____________

c. Explain what would happen if a few drops of NaOH would be added to this buffer. Would the pH change? If so, how much and would it increase or decrease?

pH would ________________

Explanation:

46. Consider the following buffer equilibrium:

$HF_{(aq)}$	+ $H_2O_{(l)}$ ⇆	$H_3O^+_{(aq)}$	+	$F^-_{(aq)}$
high concentration		low concentration		high concentration

Using LeChatelier's Principle, explain what happens to the pH of the buffer solution when a small amount of NaOH is added.

If equal moles of HF and F^- are used, what will be the approximate pH level that this buffer will work at?

47. If 1.00 moles of HCN and 1.00 moles of NaCN are added to 1.00 L of water, what pH will the buffer remain relatively constant at?
A. 9.31
B. 0.00
C. 7.00
D. 4.69

48. If 1.00 moles of CH_3COOH and 1.00 moles of $NaCH_3COO$ are added to 1.00 L of water, what pH will the buffer remain relatively constant at?
A. 4.74
B. 0.00
C. 7.00
D. 9.26

49. If 1.00 moles of NH_4NO_3 and 1.00 moles of NH_3 are added to 1.00 L of water, what pH will the buffer remain relatively constant at?
A. 9.25
B. 0.00
C. 7.00
D. 4.75

50. Consider the following buffer equilibrium:

$$HF_{(aq)} + H_2O_{(l)} \leftrightarrows H_3O^+_{(aq)} + F^-_{(aq)}$$

What would limit the buffering action if HCl were added?
A. $[F^-]$
B. $[H_3O^+]$
C. $[H_2O]$
D. [HF]

51. Consider the following buffer equilibrium:

$$HF_{(aq)} + H_2O_{(l)} \leftrightarrows H_3O^+_{(aq)} + F^-_{(aq)}$$

What would limit the buffering action if KOH were added?
A. $[H_2O]$
B. $[H_3O^+]$
C. $[F^-]$
D. [HF]

52. Consider the following buffer equilibrium:

$$HCN + H_2O \leftrightarrows CN^- + H_3O^+$$

When 25 mL of 0.200 M KOH are added, the pH rises dramatically. Why?

A. The KOH reacts with the HCN instead of the H_3O^+, causing a shift left instead of a shift right.
B. The KOH is a strong base and forces the CN^- to act as an acid.
C. The KOH becomes part of the buffer solution.
D. The KOH exceeds the buffer capacity.

53. Which of the following would be the net ionic equation for the reaction between HCl and KOH?

A. $H^+ + Cl^- + K^+ + OH^- \rightarrow H_2O + KCl$
B. $H^+ + Cl^- + K^+ + OH^- \rightarrow H_2O + Cl^- + K^+$
C. $HCl + KOH \rightarrow H_2O + KCl$
D. $H^+ + OH^- \rightarrow H_2O$

54. Which of the following is the net ionic equation for the neutralization of CH_3COOH with $NaOH?_{(aq)}$

A. $CH_3COOH_{(aq)} + NaOH_{(aq)} \rightarrow NaCH_3COO^-_{(aq)} + H_2O_{(l)}$
B. $CH_3COOH_{(aq)} + OH^-_{(aq)} \rightarrow CH_3COO^-_{(aq)} + H_2O_{(l)}$
C. $CH_3COO^-_{(aq)} + OH^-_{(aq)} \rightarrow CH_3COOH_{(aq)} + O^{-2}_{(aq)}$
D. $CH_3COOH\text{-}_{(aq)} + H^+_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightarrow Na^+ + CH_3COO^-_{(aq)} + H_2O_{(l)}$

55. Write the net ionic equation for the neutralization of $HF_{(aq)}$ with $Sr(OH)_{2\,(aq)}$.

A. $2HF_{(aq)} + Sr(OH)_{2\,(aq)} \rightarrow SrF_{2\,(s)} + 2\,H_2O_{(l)}$
B. $2HF_{(aq)} + Sr^{+2}_{(aq)} + 2\,OH^-_{(aq)} \rightarrow SrF_{2\,(s)} + 2H_2O_{(l)}$
C. $HF_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + F^-_{(aq)}$
D. $HF_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + F^-_{(aq)}$

56. Write the net ionic equation for the neutralization of $HCH_3COO_{(aq)}$ with $Sr(OH)_{2\,(aq)}$.

A. $2HCH_3COO_{(aq)} + Sr(OH)_{2\,(aq)} \rightarrow Sr(CH_3COO)_{2\,(aq)} + 2\,H_2O_{(l)}$
B. $HCH_3COO_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + CH_3COO^-_{(aq)}$
C. $2H^+_{(aq)} + 2\,CH_3COO^-_{(aq)} + Sr^{+2}_{(aq)} + 2\,OH^-_{(aq)} \rightarrow Sr(CH_3COO)_{2\,(aq)} + 2H_2O_{(l)}$
D. $HCH_3COO_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$

57. Write the net ionic equation for the neutralization of $HBr_{(aq)}$ with $Sr(OH)_{2\,(aq)}$.

A. $2HBr_{(aq)} + Sr(OH)_{2\,(aq)} \rightarrow SrBr_{2\,(aq)} + 2\,H_2O_{(l)}$
B. $2H^+_{(aq)} + 2\,Br^-_{(aq)} + Sr^{+2}_{(aq)} + 2\,OH^-_{(aq)} \rightarrow SrBr_{2\,(aq)} + 2H_2O_{(l)}$
C. $HBr_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + Br^-_{(aq)}$
D. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

58. What is the net ionic equation for the neutralization of 0.1 M $Sr(OH)_2$ (aq) with 0.1 M H_2SO_4 $_{(aq)}$?

A. $Sr^{+2}{}_{(aq)} + SO_4{}^{-2}{}_{(aq)} \rightarrow SrSO_{4\,(s)}$

B. $Sr(OH)_{2\,(aq)} + H_2SO_{4\,(aq)} \rightarrow SrSO_{4\,(s)} + 2H_2O_{(l)}$

C. $H^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow H_2O_{(l)}$

D. $Sr^{+2}{}_{(aq)} + 2OH^-{}_{(aq)} + 2H^+{}_{(aq)} + SO_4{}^{-2}{}_{(aq)} \rightarrow SrSO_{4\,(s)} + 2\,H_2O_{(l)}$

59. Which net ionic equation best describes the reaction between NaOH and H_2S?

A. $2NaOH_{(aq)} + H_2S_{(aq)} \rightarrow 2H_2O\,(l) + Na_2S_{(aq)}$

B. $2Na^+{}_{(aq)} + 2OH^-{}_{(aq)} + 2H^+{}_{(aq)} + S^{-2}{}_{(aq)} \rightarrow 2H_2O_{(l)} + 2Na^+{}_{(aq)} + S^{-2}{}_{(aq)}$

C. $OH^-{}_{(aq)} + H^+{}_{(aq)} \rightarrow H_2O_{(l)}$

D. $2OH^-{}_{(aq)} + H_2S_{(aq)} \rightarrow 2H_2O_{(l)} + S^{-2}{}_{(aq)}$

60. The strong acid, $HNO_{3\,(aq)}$ is titrated with the weak base, $NH_{3\,(aq)}$. What is the net ionic equation for this reaction?

A. $H^+{}_{(aq)} + NH_{3\,(aq)} \rightarrow NH_4{}^+{}_{(aq)}$

B. $H^+{}_{(aq)} + NO_3{}^-{}_{(aq)} + NH_3\,(aq) \rightarrow NH_4{}^+{}_{(aq)} + NO_3{}^-{}_{(aq)}$

C. $H^+{}_{(aq)} + OH^- \rightarrow H_2O_{(l)}$

D. $HNO_{3\,(aq)} + NH_{3\,(aq)} \rightarrow NH_4NO_{3\,(aq)}$

61. Which of the following is the complete ionic equation for the titration of $HCl_{(aq)}$ with KOH $_{(aq)}$?

A. $H^+{}_{(aq)} + Cl^-{}_{(aq)} + K^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)}$

B. $HCl_{(aq)} + KOH_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)}$

C. $H^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow H_2O_{(l)}$

D. $H^+{}_{(aq)} + Cl^-{}_{(aq)} + K^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow K^+{}_{(aq)} + Cl^-{}_{(aq)} + H_2O_{(l)}$

62. What is the net ionic equation for the titration of $H_3PO_{4\,(aq)}$ with $Sr(OH)_{2\,(aq)}$?

A. $6H^+{}_{(aq)} + 6OH^-{}_{(aq)} \rightarrow 6H_2O_{(l)}$

B. $6H^+{}_{(aq)} + 2PO_4{}^{-3}{}_{(aq)} + 3Sr^{+2}{}_{(aq)} + 6OH^-{}_{(aq)} \rightarrow 3Sr^{+2}{}_{(aq)}\ \ 2PO_4{}^{-3}{}_{(aq)} + 6H_2O_{(l)}$

C. $H^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow H_2O_{(l)}$

D. $2H_3PO_{4\,(aq)} + 3Sr^{+2}{}_{(aq)} + 6OH^-{}_{(aq)} \rightarrow Sr_3(PO_4)_{2\,(s)} + 6H_2O_{(l)}$

63. Write the net ionic equation for the acid-base reaction that occurs between $NaNO_{2\,(aq)}$ and $NH_4Cl_{(aq)}$.

64. For the titration between 0.20 M $Sr(OH)_2$ and 0.20 M H_2SO_3

a. Write the formula equation

b. Write the complete ionic equation

c. Write the net ionic equation

d. Explain why the electrical conductivity of the products is less than that of the reactants

65. Which statement describes the pH of the equivilence point of a titration of 0.200 M CH_3COOH by 0.200 M KOH?

A. The pH = 7 because the CH_3COOH and KOH neutralize each other.
B. The pH < 7 because the KCH_3COO hydrolizes to form H_3O^+.
C. The pH > 7 because the KCH_3COO hydrolizes to form OH^-.
D. The pH = 7 because the no hydrolysis of products is possible.

66. Which statement describes the pH of the equivilence point of a titration of 0.200 M NH_3 by 0.200 M HI?

A. The pH > 7 because the NH_4^+ hydrolizes to form OH^-.
B. The pH = 7 because the NH_3 and HI neutralize each other.
C. The pH < 7 because the NH_4^+ hydrolizes to form H_3O^+.
D. The pH = 7 because the no hydrolysis of products is possible.

67. What is the $[H_3O^+]$ at the equivilence point for the titration between HBr and KOH?

A. 1.0×10^{-5} M
B. 1.0×10^{-7} M
C. 1.0×10^{-9} M
D. 0.0 M

68. At the equivilence point, the titration of HCl with NH_3 will form a solution which is

A. acidic with pH < 7
B. neutral with pH = 7
C. basic with pH >7
D. acidic with pH > 7

69. At the equivilence point, the titration of HCN with NaOH will form a solution which is
   A. basic with pH < 7
   B. neutral with pH = 7
   C. basic with pH >7
   D. acidic with pH < 7

70. A solution of NaOH $_{(aq)}$ was standardized by titration using oxalic acid ($H_2C_2O_{4\ (s)}$) as the primary standard. The following data was collected:

   Mass of $H_2C_2O_{4\ (s)}$ used = 1.02 g
   Volume of NaOH $_{(aq)}$ used = 40.0 mL

   Calculate the concentration of the NaOH $_{(aq)}$.

71. A titration was performed by adding 0.115 M HCl to a 25.00 mL sample of $Ba(OH)_2$. Calculate the $[Ba(OH)_2]$ from the following data:

	Trial #1	Trial #2	Trial #3
Inital volume of HCl (mL)	4.00	22.45	3.45
Final volume of HCl (mL)	22.45	42.85	22.00

72. A titration was performed by adding 0.150 M NaOH to a 10.00 mL sample of an unknown diprotic weak acid H_2A. Calculate the $[H_2A]$ from the following data:

	Trial #1	Trial #2	Trial #3
Inital volume of NaOH (mL)	4.50	24.75	2.00
Final volume of NaOH (mL)	24.65	44.65	22.25

b. If the pH of the 10.00 mL of H_2A was 3.93, determine the Ka for H_2A

c. Using your data booklet, identify the unknown acid. H_2A = ______________

73. A titration was performed by adding 0.120 M $Sr(OH)_2$ to a 10.00 mL sample of an unknown monoprotic weak acid HA. Calculate the [HA] from the following data:

	Trial #1	Trial #2	Trial #3
Inital volume of $Sr(OH)_2$ (mL)	2.20	23.80	5.60
Final volume of $Sr(OH)_2$ (mL)	22.65	43.85	25.55

b. If the pH of the 10.00 mL of HA was 2.04, determine the Ka for HA

c. Using your data booklet, identify the unknown acid. HA = ______________

74. Which of the following titrations would have a pH >7 at the equivilence point?

A. HCl with $Sr(OH)_2$

B. $HClO_4$ with NH_3

C. HI with KOH

D. HCOOH with NaOH

75. Calculate the volume of 0.500 M NaOH required to completely neutralize 25.0 mL of 0.450 M H_2SO_4.

A. 22.5 mL

B. 45.0 mL

C. 9.00 mL

D. 11.3 mL

76. Calculate the volume of 0.300 M HNO_3 needed to completely neutralize 25.0 mL of 0.250 M $Sr(OH)_2$.
   A. 41.7 mL
   B. 20.8 mL
   C. 10.4 mL
   D. 15.0 mL

77. How many moles of $Ba(OH)_2$ are required to react completely with 100.0 mL of 0.250 M HNO_3
   A. 0.0500 moles
   B. 1.25 moles
   C. 0.0250 moles
   D. 0.0125 moles

78. A 10.0 mL sample of H_2SO_3 is completely neutralized by titration with 18.6 mL of 0.10 M NaOH. Calculate the concentration of the acid.
   A. 0.37 M
   B. 0.74 M
   C. 0.19 M
   D. 0.093 M

79. During a titration, 25.0 mL of $H_3PO_{4\ (aq)}$ is completely neutralized by 42.6 mL of 0.20 M NaOH. Calculate the concentration of the acid.
   A. 0.11 M
   B. 1.0 M
   C. 0.34 M
   D. 0.17 M

80. A 20.0 mL sample of HCl is titrated with 25.0 mL of 0.20 M $Sr(OH)_2$. What is the concentration of the acid?
   A. 0.50 M
   B. 0.25 M
   C. 0.13 M
   D. 0.20 M

81. A 25.0 mL sample of H_2SO_3 is titrated with 20.0 mL of 0.150 M NaOH. Calculate the concentration of the H_2SO_3.
   A. 0.00300 M
   B. 0.240 M
   C. 0.0600 M
   D. 0.120 M

82. What volume of 0.500 M NaOH is required to neutralize 25.0 mL of a 0.250 M HBr?
   A. 20.0 mL
   B. 25.0 mL
   C. 5.00 mL
   D. 12.5 mL

83. A 25.0 mL sample of a diprotic weak acid is titrated with 20.2 mL of 0.10 M NaOH. What is the concentration of the acid?
A. 0.040 M
B. 0.12 M
C. 0.16 M
D. 0.080 M

84. During a titration, what volume of 0.500 M KOH would be necessary to completely neutralize 10.0 mL of 2.00 M CH_3COOH?
A. 25.0 mL
B. 20.0 mL
C. 10.0 mL
D. 40.0 mL

85. During a titration, what volume of 0.500 M $Ba(OH)_2$ would be necessary to completely neutralize 10.0 mL of 2.00 M CH_3COOH?
A. 25.0 mL
B. 40.0 mL
C. 10.0 mL
D. 20.0 mL

86. The complete neutralization of 15.0 mL of KOH requires 0.0250 moles of H_2SO_4. The [KOH] was
A. 1.67 M
B. 0.833 M
C. 3.75×10^{-4} M
D. 3.33 M

87. A 250.0 mL sample of HCl with a pH of 2.000 is completely neutralized with 0.200 M NaOH.

a. What volume of NaOH is required to reach the stoichiometric point?

b. Write the net ionic equation for the neutralization.

c. If the HCl were titrated with 0.200 M $NH_{3\ (aq)}$ instead of 0.200 M NaOH, how would the volume of base required to reach the equivilence point compare with the volume calculated in part a) ? Explain your answer.

88. Which of the following will dissolve in water to produce an acidic solution?

A. MgO
B. Na_2O
C. CO_2
D. CaO

89. Which of the following will dissolve in water to produce an acidic solution?

A. BaO
B. Rb_2O
C. SO_2
D. CaO

90. What reaction occurs when sodium oxide dissolves in water?

A. $NaO_{(s)} + H_2O_{(l)} \rightarrow NaOH_{(aq)}$
B. $Na_2O_{(s)} + H_2O_{(l)} \rightarrow 2NaOH_{(aq)}$
C. $NaO_{(s)} \rightarrow Na^{+2}_{(aq)} + O^{-2}_{(aq)}$
D. $Na_2O_{(s)} \rightarrow 2Na^{+}_{(aq)} + O^{-2}_{(aq)}$

91. What reaction occurs when strontium oxide dissolves in water?

A. $SrO_{(s)} \rightarrow Sr^{+2}_{(aq)} + O^{-2}_{(aq)}$
B. $SrO_{(s)} + H_2O_{(l)} \rightarrow H_2SrO_{2\ (aq)}$
C. $SrO_{(s)} + H_2O_{(l)} \rightarrow Sr(OH)_{2\ (aq)}$
D. $Sr_2O_{(s)} \rightarrow 2Sr^{+}_{(aq)} + O^{-2}_{(aq)}$

92. What reaction occurs when carbon dioxide dissolves in water?

A. $CO_{2\,(g)} + 2H_2O_{(l)} \rightarrow C(OH)_{4\,(aq)}$

B. $CO_{2\,(g)} + H_2O_{(l)} \rightarrow H_2CO_{3\,(aq)}$

C. $CO_{2\,(g)} \rightarrow C^{+4}_{(aq)} + 2O^{-2}_{(aq)}$

D. $CO_{2\,(g)} \rightarrow CO^{+2}_{(aq)} + O^{-2}_{(aq)}$

93. What is produced when MgO is added to water?

A. the base $Mg(OH)_2$

B. the amphiprotic species H_2MgO

C. the metal Mg

D. the acid HMgO

94. What is produced when Se_2O_3 is added to water?

A. $Se_2O_{3\,(s)} + H_2O_{(l)} \rightarrow H_2Se_2O_{4\,(aq)}$

B. $2Se_2O_{3\,(s)} + 4H_2O_{(l)} \rightarrow 4SeH_{2\,(g)} + 5O_{2\,(g)}$

C. $Se_2O_{3\,(s)} + H_2O_{(l)} \rightarrow 2Se\,(s) + 2O_{2\,(g)} + H_{2\,(g)}$

D. $Se_2O_{3\,(s)} + 3H_2O_{(l)} \rightarrow 2Se(OH)_{3\,(aq)}$

95. For each of the following, predict whether the anhydride will form an acidic or basic solution, and provide the equation to support your answer.

Prediction

a. $BaO + H_2O \rightarrow$ ________________

b. $Cl_2O_7 + H_2O \rightarrow$ ________________

c. $Li_2O + H_2O \rightarrow$ ________________

96. For each of the following, predict whether the anhydride will form an acidic or basic solution, and provide the equation to support your answer.

Prediction

a. $TiO_2 + H_2O \rightarrow$ ________________

b. $Cl_2O_5 + H_2O \rightarrow$ ________________

c. $Rb_2O + H_2O \rightarrow$ ________________

97. For each of the following, provide the anhydride that mixed with water to produce the solution.

a. H_3PO_4 → H_2O + ___________

b. $Mg(OH)_2$ → H_2O + ___________

c. H_2SO_3 → H_2O + ___________

98. For each of the following, provide the anhydride that mixed with water to produce the solution.

a. $HClO_4$ → H_2O + ___________

b. $Ca(OH)_2$ → H_2O + ___________

c. HNO_3 → H_2O + ___________

99. During the late 1970's, some of the small lakes in Northern Ontario were severely damaged by the acid rain produced by the nickel smelters found in the area. The lakes were dead - no fish, insects or plants could survive in the acidic waters. One lake was selected as an experiment for restoration.

Over one hundred truckloads of crushed limestone ($CaCO_3$) were dumped into the lake. As the limestone entered the water, three observations were noted:

1. The white limestone dissolved quickly initially, but slowed down until there was a layer over a meter deep on the bottom of the lake. A month later the layer had disappeared.

2. When the limestone initially disappeared, there appeared to be a large amount of gas produced that slowly rose to the top of the water before going into the air.

3. Samples of the bottom of the lake, taken several weeks after the dumping of the limestone showed high amounts of calcium ions but very small amounts of carbonate ions.

a. Explain why the limestone took a long time to fully dissolve.

b. Using hydrolysis and Le Chatelier's Principle, explain what the bubbles of gas were and how those gas bubbles were produced.

c. Explain why there were high concentrations of calcium ions but not carbonate ions in the samples taken several weeks later.

100. The property common to both 0.10 M NH_3 and 0.10 M NaOH is that both solutions

A. turn blue litmus paper red
B. have a pH > 7
C. dissociate 100%
D. react with magnesium to produce hydrogen gas

101. Consider the following Bronsted-Lowry equilibrium:

$$C_6H_5NH_{2\ (aq)} + H_2PO_4^-{}_{(aq)} \leftrightarrows C_6H_5NH_3^+{}_{(aq)} + HPO_4^{-2}{}_{(aq)}$$

The substances acting as acids and bases from left to right are:
A. base, acid, base, acid
B. base, acid, acid, base
C. acid, base, acid, base
D. acid, base, base, acid

102. Which of the following will have the lowest electrical conductivity?
A. 1.00 M NaCN
B. 1.00 M $NaHCO_3$
C. 1.00 M $HClO_4$
D. 1.00 M $H_2C_2O_4$

103. In a 1.0 M HF solution, the concentrations of HF, F^- and OH^- , from highest to lowest is
A. $[OH^-] > [HF] > [F^-]$
B. $[OH^-] > [F^-] > [HF]$
C. $[F^-] > [HF] > [OH^-]$
D. $[HF] > [F^-] > [OH^-]$

104. Consider the following equilibrium:

$$H_3AsO_4 + HSeO_4^- \leftrightarrows H_2AsO_4^- + H_2SeO_4$$

Reactants are favored in this equilibrium. Which of the following describes the relative strengths of the acids and bases?

	Stronger Acid	Stronger Base
A.	H_3AsO_4	$H_2AsO_4^-$
B.	H_3AsO_4	$HSeO_3^-$
C.	H_2SeO_4	$HSeO_3^-$
D.	H_2SeO_4	$H_2AsO_4^-$

105. When comparing 0.1 0 M HPO_4^{-2} and 0.10 M $HC_2O_4^-$ as acids, which of the following is true?
A. $HC_2O_4^-$ is stronger and its pH is smaller
B. HPO_4^{-2} is weaker and its pH is smaller
C. $HC_2O_4^-$ is weaker and its pH is larger
D. HPO_4^{-2} is stronger and its pH is larger

106. Consider the following equilibrium:

$$2H_2O_{(l)} + \text{energy} \leftrightarrows H_3O^+_{(aq)} + OH^-_{(aq)}$$

A few drops of NaOH are added and a new equilibrium is established. The new equilibrium can be described by

A. pH = pOH and $K_w > 1.0 \times 10^{-14}$

B. pH < pOH and $K_w = 1.0 \times 10^{-14}$

C. pH > pOH and $K_w = 1.0 \times 10^{-14}$

D. pH = pOH and $K_w < 1.0 \times 10^{-14}$

107. At 20°C the ionization constant of water (K_w) is 6.76×10^{-15}. Calculate the pOH and pH of water at 20°C.

	pH	pOH
A.	7.085	6.915
B.	7.085	7.085
C.	6.915	7.085
D.	7.000	7.000

108. Which of the following solutions would have a pH = 2.00?

A. 0.010 M H_2SO_4

B. 0.010 M NaOH

C. 0.010 M HCl

D. 0.010 M HCN

109. Using calculations, show why the electrical conductivity of 1.0 M H_2CO_3 will be less than that for 0.10 M HCl.

110. Calculate the pH of a 0.010 M NH_4CN solution.

111. Consider the following equilibrium:

$$2H_2O_{(l)} \leftrightarrows H_3O^+{}_{(aq)} + OH^-{}_{(aq)}$$

What changes occur to $[H_3O^+]$ and pH when $NaHSO_3$ is added?

	$[H_3O^+]$	pH
A.	decreases	decreases
B.	decreases	increases
C.	increases	increases
D.	increases	decreases

112. In an aqueous solution of $Fe(NO_3)_3$, the pH is

A. greater than 7 and the solution is basic
B. less than 7 and the solution is acidic
C. greater than 7 and the solution is acidic
D. equal to 7 and the solution is neutral

113. The $HCO_3^-{}_{(aq)}$ ion will act as

A. a base since $K_a < K_b$
B. a acid since $K_a > K_b$
C. a acid since $K_a < K_b$
D. a base since $K_a > K_b$

114. Consider the following indicator equilibrium:

$$HIn + H_2O \leftrightarrows H_3O^+ + In^-$$

Which of the following is true about the transition point of this indicator?

A. [HIn] > [In^-]
B. moles of H_3O^+ = moles of In^-
C. [HIn] = [In^-]
D. pH = 7.0

115. What color would 0.10 M HCl be in an indicator mixture consisting of phenol red and bromcresol green?

A. yellow
B. green
C. purple
D. blue

116. When the indicator thymol blue is added to 0.010 M solution of an unknown acid, the solution is orange. The acid could be

A. HCN
B. HF
C. HNO_3
D. H_2S

117. Consider the following equilibrium for the chemical indicator phenol red, HInd, at a pH = 7.3 (orange).

$$\underset{\text{yellow}}{HInd} + H_2O \leftrightarrows H_3O^+ + \underset{\text{red}}{Ind^-}$$

When some Na_2CO_3 is added, what stress is imposed on the equilibrium and what colour change occurs?

	Stress	Indicator Colour Change
A.	decreased [H_3O^+]	turns red
B.	decreased [H_3O^+]	turns yellow
C.	increased [H_3O^+]	turns red
D.	increased [H_3O^+]	turns yellow

118. A chemical indicator has a $K_a = 1.6 \times 10^{-4}$. What is the pH at the transition point and what is the identity of the indicator?

	pH	Indicator
A.	10.2	phenophthalien
B.	3.8	methyl orange
C.	10.2	thymophthalien
D.	3.8	bromcresol green

119. At 45.0 ^oC, $K_w = 4.00 \times 10^{-14}$ for pure water.

a. Calculate the pH of water at 45.0 ^oC.

b. A mixture of the indicators Thymol Blue and Chlorophenol Red is added to the water. What is the resulting colour of the mixture? Explain.

Resulting color _______________
Explaination:

120. A 20.0 mL sample of H_2SO_4 is titrated with 25.0 mL of 0.20 M $Sr(OH)_2$. What is the concentration of the acid?
A. 0.25 M
B. 0.50 M
C. 0.13 M
D. 0.20 M

121. At the equivilence point, the titration of HCl with $Ba(OH)_2$ will form a solution which is
A. basic with pH < 7
B. neutral with pH = 7
C. basic with pH >7
D. acidic with pH < 7

122. Which of the following pairs of chemicals could be used to make a buffer solution?
A. HI and NaI
B. $NaClO_4$ and $HClO_4$
C. HCN and NaCN
D. HNO_3 and $NaNO_3$

123. Consider the following buffer equilibrium:

$$HF_{(aq)} + H_2O_{(l)} \leftrightarrows H_3O^+_{(aq)} + F^-_{(aq)}$$

What would limit the buffering action if KCH_3COO were added?

A. $[H_2O]$
B. $[F^-]$
C. $[H_3O^+]$
D. $[HF]$

124. A titration was performed by adding 0.500 M NaOH to a 25.00 mL sample of an unknown diprotic weak acid H_2A. Calculate the $[H_2A]$ from the following data:

	Trial #1	Trial #2	Trial #3
Inital volume of NaOH (mL)	2.20	23.80	5.60
Final volume of NaOH (mL)	22.65	43.85	25.55

b. If the pH of the 25.00 mL of H_2A was 3.53, determine the Ka for H_2A

c. Using your data booklet, identify the unknown acid. H_2A = ______________