General Chemistry II Lecture Spring 2020 Test 4 4/17/20 F Sect A Dr. Hahn Exam # _____

Name Key (print) Name _____(sign)
Please show work for partial credit &full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly.

I prefer that you print the test and scan in the completed Test. For the multiple choice instead of scanning in the entire 3 pages of multiple choice, **fill in the multiple choice sheet on the last page of the test (after the short answers) and return that page instead.** Also for those who do NOT have a printer and scanner, it is OK to just give multiple choice number with the correct letter and to just give short answer number on a blank sheet of paper and show work by the short answer number & cell phone photo in your paper.

In either case you have 2 hours 15 minutes from the time that you open the emailed test until you email the completed test back to me. This test is Open Notes and Open Book but NOT open another person. **This is a 50 minuts test.** The additional time is to allow for download and upload time. Your email time stamp is the time stamp for when you returned the test. If you have questions or if you notice a typo, I will open livestreaming during the time of the test. You may log on and unmute yourself or chat ask a question during the livestream. You also may cell phone call or text me the question. If you email me a question, I may miss the email in time to get back to you before the turn in deadline.

M = moles solute/ L soln $K_w=[H^+][OH^-] = 1.0 \times 10^{-14}$ pKw = pH+pOH = 14 p(anything) = - log (anything) $[H^+]$ = antilog (-pH)

MULTIPLE CHOICE. Choose the one best alternative.

1) Which is a net ionic equation for the neutralization of a weak acid with a strong base? 1) D

A) $HF(aq) + LiOH(aq) = H_2O(l) + LiF(aq)$
B) $H_3O^+(aq) + OH^-(aq) = 2\ H_2O(l)$
C) $HBr(aq) + NaOH(aq) = H_2O(l) + NaBr(aq)$
D) $HF(aq) + OH^-(aq) = H_2O(l) + F^-(aq)$

2) For the reaction shown below, which change in conditions made to the system at equilibrium will result in a net reaction to the right to form more product? 2) C

$$C(s) + 2\ H_2(g) = CH_4(g) \quad \Delta H° = -74.8\ kJ$$ +heat

A) increasing the volume ← 2mol
B) decreasing the pressure → 1mol
C) lower Temperature → +heat
D) removing H_2 ←

3) Which statement about buffers is true? 3) B

A) A buffer does not change pH on addition of a strong acid or strong base.
B) Buffers resist change in pH upon addition of small amounts of strong acid or strong base.
C) Buffers have a pH = 7.
D) Buffers consist of a strong acid and its conjugate base.

4) An acidic solution at 25°C has 4) C

A) $[H_3O^+] < 1 \times 10^{-7}\ M > [OH^-]$.
B) $[H_3O^+] > [OH^-] > 1 \times 10^{-7}\ M$.
C) $[H_3O^+] > 1 \times 10^{-7}\ M > [OH^-]$.
D) $[H_3O^+] = [OH^-] > 1 \times 10^{-7}\ M$.

5) Which of these neutralization reactions has a pH = 7 when equal molar amounts of acid and base are mixed? 5) C

A) $CH_3CO_2H(aq) + LiOH(aq) = H_2O(l) + LiCH_3CO_2(aq)$

B) $HI(aq) + C_5H_5N(aq) = C_5H_5NHI(aq)$

C) $HI(aq) + KOH(aq) = H_2O(l) + KI(aq)$

D) $HNO_2(aq) + NH_3(aq) = NH_4NO_2(aq)$

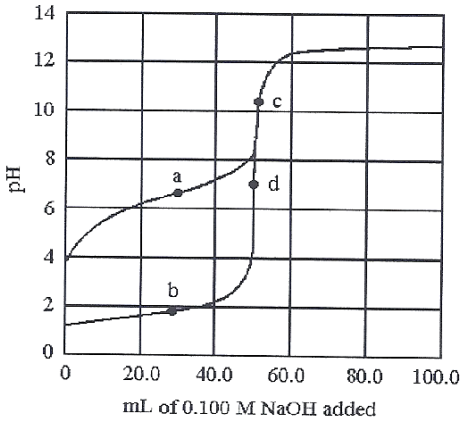
6) What is the common ion in a solution prepared by mixing 0.55 M $LiCH_3CO_2$ with 0.10 M CH_3CO_2H? 6) B

A) OH^- B) $CH_3CO_2^-$ C) Li^+ D) H_3O^+

7) Which of the following solutions has the highest concentration of hydroxide ions $[OH^-]$? 7) B

A) pH = 3.21 B) pH = 12.04 C) pH = 7.83 D) pH = 10.93

The following plot shows two titration curves, each representing the titration of 50.00 mL of 0.100 M acid with 0.100 M NaOH.



8) Which point a–d represents a buffer region? 8) A

A) point a B) point b C) point c D) point d

9) When equal molar amounts of the following sets of compounds are mixed in water, which will **not** form a buffer solution? 9) A

A) HNO_3 with $LiNO_3$ strong acid / strong base

B) KH_2PO_4 with K_2HPO_4

C) NH_3 with NH_4I

D) CH_3CO_2H with $LiCH_3CO_2$

10) What is the Henderson–Hasselbalch equation for the acidic buffer HA/A–? 10) A

A) $pH = pK_a + \log\{[A^-]/[HA]\}$

B) pH = 14 – pOH

C) $pH = -\log[H_3O^+]$

D) $pH = pK_a - \log\{[A^-]/[HA]\}$

11) What are the conjugate acid-base pairs for $NH_3(aq) + H_2O(l) = NH_4^+(aq) + OH^-(aq)$ 11) B

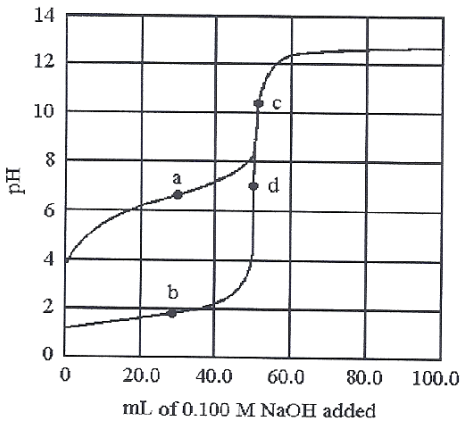
A) NH_3, H_2O and NH_4^+, OH^-
B) NH_3, NH_4^+ and H_2O, OH^-
C) NH_3, OH^- and H_2O, NH_4^+
D) NH_3 and NH_4^+

12) A solution with a hydrogen ion concentration of 3.25×10^{-2} M is _____ and has a hydroxide concentration of _____. 12) A

A) acidic, 3.08×10^{-13} M
B) basic, 3.08×10^{-13} M
C) acidic, 3.08×10^{-12} M
D) basic, 3.08×10^{-12} M

$\frac{1.0 \times 10^{-14}}{3.25 \times 10^{-2}} = 3.08 \times 10^{-13}$

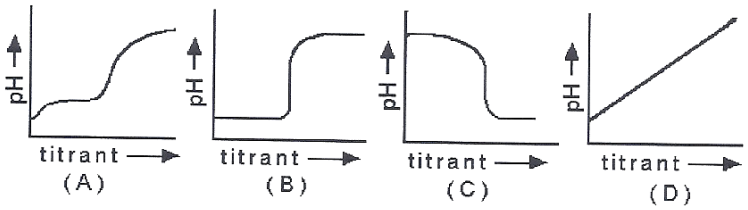
The following plot shows two titration curves, each representing the titration of 50.00 mL of 0.100 M acid with 0.100 M NaOH.



13) Which point a-d represents the equivalence point for the titration of a strong acid? 13) D

A) point a B) point b C) point c D) point d

Use the graphs below to answer the following questions.



14) What is the characteristic pH-titrant curve for the titration of a strong acid by a strong base? 14) B

A) A B) B C) C D) D

15) What is the characteristic pH-titration curve for the titration of a weak acid by a strong base? 15) A

A) A B) B C) C D) D

16) What is the equilibrium constant expression (K_a) for $HCN(aq) + H_2O(l) = H_3O^+(aq) + CN^-(aq)$. 16) B

A) $K_a = ([H_3O^+][CN^-])/([HCN][H_2O])$ B) $K_a = ([H_3O^+][CN^-])/([HCN])$

C) $K_a = ([HCN][H_2O])/([H_3O^+][CN^-])$ D) $K_a = ([HCN])/([H_3O^+][CN^-])$

Short Answer. Show work for partial credit &full credit on the Short Answer Questions.

p(Anything)= - log (Anything), [H+] = antilog (- pH) M = moles / liter, 1000 mL = 1 Liter {pH = pKa + log [base]/[acid]}

17) What is the pH of a buffer system made by dissolving 5.23 mole H CN and 2.5 mole CN- in enough water to make 1.000 L of the solution ? $K_a = 4.9 \times 10^{-10}$ for H CN (12 pts)
(show work) Use EITHER Henderson Hasselbalch or ICE table.

$4.9 \times 10^{-10} = \frac{(x)(2.5+x)}{(5.23-x)}$ $x \ll$ small

	H CN (aq)	+ H_2O (l) -->	H_3O^+ (aq)	+ CN^- (aq)
I	5.23		0	2.5
C	-x		+x	+x
E	5.23 - x		x	2.5 + x

$\frac{4.9 \times 10^{-10}}{(2.5)}(5.23) = x$

$x = 1.03 \times 10^{-9}$

$pH = 8.989$

$pH = -\log(4.9 \times 10^{-10}) + \log\left(\frac{2.5m}{5.23m}\right) = 9.30 + (-0.321)$

$= 8.98$

18) Determine the acid dissociation constant for a 0.255 M H F solution that has a pH of 1.89 (HF is a weak acid) (8 pts) $HF(aq) + H_2O(l) = H_3O^+(aq) + F^-(aq)$. $[H+] = 10^{-pH}$ (13 pts)

H F	H_3O^+	F -
0.255	0	0
-0.129	0.0129	0.0129
0.258 - 0.0129	0.0129	0.0129

$pH = 1.89$

$[H+] = 10^{-1.89} = 0.0129$

$K_a = \frac{[H_3O^+][F^-]}{[HF]}$

$K_a = \frac{(0.0129)(0.0129)}{(0.255 - 0.0129)}$

$K_a = \frac{1.66 \times 10^{-4}}{(0.242)} = 6.86 \times 10^{-4}$

19) a) What is the $[H_3O^+]$ concentration of a solution of H Br of 0.250 M (5 pts)

$[H_3O^+] = 0.250\,m$

b) What is the pH of the above solution ? (5 pts)

$pH = -\log(0.250) = 0.602$

c) What is the [OH-] of the solution ? (5 pts)

$[H_3O^+][OH^-] = 1.0 \times 10^{-14}$

$[OH^-] = \left(\frac{1.0 \times 10^{-14}}{0.250}\right) = 4.0 \times 10^{-14}\,M$

20) Multiple Choice: After you decide on your multiple choice letter choices, input the letter choices by numbers. (Thanks: It takes less of a toll on my printer ink if you do this rather than emailing me your entire multiple choice pages.)

1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____

9 ____ 10 ____ 11 ____ 12 ____ 13 ____ 14 ____ 15 ____ 16 ____

General Chemistry II Lecture Spring 2020 Test 4 4/17/20 F Sect C Dr. Hahn Exam # _____

Name Key (print) Name _____(sign)
Please show work for partial credit &full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly.

I prefer that you print the test and scan in the completed Test. For the multiple choice instead of scanning in the entire 3 pages of multiple choice, **fill in the multiple choice sheet on the last page of the test (after the short answers) and return that page instead.** Also for those who do NOT have a printer and scanner, it is OK to just give multiple choice number with the correct letter and to just give short answer number on a blank sheet of paper and show work by the short answer number & cell phone photo in your paper.

In either case you have 2 hours 15 minutes from the time that you open the emailed test until you email the completed test back to me. This test is Open Notes and Open Book but NOT open another person. **This is a 50 minuts test.** The additional time is to allow for download and upload time. Your email time stamp is the time stamp for when you returned the test. If you have questions or if you notice a typo, I will open livestreaming during the time of the test. You may log on and unmute yourself or chat ask a question during the livestream. You also may cell phone call or text me the question. If you email me a question, I may miss the email in time to get back to you before the turn in deadline.

M = moles solute/ L soln $K_w=[H^+][OH^-] = 1.0 \times 10^{-14}$ $pK_w = pH+pOH = 14$ p(anything) = - log (anything) $[H^+]$ = antilog (-pH)

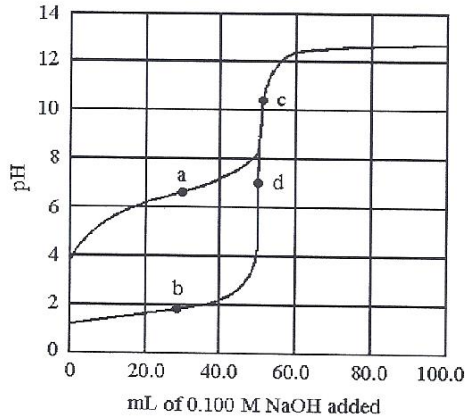
MULTIPLE CHOICE. Choose the one best alternative.

1) What is the equilibrium constant expression (K_a) for $HCN(aq) + H_2O(l) = H_3O^+(aq) + CN^-(aq)$. 1) C

A) $K_a = ([H_3O^+][CN^-])/([HCN][H_2O])$ B) $K_a = ([HCN])/([H_3O^+][CN^-])$

C) $K_a = ([H_3O^+][CN^-])/([HCN])$ D) $K_a = ([HCN][H_2O])/([H_3O^+][CN^-])$

The following plot shows two titration curves, each representing the titration of 50.00 mL of 0.100 M acid with 0.100 M NaOH.



2) Which point a-d represents a buffer region? 2) A

A) point a B) point b C) point c D) point d

3) Which point a-d represents the equivalence point for the titration of a strong acid? 3) D

A) point a B) point b C) point c D) point d

4) For the reaction shown below, which change in conditions made to the system at equilibrium will result in a net reaction to the right to form more product? 4) C

$C(s) + 2\,H_2(g) = CH_4(g) \quad \Delta H° = -74.8$ kJ + heat (product)

2 mol 1 mol

A) removing H_2 ←
B) increasing the volume ←
C) lower Temperature ←→
D) decreasing the pressure →←

5) When equal molar amounts of the following sets of compounds are mixed in water, which will **not** form a buffer solution? 5) D

A) KH_2PO_4 with K_2HPO_4
B) NH_3 with NH_4I
C) CH_3CO_2H with $LiCH_3CO_2$
D) HNO_3 with $LiNO_3$

6) Which of these neutralization reactions has a pH = 7 when equal molar amounts of acid and base are mixed? 6) A

A) $HI(aq) + KOH(aq) = H_2O(l) + KI(aq)$
B) $CH_3CO_2H(aq) + LiOH(aq) = H_2O(l) + LiCH_3CO_2(aq)$
C) $HI(aq) + C_5H_5N(aq) = C_5H_5NHI(aq)$
D) $HNO_2(aq) + NH_3(aq) = NH_4NO_2(aq)$

$\frac{(1.0\times10^{-14})}{(3.25\times10^{-2})} =$

7) A solution with a hydrogen ion concentration of 3.25×10^{-2} M is _____ and has a hydroxide concentration of _____. 7) A

A) acidic, 3.08×10^{-13} M
B) basic, 3.08×10^{-12} M
C) acidic, 3.08×10^{-12} M
D) basic, 3.08×10^{-13} M

8) Which is a net ionic equation for the neutralization of a weak acid with a strong base? 8) C

A) $HBr(aq) + NaOH(aq) = H_2O(l) + NaBr(aq)$
B) $H_3O^+(aq) + OH^-(aq) = 2\,H_2O(l)$
C) $HF(aq) + OH^-(aq) = H_2O(l) + F^-(aq)$
D) $HF(aq) + LiOH(aq) = H_2O(l) + LiF(aq)$

9) Which of the following statements about a catalyst is true? 9) C

A) A catalyst is consumed in a chemical reaction.
B) A catalyst increases the pressure of a reaction.
C) A catalyst provides a lower energy pathway for a reaction.
D) A catalyst decreases the position of the equilibrium in a reaction.

10) Which of the following solutions has the highest concentration of hydroxide ions $[OH^-]$? 10) C

A) pH = 10.93 B) pH = 7.83 C) pH = 12.04 D) pH = 3.21

11) An acidic solution at 25°C has 11) C

A) $[H_3O^+] > [OH^-] > 1 \times 10^{-7}$ M.
B) $[H_3O^+] < 1 \times 10^{-7}$ M $> [OH^-]$.
C) $[H_3O^+] > 1 \times 10^{-7}$ M $> [OH^-]$.
D) $[H_3O^+] = [OH^-] > 1 \times 10^{-7}$ M.

12) What is the hydronium ion concentration with a pH of 3.15? $10^{-3.15}$ 12) D

A) 1.41×10^{-11} M B) 3.15 M C) 10.85 M D) 7.08×10^{-4} M

13) What are the conjugate acid-base pairs for $NH_3(aq) + H_2O(l) = NH_4^+(aq) + OH^-(aq)$ 13) D

A) NH_3, OH^- and H_2O, NH_4^+ B) NH_3, H_2O and NH_4^+, OH^-

C) NH_3 and NH_4^+ D) NH_3, NH_4^+ and H_2O, OH^-

14) Which statement about buffers is true? 14) A

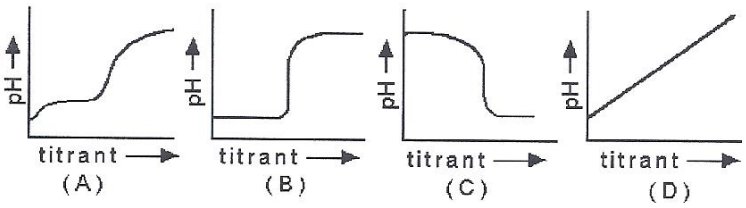
A) Buffers resist change in pH upon addition of small amounts of strong acid or strong base.

B) Buffers have a pH = 7.

C) Buffers consist of a strong acid and its conjugate base.

D) A buffer does not change pH on addition of a strong acid or strong base.

Use the graphs below to answer the following questions.



15) What is the characteristic pH-titration curve for the titration of a weak acid by a strong base? 15) A

A) A B) B C) C D) D

16) Which is a net ionic equation for the neutralization of a strong acid with a strong base? 16) B

A) $HF(aq) + NaOH(aq) = H_2O(l) + NaF(aq)$ B) $H_3O^+(aq) + OH^-(aq) = 2\ H_2O(l)$

C) $HI(aq) + NaOH(aq) = H_2O(l) + NaI(aq)$ D) $HCl(aq) + OH^-(aq) = H_2O(l) + Cl^-(aq)$

Short Answer. Show work for partial credit &full credit on the Short Answer Questions.

p(Anything)= - log (Anything), [H+] = antilog (- pH) M = moles / liter, 1000 mL = 1 Liter {pH = pKa + log [base]/[acid]}

17) What is the pH of a buffer system made by dissolving 0.793 mole H CN and 0.525 mole CN- in enough water to make 1.000 L of the solution ? $K_a = 4.9 \times 10^{-10}$ for H CN (12 pts) (show work) Use EITHER Henderson Hasselbalch or ICE table.

$HCN_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + CN^-_{(aq)}$

	HCN (aq)	H_2O (l)	H_3O^+ (aq)	CN^- (aq)
I	0.793		0	0.525
C	−x		+x	+x
E	0.793−x		x	x + 0.525

$4.9\times10^{-10} = \frac{(x)(0.525+x)}{(0.793-x)}$

x << small

$4.9\times10^{-10} = \frac{(x)(0.525)}{(0.793)}$

$x = \frac{(4.9\times10^{-10})(0.793)}{(0.525)} = 7.40\times10^{-10}$

$pH = -\log(4.9\times10^{-10}) + \log\left(\frac{0.525}{0.793}\right) = 9.13$

18) What is the hydronium ion concentration of a 0.0882 M acetic acid solution with $K_a = 1.8 \times 10^{-5}$? The equation for the dissociation of acetic acid is: (13 pts) $CH_3CO_2H(aq) + H_2O(l) = H_3O^+(aq) + CH_3CO_2^-(aq)$.

CH_3CO_2H	H_3O^+	$CH_3CO_2^-$
0.0882	0	0
−x	+x	+x
0.0882−x	x	x

$1.8\times10^{-5} = \frac{[H_3O^+][CH_3CO_2^-]}{[CH_3CO_2H]} = \frac{x^2}{0.0882-x}$

Assume x << small → $1.8\times10^{-5} = \frac{x^2}{0.0882}$

$x^2 = (1.8\times10^{-5})(0.0882)$

$x = \sqrt{(1.8\times10^{-5})(0.0882)} = 1.26\times10^{-3}$

(0.00126)

$pH = 9.13$

19) a) What is the $[H_3O^+]$ concentration of a solution of H I of 0.017 M (5 pts)

$[H_3O^+] = 0.017\ M$ ← (strong acid)

b) What is the pH of the above solution ? (5 pts)

$pH = -\log(0.017) = 1.77$

c) What is the [OH-] of the solution ? (5 pts)

$[OH^-][H_3O^+] = 1.0 \times 10^{-14}$

$[OH^-] = \frac{1.0 \times 10^{-14}}{(0.017)} = 5.88 \times 10^{-13}$

20) Multiple Choice: After you decide on your multiple choice letter choices, input the letter choices by the numbers. (Thanks: It takes less of a toll on my printer ink if you do this rather than emailing me your entire multiple choice pages.)

1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____

9 ____ 10 ____ 11 ____ 12 ____ 13 ____ 14 ____ 15 ____ 16 ____

General Chemistry II Lecture Spring 2020 Test 4 4/17/20 F Sect MakeUp Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit &full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly.

I prefer that you print the test and scan in the completed Test. For the multiple choice instead of scanning in the entire 3 pages of multiple choice, **fill in the multiple choice sheet on the last page of the test (after the short answers) and return that page instead.** Also for those who do NOT have a printer and scanner, it is OK to just give multiple choice number with the correct letter and to just give short answer number on a blank sheet of paper and show work by the short answer number & cell phone photo in your paper.

In either case you have 2 hours 15 minutes from the time that you open the emailed test until you email the completed test back to me. This test is Open Notes and Open Book but NOT open another person. **This is a 50 minuts test.** The additional time is to allow for download and upload time. Your email time stamp is the time stamp for when you returned the test. If you have questions or if you notice a typo, I will open livestreaming during the time of the test. You may log on and unmute yourself or chat ask a question during the livestream. You also may cell phone call or text me the question. If you email me a question, I may miss the email in time to get back to you before the turn in deadline.

M = moles solute/ L soln $K_w=[H^+][OH^-] = 1.0 \times 10^{-14}$ pKw = pH+pOH = 14 p(anything) = - log (anything) $[H^+]$ = antilog (-pH)

MULTIPLE CHOICE. Choose the one best alternative.

1) What is the Henderson-Hasselbalch equation for the acidic buffer HA/A-? 1) B

A) $pH = pK_a - \log\{[A^-]/[HA]\}$ B) $pH = pK_a + \log\{[A^-]/[HA]\}$

C) $pH = -\log[H_3O^+]$ D) pH = 14 - pOH

2) What are the conjugate acid-base pairs for $NH_3(aq) + H_2O(l) = NH_4^+(aq) + OH^-(aq)$ 2) B

A) NH_3 and NH_4^+ B) NH_3, NH_4^+ and H_2O, OH^-

C) NH_3, H_2O and NH_4^+, OH^- D) NH_3, OH^- and H_2O, NH_4^+

3) Which of the following solutions has the highest concentration of hydroxide ions $[OH^-]$? 3) B

A) pH = 7.83 B) pH = 12.04 C) pH = 3.21 D) pH = 10.93

4) When equal molar amounts of the following sets of compounds are mixed in water, which will **not** form a buffer solution? 4) B

A) NH_3 with NH_4I B) HNO_3 with $LiNO_3$

C) KH_2PO_4 with K_2HPO_4 D) CH_3CO_2H with $LiCH_3CO_2$

5) Which of these neutralization reactions has a pH = 7 when equal molar amounts of acid and base are mixed? 5) C

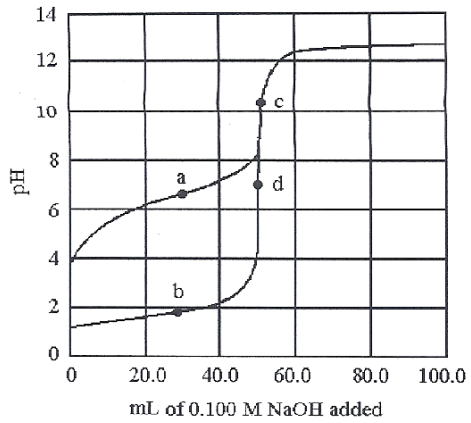
A) $HI(aq) + \cancel{C_5H_5N}(aq) = \cancel{C_5H_5NH}I(aq)$ (NH_3, NH_4I)

B) $CH_3CO_2H(aq) + LiOH(aq) = H_2O(l) + LiCH_3CO_2(aq)$

C) $HI(aq) + KOH(aq) = H_2O(l) + KI(aq)$

D) $HNO_2(aq) + NH_3(aq) = NH_4NO_2(aq)$

The following plot shows two titration curves, each representing the titration of 50.00 mL of 0.100 M acid with 0.100 M NaOH.



6) Which point a–d represents the equivalence point for the titration of a strong acid? 6) D

A) point a B) point b C) point c D) point d

7) Which statement about buffers is true? 7) B

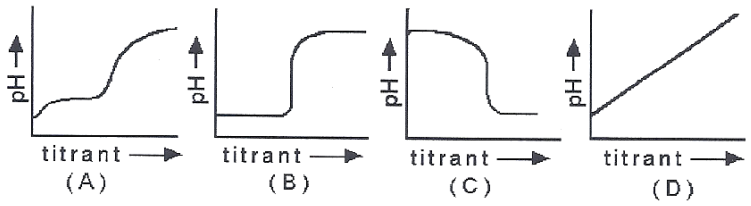
A) A buffer does not change pH on addition of a strong acid or strong base.

B) Buffers resist change in pH upon addition of small amounts of strong acid or strong base.

C) Buffers have a pH = 7.

D) Buffers consist of a strong acid and its conjugate base.

Use the graphs below to answer the following questions.



8) What is the characteristic pH–titration curve for the titration of a weak acid by a strong base? 8) A

A) A B) B C) C D) D

9) What is the hydronium ion concentration with a pH of 3.15? $10^{-3.15}$ 9) C

A) 1.41×10^{-11} M B) 3.15 M C) 7.08×10^{-4} M D) 10.85 M

10) What is the common ion in a solution prepared by mixing 0.55 M $LiCH_3CO_2$ with 0.10 M CH_3CO_2H? 10) A

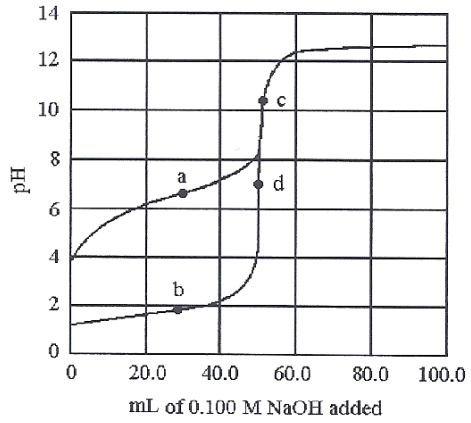
A) $CH_3CO_2^-$ B) OH^- C) Li^+ D) H_3O^+

11) A solution with a hydrogen ion concentration of 3.25×10^{-2} M is _____ and has a hydroxide concentration of _____. 11) B

A) basic, 3.08×10^{-12} M
B) acidic, 3.08×10^{-13} M
C) basic, 3.08×10^{-13} M
D) acidic, 3.08×10^{-12} M

$\frac{1.0 \times 10^{-14}}{3.25 \times 10^{-2}}$

The following plot shows two titration curves, each representing the titration of 50.00 mL of 0.100 M acid with 0.100 M NaOH.



12) Which point a–d represents a buffer region? 12) A

A) point a B) point b C) point c D) point d

13) What is the equilibrium constant expression (K_a) for $HCN(aq) + H_2O(l) = H_3O^+(aq) + CN^-(aq)$. 13) B

A) $K_a = ([HCN][H_2O])/([H_3O^+][CN^-])$
B) $K_a = ([H_3O^+][CN^-])/([HCN])$
C) $K_a = ([H_3O^+][CN^-])/([HCN][H_2O])$
D) $K_a = ([HCN])/([H_3O^+][CN^-])$

14) For the reaction shown below, which change in conditions made to the system at equilibrium will result in a net reaction to the right to form more product? 14) B

$C(s) + 2\,H_2(g) = CH_4(g) \quad \Delta H° = -74.8$ kJ + heat

2 mol 1 mol

A) increasing the volume ←
B) lower Temperature → (removed)
C) decreasing the pressure ←
D) removing H_2 ←

15) Which is a net ionic equation for the neutralization of a weak acid with a strong base? 15) C

A) $H_3O^+(aq) + OH^-(aq) = 2\,H_2O(l)$
B) $HBr(aq) + NaOH(aq) = H_2O(l) + NaBr(aq)$
C) $HF(aq) + OH^-(aq) = H_2O(l) + F^-(aq)$
D) $HF(aq) + LiOH(aq) = H_2O(l) + LiF(aq)$

16) An acidic solution at 25°C has

16) A

A) $[H_3O^+] > 1 \times 10^{-7}$ M > $[OH^-]$.

B) $[H_3O^+] > [OH^-] > 1 \times 10^{-7}$ M.

C) $[H_3O^+] = [OH^-] > 1 \times 10^{-7}$ M.

D) $[H_3O^+] < 1 \times 10^{-7}$ M > $[OH^-]$.

Short Answer. Show work for partial credit &full credit on the Short Answer Questions.

p(Anything)= - log (Anything), [H+] = antilog (- pH) M = moles / liter, 1000 mL = 1 Liter {pH = pKa + log [base]/[acid]}

17) What is the pH of a buffer system made by dissolving 1.25 mole H A and 3.03 mole A- in enough water to make 1.000 L of the solution ? $K_a = 2.5 \times 10^{-8}$ for H A (12 pts) (show work) Use EITHER Henderson Hasselbalch or ICE table.

$2.5 \times 10^{-8} = \frac{(x)(3.03+x)}{(1.25-x)}$

	HA (aq) +	H_2O (l) -->	H_3O^+ (aq) +	A^- (aq)
I	1.25 M	—	0	3.03 M
C	−x		+x	+x
E	1.25 − x		x	3.03 + x

x << small

$2.5 \times 10^{-8} = \frac{(x)(3.03)}{(1.25)}$

$x = \frac{(2.5 \times 10^{-8})(1.25)}{(3.03)}$

$x = 1.03 \times 10^{-8}$

$pH = 7.99$

$pH = -\log(2.5 \times 10^{-8}) + \log\left(\frac{3.03}{1.25}\right)$

$pH = 7.60 + 0.385 = 7.98$

18) Determine the acid dissociation constant for a 0.255 M H CN solution that has a pH of 4.95. (HCN is a weak acid) (13 pts) H CN (aq) + H_2O (l) --> H_3O^+ (aq) + CN^- (aq) $[H+] = 10^{-pH}$

	H CN	H_3O^+	CN^-
I	0.255	0	0
	−x	+x	+x
	0.255 − x	x	x

$pH = 4.95$

$[H^+] = 10^{-4.95}$

$[H^+] = 1.12 \times 10^{-5} = x$

$K_a = \frac{(1.12 \times 10^{-5})(1.12 \times 10^{-5})}{(0.255 - 1.12 \times 10^{-5})} = 4.92 \times 10^{-10}$

small — leave out

19) a) What is the $[H_3O^+]$ concentration of a solution of H NO_3 of 0.502 M HNO_3 (5 pts)

$[H_3O^+] = 0.502\ M$

b) What is the pH of the above solution ? (5 pts)

$pH = -\log(0.502) = 0.299$

c) What is the [OH-] of the solution ? (5 pts)

$[OH^-][H_3O^+] = 1.0 \times 10^{-14}$

$[OH^-] = 1.0 \times 10^{-14} / 0.502 = 1.99 \times 10^{-14}$

20) Multiple Choice: After you decide on your multiple choice letter choices, input the letter choices by numbers. (Thanks: It takes less of a toll on my printer ink if you do this rather than emailing me your entire multiple choice pages.)

1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____

9 ____ 10 ____ 11 ____ 12 ____ 13 ____ 14 ____ 15 ____ 16 ____