ame		(print) Name			(sign)
estions have no p	or partial credit on the Lo partial credit. Please wr pts print and sign exam)	ng Answers and in some ite anything you want gra	of the Short Answe aded legibly. If I	r Questions. Mul cannot read your v	tiple choice work. I obviou
-	pKa + pKb = 14 g (anything) $pH = pK_a$				w p
art I MULTIPLI s per question, 2	E CHOICE. Choose the o 8 pts pts total)	ne alternative that best	completes the state	ment or answers t	the question.
1) Calculate A) 4.0	e the pOH in an aqueous s	solution with a pH of 9.85 C) 5.15	at 25°C. (pH + p D) 2.15	OH = 14) E) 3.15	1)
A) A s B) A s D) A s	the following solutions is solution that is 0.10 M H Colution that is 0.10 M Na solution that is 0.10 M H Colution that is 0.10 M H Colution that is 0.10 M H Fine of the above are buffer	I and 0.10 M NH4 ⁺ OH and 0.10 M K OH 2H3O2 and 0.10 M Li C2 and 0.10 M Na C2H3O2	H3O2	-9,85 = 4,	15 ²⁾ —
{[H ₃ O+ A) 9.2 ∂70.2 €) 5.5 (D) 1.8	e the concentration of H ₃ 0 $[OH-] = 1.0 \times 10^{-14}$ $\times 10^{-2} M$ $\times 10^{-1} M$ $\times 10^{-10} M$ $\times 10^{-10} M$ $\times 10^{-12} M$	Ot in a solution that contains (430^{+})			3) ~10
A) HO	H3COOH NO3 SO4				4)
A) NI B) C ₂ C) H ₂	f the following is NOT a c 14 ⁺ /NH3 H3O2 ⁻ /HC2H3O2 SO3/HSO3 ⁻ SO ⁺ /OH ⁻ I of the above are conjuga				5)

6) Determine the K_a for CH3NH3+ at 25°C. The K_b for CH3NH2 is 4.4×10^{-4} . $\{K_a \times K_b = 1.0 \times 10^{-4}\}$

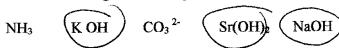
- 10-14}
 - A) 3.1×10^{-10}
 - B) 5.6×10^{-10}
 - C) 6.8×10^{-11}
- E) 2.3 × 10⁻³

 $k_a = \frac{1.0 \times 10^{-14}}{4.4 \times 10^{-4}} = \frac{2.3 \times 10^{-14}}{10^{-14}}$

7) What is the conjugate acid of HCO₃⁻?

- A) H₃O⁺
- (C) H₂CO₃ D) CO₃²-
- E) H2O

1. Circle the Strong Base among the following: (5 pts)



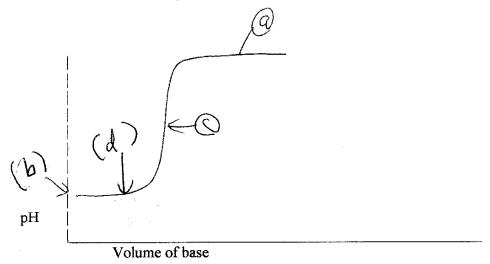
2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

$$HCN(aq) + H_2O(1) \rightarrow 470^+ + CN^-$$

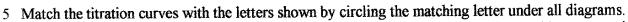
3. What is the pH of a H Cl (strong acid) with a concentration of 0.350 M? Please show work for partial credit & full credit. $\{pH = -\log [H^{+}]\}$ (6 pts)

$$[H^{+}] = [H_{3}O^{+}] = \frac{0.450}{0.450} \quad pH = \frac{0.45}{0.450} = 0.456$$

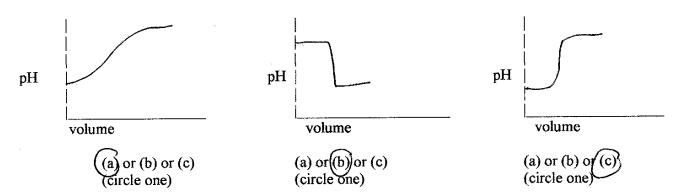
4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) M = (# moles base - # moles acid) / total volume (b) [H⁺] = [H₃O⁺] = [HA] (HA is a generic strong acid) (c) pH = 7 (d) M = (# moles acid - # moles base) / total volume (3 pts each, 6 pts)



Dr. Hahn General Chemistry II Lecture Spring 13 Exam III 9:30 am form A



- (a) a weak acid to which you add a strong base titration (b) strong base to which you add a strong acid
- (c) strong acid to which you add a strong acid (One letter matches one titration curve.) (2 pts each, 6 pts)



6. For the reaction $CaF_2(s) \rightarrow Ca^{+2} + 2 F^{-1}$ give the expression for Ksp

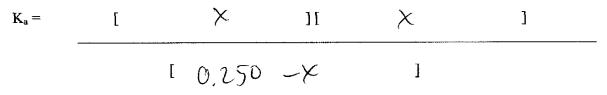
$$Ksp = Cat^2$$
 (6 pts)

7 If the K_a of H $C_2H_3O_2$ is 1.8×10^{-5} , set up to find the $[H_3O^+]$ concentration at equilibrium. The initial concentration of H $C_2H_3O_2$ is 0.250 M. (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)

a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[H C ₂ H ₃ O ₂]	[H ₃ O ⁺]	[C ₂ H ₃ O ₂]
Initial	0.250	0	6
Change	- x	+ X	+x
Equilibrium	0.250 -X	X	X

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)



4

1. Calculate the pH of a buffer solution with a concentration of 0.15 M H CN and 0.30 M Na CN. pKa of H CN is 9.31 Use the Henderson Hasselbalch: pH = pKa + log { [base] / [acid] } (10 pts)

$$pH = 9.31 + log \left(\frac{0.30}{0.15}\right)$$

$$pH = 9.31 + 0.30 = 9.61$$

2. In a titration, if you add 50.0 mL of a strong base(KOH) with a concentration of 0.35 M to a 30.0 mL solution of a strong acid (HNO3) of concentration of 0.10 M, what is the [OH]? (This is an after equivalence point problem.) (15 pts)

$$(0.07) = \frac{0.0145}{0.089l} = 0.181 \text{ m off}$$

Name	Keiz	(print) Name			(sign)
Please show wo questions have i	rk for partial credit on t	he Long Answers and in son ase write anything you want	ne of the Short Answe	er Questions. Multi	
		14 $K_a \times K_b = 1.0 \times 10^{\circ}$ = $pK_a + log \{ [base] / [aci]$			у р
	PLE CHOICE. Choose n, 28 pts pts total)	the one alternative that be	st completes the state	ement or answers th	ne question. (4
1) Deter	mine the K _a for CH3N	H ₃ + at 25°C. The K _b for CH	3NH ₂ is 4.4 × 10 ⁻⁴ . {	$K_a \times K_b = 1.0 \times$	1)
B)	4} 5.6 × 10 ⁻¹⁰ 6.8 × 10 ⁻¹¹ 12.3 × 10 ⁻¹¹ 3.1 × 10 ⁻¹⁰ 2.3 × 10 ⁻³	Fa= 1.0×10 4.4×10	-16 $-4 = 2.3$	X10 ⁻¹¹	
A)	h of the following is NO C ₂ H ₃ O ₂ ⁻ /HC ₂ H ₃ O ₂ H ₂ SO ₃ /HSO ₃ ⁻)T a conjugate acid-base pai	r?		2)
(D)	NH4 ⁺ /NH3 H3O ⁺ /OH ⁻ All of the above are co	njugate acid–base pairs.			
	is the conjugate acid o		D) H ₂ O	е) со ₃ 2-	3)
{[H ₃ (A) B) C) D)	olate the concentration of O^+ [OH-] = 1.0 x 10 1.8 x 10 ⁻¹⁰ M 9.2 x 10 ⁻¹ M 9.2 x 10 ⁻² M 1.8 x 10 ⁻¹² M 5.5 x 10 ⁻¹⁰ M	of H ₃ O ⁺ in a solution that co -14 } $ \begin{bmatrix} O & F \\ \end{bmatrix} = $			4)

5) Identify the dipro	tic acid.				5)	
A) HClO ₄						
B) CH ₃ COOH						
C) HNO ₃						
D) HCl						
(E) H ₂ SO ₄						
6) Which of the follo	wing solutions is a	good buffer system?			6)	
A) A solution th	hat is 0.10 M H Cl a	ınd 0.10 M NH4+				
B) A solution th	hat is 0.10 M H F aı	nd 0.10 M Na C2H3O	2			
C) A solution th	hat is 0.10 M Na Ol	H and 0.10 M K OH				
(D) A solution the	hat is 0.10 M H C ₂ F	13O2 and 0.10 M Li C	2H3O2			
E) None of the	above are buffer sy	ystems.				
7) Calculate the pOF	I in an aqueous sol	ution with a pH of 9.8	35 at 25°C. (pH + p	OH = 14)	7) _	
A) 2.15	B) 4.00	(2)4.15	D) 3.15	E) 5.15		
		POH	= 14-9,	85 = 415	-	

1. Circle the Weak Base among the following: (5 pts)

Sr(OH)₂ NaOH NH₃ K OH CO₃²

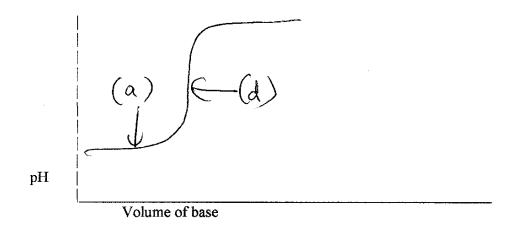
2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

 $HF(aq) + H_2O(1) \rightarrow \begin{array}{c} + & - \\ + & - \end{array}$

3. What is the pH of a HNO₃ (strong acid) with a concentration of 0.630 M? Please show work for partial credit & full credit. $\{pH = -\log [H^{+}]\}$ (6 pts)

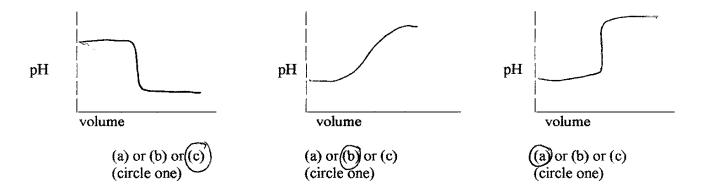
 $[H^{+}] = [H_{3}O^{+}] = \frac{0.630 \text{ M}}{0.630 \text{ M}} = \frac{0.201}{0.630}$ 0.4 = -(-0.201)

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) M = (# moles acid - # moles base) / total volume (b) M = (# moles base - # moles acid) / total volume (c) [H⁺] = [H₃O⁺] = [HA] (HA is a generic strong acid) (d) pH = 7 (3 pts each, 6 pts)



3

- 5 Match the titration curves with the letters shown by circling the matching letter under all diagrams.
- (a) strong acid to which you add a strong acid (b) a weak acid to which you add a strong base titration
- (c) strong base to which you add a strong acid (One letter matches one titration curve.) (2 pts each, 6 pts)

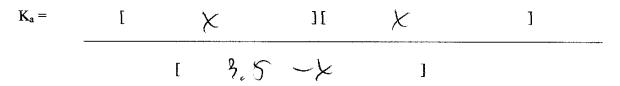


5. For the reaction Al (OH)₃ (s) \rightarrow Al⁺³ + 3 OH · give the expression for Ksp

- 7 What is the [H₃O ⁺] at equilibrium of 3.5 M of H F dissolved in water? The K_a of H F is 3.5 x 10⁻⁴. (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)
 - a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[HF]	[H ₃ O ⁺]	[F]
Initial	3.5	0	0
Change	<u>-x</u>	+ X	+x
Equilibrium	3.5-X	X	X

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (Do not complete this question by solving for the x. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)



1. Calculate the pH of a buffer solution with a concentration of 0.15 M CH₃COOH and 0.25 M CH₃COO Na. pK_a of CH₃COOH is 4.74. Use the Henderson Hasselbalch: $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$

$$pH = 4.74 + log \left(\frac{0.25}{0.15}\right)$$
 $pH = 4.74 + 0.22 = 4.96$

2. In a titration, if you add 10.0 mL of a strong base (Li OH) with a concentration of 0.15 M to a 10.0 mL solution of a strong acid (HBr) of concentration of 0.50 M, what is the [H₃O⁺]? (This is a before equivalence point problem.) (15 pts)

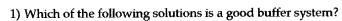
$$[U_30t] = \frac{3.50 \times 10^{-3} \text{ ml}}{0.02 \text{ l}} = 0.115 \text{ m}$$

	,	CHEM 102) Form A 4/10/13 11:30 am MWF Dr.	//
Name	Rey	(print) Name	(sign)
Please she	ow work for partial cred	it on the Long Answers and in some of the Short Ar Please write anything you want graded legibly.	swer Questions. Multiple choice

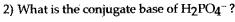
ısly cannot grade it. (1 pts print and sign exam)

pKa + pKb = 14 $K_a \times K_b = 1.0 \times 10^{-14}$ $[H_3O^+][OH^-] = 1.0 \times 10^{-14} = k_W$ p pH + pOH = 14(anything) = -log (anything) $pH = pK_a + log \{ [base] / [acid] \}$ M = molarity = moles / liter

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (4 pts per question, 28 pts pts total)



- A) A solution that is 0.10 M H Cl and 0.10 M NH4+
- B) A solution that is 0.10 M Na OH and 0.10 M K OH
- C) A solution that is 0.10 M H F and 0.10 M Na C2H3O2
- D) A solution that is 0.10 M H C₂H₃O₂ and 0.10 M Li C₂H₃ ϕ_2
- E) None of the above are buffer systems.



- A) H₃O⁺
- B) OH-
- D) PO₄3-
- E) H₃PO₄

3) Calculate the pOH in an aqueous solution with a pH of 9.85 at 25°C.
$$\{pH + pOH = 14\}$$

- A) 4.00
- .___(C) 5.15
- D) 3.15
- E) 2.15
- 4) Determine the K_b for CN^- at 25°C. The K_a for HCN is 4.9×10^{-10} . $\{K_a \times K_b = 1.0 \times 10^{-14}\}$
 - A) 4.9 × 10⁻¹⁴
 - B) 2.3×10^{-9}
 - C) 1.4×10^{-5}
 - D) 3.7×10^{-7}
 - 田 2.0×10-5
- $k_b = \frac{1.0 \times 10^{-14}}{4.9 \times 10^{-10}} = 2.0 \times 10^{-5}$
- 5) Calculate the concentration of OH⁻ in a solution that contains 3.9 x 10⁻⁴ M H₃O⁺ at 25°C.

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

- A) 3.9×10^{-4} M
- B) 2.7×10^{-3} M
- \bigcirc 2.6 × 10⁻¹¹ M
 - D) 2.7×10^{-2} M
 - E) 2.6×10^{-12} M
- $[0H] = \frac{1.0 \times 10^{-14}}{3.9 \times 10^{-4}} = 2.6 \times 10^{-11}$

6) Which of the follow A) C ₂ H ₃ O ₂ ⁻ /H ₀		gate acid-base pair?			6)	_
B) NH ₄ +/NH ₃						
(C) H ₃ O ⁺ /OH ⁻						
D) H ₂ SO ₃ /HSO	3					
E) All of the abo	ove are conjugate ac	id-base pairs.				
7) Identify the triprot	ic acid.	C) HNO2	D) H2SO4	(E3)H3PO4	7)	_

- 1. Circle the Strong Weak Acid among the following: (5 pts)

 HBr CH₃COOH H₂SO₄ (HF) HSO₄ (+ N Ü₂
- 2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

3. What is the pH of a H I solution (strong acid) with a concentration of 0.115 M? Please show work for partial credit & full credit. $\{pH = -\log [H^+]\}$ (6 pts)

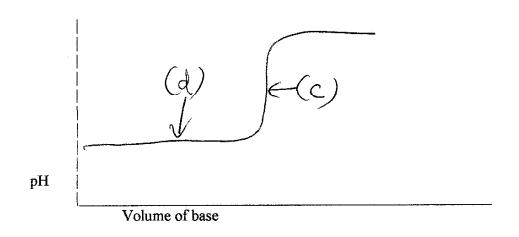
$$[H^{+}] = [H_{3}O^{+}] = 0, [15 \text{ m}]$$

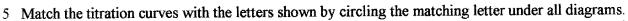
$$pH = 0.94$$

$$pH = -(-0.94)$$

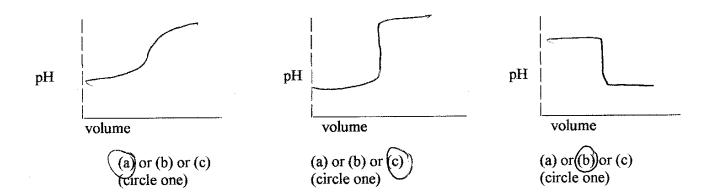
$$pH = 0.94$$

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) $M = (\# \text{ moles base - } \# \text{ moles acid}) / \text{ total volume (b) } [H^+] = [H_3O^+] = [HA] (HA is a generic strong acid) (c) pH = 7 (d) <math>M = (\# \text{ moles base}) / \text{ total volume}$ (3 pts each, 6 pts)





- (a) a weak acid to which you add a strong base titration (b) strong base to which you add a strong acid
- (c) strong acid to which you add a strong acid (One letter matches one titration curve.) (2 pts each, 6 pts)



5. For the reaction $PbI_2(s) \rightarrow Pb^{+2} + 2\Gamma$ give the expression for Ksp

$$Ksp = \frac{\int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int \int_{-\infty}^{\infty} \int_{-\infty}^{\infty$$

7 What is the $[H_3O^{+}]$ at equilibrium of 0.155 M of CH₃COOH dissolved in water ? The K_a of CH₃COOH is 1.8×10^{-5} . (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)

a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[CH ₃ COOH]	[H ₃ O ⁺]	[CH ₃ COO ⁻]
Initial	0.155	0	0
Change	~×	+ X	1 + x
Equilibrium	0.155 -X	X	×

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)

$$K_{a} = \begin{bmatrix} & \chi & 1 & \chi & 1 \\ & Q_{1}(55 - \chi) & 1 & 1 \end{bmatrix}$$

Dr. Hahn General Chemistry II Lecture Spring 13 Exam III 11:30 am form A

1. Calculate the pH of a buffer solution with a concentration of 0.50 M H F and 0.25 M Na F. pK_a of H F is 3.46 Use the Henderson Hasselbalch: $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$

$$pH = 3.46 + log \left(\frac{0.25}{0.50}\right)$$
 $pH = 3.16$
 $pH = 3.46 + (-0.36)$

2. In a titration, if you add 20.0 mL of a strong base(K OH) with a concentration of 0.20 M to a 50 mL solution of a strong acid (HNO3) of concentration of 0.45 M, what is the [H₃O⁺]? (This is a before equivalence point problem.) (15 pts)

total volume

$$\frac{4 \text{ moles}}{\text{aund}} = \frac{90.0 \text{ mol}}{\text{Hr03}} \times \frac{0.45 \text{ mol}}{1000 \text{ mol} \text{Hr03}} = 0.0225 \text{ mol}}{1000 \text{ mol} \text{Hr03}} \times \frac{900 \text{ mol}}{1000 \text{ mol}} = 4.0 \times 10^{-3} \times 1000 \text{ mol}}{1000 \text{ mol}} = 4.0 \times 10^{-3} \times 1000 \text{ mol}}$$

$$\frac{(430^{4})^{2}}{(430^{4})^{2}} = \frac{0.0225 \text{ mol}}{1000 \text{ mol}} = \frac{0.0185}{0.0700 \text{ l}^{2}}$$

$$\frac{1000 \text{ me}}{0.264 \text{ m}} = \frac{0.264 \text{ m}}{0.264 \text{ m}}$$

Exam III General Chemistry II (CHEM 102) Form B 4/10/13 11:30 am MWF Dr. Hahn Exam # Name(print) Name	(sign)
Please show work for partial credit on the Long Answers and in some of the Short Answer Questions. Multiple questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work cannot grade it. (1 pts print and sign exam)	e choice k, I obviousl
$pH + pOH = 14$ $pKa + pKb = 14$ $K_a \times K_b = 1.0 \times 10^{-14}$ $[H_3O^+][OH^-] = 1.0 \times 10^{-14} = k_W$ (anything) = $-\log$ (anything) $pH = pK_a + \log \{ [base] / [acid] \}$ $M = molarity = moles / liter$	p
Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the pts per question, 28 pts pts total)	question. (4
1) Calculate the concentration of OH ⁻ in a solution that contains 3.9×10^{-4} M H ₃ O ⁺ at 25°C. {[H ₃ O ⁺][OH ⁻] = 1.0×10^{-14} } A) 3.9×10^{-4} M B) 2.7×10^{-2} M C) 2.6×10^{-12} M D) 2.7×10^{-3} M E) 2.6×10^{-11} M	1)
2) Determine the K_b for CN^- at 25°C. The K_a for HCN is 4.9×10^{-10} . { $K_a \times K_b = 1.0 \times 10^{-14}$ } (A) 2.0×10^{-5} (B) 1.4×10^{-5} (C) 2.3×10^{-9} (D) 4.9×10^{-14} (E) 3.7×10^{-7}	2)
3) Which of the following solutions is a good buffer system? A) A solution that is 0.10 M Na OH and 0.10 M K OH B) A solution that is 0.10 M H Cl and 0.10 M NH ₄ ⁺ C) A solution that is 0.10 M H F and 0.10 M Na C ₂ H ₃ O ₂ D) A solution that is 0.10 M H C ₂ H ₃ O ₂ and 0.10 M Li C ₂ H ₃ O ₂ E) None of the above are buffer systems.	3)
4) Calculate the pOH in an aqueous solution with a pH of 9.85 at 25°C. {pH + pOH = 14} A) 2.15 $\stackrel{\text{(B)}}{\text{(B)}}$ 4.15 $\stackrel{\text{(C)}}{\text{(C)}}$ 4.00 $\stackrel{\text{(D)}}{\text{(D)}}$ 5.15 $\stackrel{\text{(E)}}{\text{(D)}}$ 3.15 $\stackrel{\text{(D)}}{\text{(D)}}$ 4.15 $\stackrel{\text{(D)}}{\text{(D)}}$ 4.75 $\stackrel{\text{(D)}}{\text{(D)}}$ 6.75	4)

5) Which of the follo	owing is NOT a conju	gate acid-base pair?			5)
A) NH4+/NH3	L				
(B))H3O⁺/OH⁻					
C) C ₂ H ₃ O ₂ -/F	IC2H3O2				
D) H ₂ SO ₃ /HS0	O3 ⁻				
E) All of the al	oove are conjugate ac	id-base pairs.			
6) What is the conju	gate base of H2PO4 ⁻	?			6)
A) H ₃ O ⁺	B) H ₃ PO ₄	(C) HPO4 ² -	D) PO4 ³ -	E) OH-	
7) Identify the tripro					7)
A) HClO ₄	ØNHADO4	C Has O	D) HasCo	E) HNO	

- 1. Circle the Strong Weak Acid among the following: (5 pts)

 (HBr) CH₃COOH (H₂SO₄) HF (H₂SO₄) (H NO₂)
- 2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

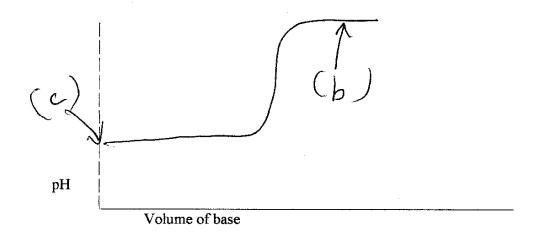
$$H CN (aq) + H_2O (l) \rightarrow 1/20$$
 + CN

3. What is the pH of a HBr (strong acid) solution with a concentration of 0.095 M? Please show work for partial credit & full credit. $\{pH = -\log [H^+]\}$ (6 pts)

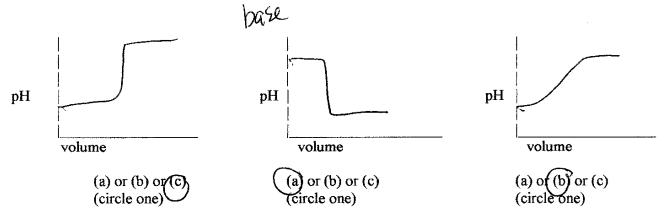
$$pH = \frac{0.095 \, \text{m}}{1.02}$$

$$pH = \frac{1.02}{-1.02} = 1.02$$

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) pH = 7 (b) M = (# moles base - # moles acid) / total volume (c) [H⁺] = [H₃O⁺] = [HA] (HA is a generic strong acid) (d) M = (# moles acid - # moles base) / total volume (3 pts each, 6 pts)



5 Match the titration curves with the letters shown by circling the matching letter under all diagrams. (a) strong base to which you add a strong acid (b) a weak acid to which you add a strong base titration (c) strong acid to which you add a strong acid (One letter matches one titration curve.) (2 pts each, 6 pts)



5. For the reaction $Ag_2 SO_4$ (s) \rightarrow 2 Ag^+ + SO_4^{-2} give the expression for Ksp

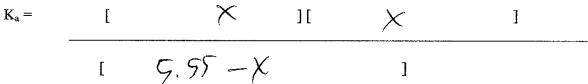
$$Ksp = \left(\frac{1}{2} \right)^{2} \left(\frac{50}{4} \right)^{2}$$
 (6 pts)

7 If the K_a of H CN is 4.9×10^{-10} , find the $[H_3O^+]$ at equilibrium if the initial concentration of H CN is 5.55 M. (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)

a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[HCN]	[H ₃ O ⁺]	[CN]
Initial	5.55		
Change	- X	+ X	t-X
Equilibrium	5,55-X	X	X

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)



Dr. Hahn General Chemistry II Lecture Spring 13 Exam III 11:30 am form B

4

1. Calculate the pH of a buffer solution with a concentration of 0.25 M H C₂H₃O₂ and 0.50 M NaC₂H₃O₂. $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$ of HC₂H₃O₂ is 4.74 Use the Henderson Hasselbalch:

In a titration, if you add 35.5 mL of a strong base(Li OH) with a concentration of 0.25 M to a 25.0 mL solution of a strong acid (HCl) of concentration of 0.20 M, what is the [OH]? (This is an after equivalence point problem.) (15 pts)

tholes =
$$45.5\text{me} \times \frac{0.25 \text{ molGior}}{1000 \text{meGior}} = 8.88 \times 10^{-3}$$

(Gior) Soln

$$\begin{array}{ll}
(0H) = \frac{8.88 \times 10^{-3} - 5.00 \times 10^{-3}}{((25.5 + 25.0 \text{ m/e}) \times \frac{1.000 \text{ m/e}}{1000 \text{ m/e}})^{2}} \\
(0H) = \frac{3.88 \times 10^{-3}}{0.06052} = 0.0641 \text{ m}
\end{array}$$

$$(04) = \frac{3.88 \times 10^{-3}}{0.06052} = 0.0641 \text{ m}$$

me		(print) Name			(sign)
ase show work for partistions have no partial conot grade it. (1 pts prin	credit. Please write				
$I + pOH = 14 \qquad pK$					w p
ything) = - log (anyt	ning) $pH = pK_a +$	log { [base] / [acid	I] } M = motanty	= moies / mer	
t I MULTIPLE CHOI per question, 28 pts pt		alternative that bes	t completes the state	ement or answers t	the question.(
1) Calculate the pC)H in an aqueous solu	ution with a pH of 9.		oOH = 14)	1)
A) 4.00	B) 4.15	C) 5.15	D) 2.15	E) 3.15	
2) Which of the fol	lowing solutions is a	oood buffer system?			2)
•	that is 0.10 M H Cl a				··· /
•	that is 0.10 M Na OF			•	
	that is 0.10 M H C ₂ H		C ₂ H ₃ O ₂		
D) A solution	that is 0.10 M H F an	nd 0.10 M Na C2H3C)2	•	
E) None of th	ne above are buffer sy	stems.			
				ET 000	2)
•	ncentration of H3O+ i	in a solution that con	tains $5.5 \times 10^{-5} \text{ M O}$	H ⁻ at 25°C.	3)
{[H ₃ O ⁺][OH ⁻]	$= 1.0 \times 10^{-14}$	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	3)
{[H ₃ O ⁺][OH-] A) 9.2 × 10−2	$= 1.0 \times 10^{-14}$ M	in a solution that con	tains 5.5 × 10 ^{−5} M O	H⁻ at 25°C.	3)
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹	= 1.0 x 10-14} M M	in a solution that con	tains 5.5 × 10 ^{−5} M O	H ⁻ at 25°C.	3)
$\{[H_3O^+][OH^-]\}$ A) 9.2×10^{-2} B) 9.2×10^{-1} C) 5.5×10^{-10}	$= 1.0 \times 10^{-14}$ M M 0_{M}	in a solution that con	tains 5.5 × 10 ^{−5} M O	H⁻ at 25°C.	3)
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹⁰	$= 1.0 \times 10^{-14}$ M M 0_{M} 0_{M}	in a solution that con	tains 5.5 × 10 ^{−5} M O	H⁻ at 25°C.	3)
$\{[H_3O^+][OH^-]\}$ A) 9.2×10^{-2} B) 9.2×10^{-1} C) 5.5×10^{-10}	$= 1.0 \times 10^{-14}$ M M 0_{M} 0_{M}	in a solution that con	tains 5.5 × 10 ^{−5} M O	H⁻ at 25°C.	3)
$\{[H_3O^+][OH^-]\}$ A) 9.2×10^{-2} B) 9.2×10^{-1} C) 5.5×10^{-16} D) 1.8×10^{-16} E) 1.8×10^{-16}	= 1.0 x 10-14} M M O _M O _M O _M	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹² E) 1.8 × 10 ⁻¹³	= 1.0 x 10-14} M M O _M O _M O _M	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	4)
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹⁰ E) 1.8 × 10 ⁻¹² 4) Identify the dipr A) HClO ₄	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁵ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOF	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹² E) 1.8 × 10 ⁻¹³ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOF C) HNO ₃	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹⁰ E) 1.8 × 10 ⁻¹² 4) Identify the dipr A) HClO ₄ B) CH ₃ COOF C) HNO ₃ D) H ₂ SO ₄	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
{[H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁰ D) 1.8 × 10 ⁻¹² E) 1.8 × 10 ⁻¹³ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOF C) HNO ₃	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.	in a solution that con	tains 5.5 × 10 ⁻⁵ M O	H⁻ at 25°C.	
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁷ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOH C) HNO ₃ D) H ₂ SO ₄ E) HCl	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid.			H⁻ at 25°C.	
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁷ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOH C) HNO ₃ D) H ₂ SO ₄ E) HCl	= 1.0 x 10-14} M M 0 M 0 M 2 M rotic acid. H			H⁻ at 25°C.	4)
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁶ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOF C) HNO ₃ D) H ₂ SO ₄ E) HCl	= 1.0 x 10-14} M M 0 M 0 M 0 M cotic acid. H H lowing is NOT a conjugation			H⁻ at 25°C.	4)
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁵ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOI C) HNO ₃ D) H ₂ SO ₄ E) HCl 5) Which of the foll A) NH ₄ ⁺ /NH	= 1.0 x 10 ⁻¹⁴ } M M O M O M O M O M O H Cotic acid. H H H H H H H H H H H H H H H H H H H			H⁻ at 25°C.	4)
([H ₃ O ⁺][OH ⁻] A) 9.2 × 10 ⁻² B) 9.2 × 10 ⁻¹ C) 5.5 × 10 ⁻¹⁶ D) 1.8 × 10 ⁻¹⁶ E) 1.8 × 10 ⁻¹⁷ 4) Identify the dipr A) HClO ₄ B) CH ₃ COOH C) HNO ₃ D) H ₂ SO ₄ E) HCl 5) Which of the foll A) NH ₄ ⁺ /NH B) C ₂ H ₃ O ₂ ⁻⁷ /	= 1.0 x 10 ⁻¹⁴ } M M O M O M O M O M O M O H O H O H O H			H⁻ at 25°C.	4)

6) Determine the K_a for CH₃NH₃⁺ at 25°C. The K_b for CH₃NH₂ is 4.4 × 10⁻⁴. {K_a x K_b = 1.0 x 6}

10⁻¹⁴}

A) 3.1 × 10⁻¹⁰

B) 5.6 × 10⁻¹⁰

C) 6.8 × 10⁻¹¹

D) 2.3 × 10⁻¹¹

E) 2.3 × 10⁻³

7) What is the conjugate acid of HCO₃⁻?

A) H₃O⁺

B) OH⁻

C) H₂CO₃

D) CO₃²
E) H₂O

1. Circle the Strong Base among the following: (5 pts)

NH₃ K OH

 CO_3^2

Sr(OH)₂ NaOH

2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

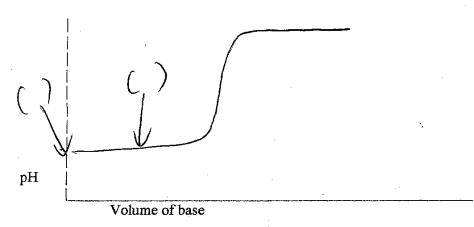
 $H CN (aq) + H₂O (I) \rightarrow$ +

3. What is the pH of a H Cl (strong acid) with a concentration of 0.350 M? Please show work for partial credit & full credit. $\{pH = -\log |H^+|\}$ (6 pts)

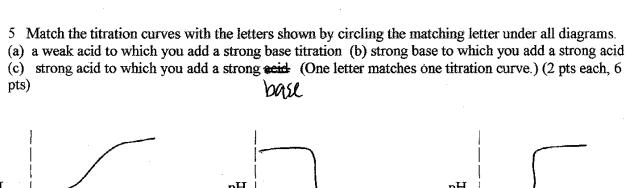
 $[H^{+}] = [H_3O^{+}] =$

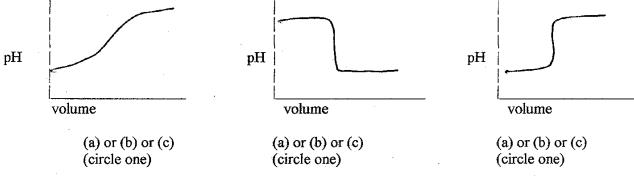
pH = ____

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) M = (# moles base - # moles acid) / total volume (b) [H⁺] = [H₃O⁺] = [HA] (HA is a generic strong acid) (c) pH = 7 (d) M = (# moles acid - # moles base) / total volume (3 pts each, 6 pts)



Dr. Hahn General Chemistry II Lecture Spring 13 Exam III 9:30 am form A





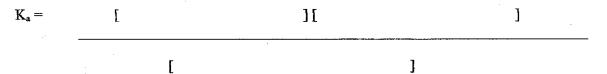
6.	For the reaction	$CaF_{2}(s)$	\rightarrow	Ca ⁺²	+	2 F	give the expression	for Ksp
----	------------------	--------------	---------------	------------------	---	-----	---------------------	---------

7 If the K_a of H $C_2H_3O_2$ is 1.8×10^{-5} , set up to find the $[H_3O^+]$ concentration at equilibrium. The initial concentration of H $C_2H_3O_2$ is 0.250 M. (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)

a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[H C ₂ H ₃ O ₂]	$[\mathrm{H_3O}^+]$	[C ₂ H ₃ O ₂]
Initial			
Change			
Equilibrium			

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)



1. Calculate the pH of a buffer solution with a concentration of 0.15 M H CN and 0.30 M Na CN. pKa of H CN is 9.31 Use the Henderson Hasselbalch: $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$

2. In a titration, if you add 50.0 mL of a strong base(KOH) with a concentration of 0.35 M to a 30.0 mL solution of a strong acid (HNO3) of concentration of 0.10 M, what is the [OH]? (This is an after equivalence point problem.) (15 pts)

Please show work for partial credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (I pts print and sign exam) PH + pOH = 14	Exam III	General Chemistry l	II (CHEM 102) For	rm B 4/10/13 9:30	am MWF Dr. Hahr	n Exam #	
questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (I pts print and sign exam) $pH + pOH = 14 pKa + pKb = 14 K_a \times K_b = 1.0 \times 10^{-14} [H_3O^+][OH^-] = 1.0 \times 10^{-14} = k_W p (anything) = *log (anything) pH = pK_a + log { [base] / [acid] } M = molarity = moles / liter$ Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (4 pts per question, 28 pts pts total) 1) Determine the K_a for CH ₃ NH ₃ * at 25°C. The K_b for CH ₃ NH ₂ is 4.4×10^{-4} . ($K_a \times K_b = 1.0 \times 1$) 10-14} A) 5.6×10^{-10} B) 6.8×10^{-11} C) 2.3×10^{-11} D) 3.1×10^{-10} E) 2.3×10^{-3} 2) Which of the following is NOT a conjugate acid-base pair? A) $C_1H_3O_2$ */ $HC_2H_3O_2$ B) H_2SO_3 / HSO_3 C) NH_4 */ NH_3 D) H_3O'/OH E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO_3 ? A) OH^- B) H_2CO_3 C) H_3O^+ D) H_2O E) CO_3^{2-} 4) Calculate the concentration of H_3O^+ in a solution that contains $5.5 \times 10^{-5} M$ OH ⁻ at 25° C. 4)	Name			(print) Name_			(sign)
(anything) = $-\log$ (anything) pH = pK _a + \log { [base] / [acid] } M = molarity = moles / liter Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (4 pts per question, 28 pts pts total) 1) Determine the K _a for CH ₃ NH ₃ * at 25°C. The K _b for CH ₃ NH ₂ is 4.4×10^{-4} . (K _a x K _b = 1.0×1)	questions	have no partial credit	t. Please write a				
pts per question, 28 pts pts total) 1) Determine the K_a for CH ₃ NH ₃ + at 25°C. The K_b for CH ₃ NH ₂ is 4.4×10^{-4} . $\{K_a \times K_b = 1.0 \times 1\}$			-	_			p
10-14} A) 5.6 × 10-10 B) 6.8 × 10-11 C) 2.3 × 10-11 D) 3.1 × 10-10 E) 2.3 × 10-3 2) Which of the following is NOT a conjugate acid-base pair? A) C2H3O2/HC2H3O2 B) H2SO3/HSO3 C) NH4†NH3 D) H3O†/OHT E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO3-? A) OHT B) H2CO3 C) H3O† D) H2O E) CO32- 4) Calculate the concentration of H3O† in a solution that contains 5.5 × 10-5 M OHT at 25°C. 4) [H3O†][OH-] = 1.0 × 10-14} A) 1.8 × 10-10 M B) 9.2 × 10-1 M C) 9.2 × 10-2 M D) 1.8 × 10-12 M				lternative that bes	t completes the state	ement or answers th	e question. (4
10-14} A) 5.6 × 10-10 B) 6.8 × 10-11 C) 2.3 × 10-11 D) 3.1 × 10-10 E) 2.3 × 10-3 2) Which of the following is NOT a conjugate acid-base pair? A) C2H3O2/HC2H3O2 B) H2SO3/HSO3 ⁻ C) NH4 ⁺ /NH3 D) H3O ⁺ /OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO3 ⁻ ? A) OH ⁻ B) H2CO3 C) H3O ⁺ D) H2O E) CO3 ² 4) Calculate the concentration of H3O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. 4) [H3O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M	1)) Determine the Ka for	r CH3NH3+ at 25°	C. The K _b for CH ₃	NH ₂ is 4.4×10^{-4} . {]	$K_a \times K_b = 1.0 \times$	1)
A) 5.6 × 10 ⁻¹⁰ B) 6.8 × 10 ⁻¹¹ C) 2.3 × 10 ⁻¹¹ D) 3.1 × 10 ⁻¹⁰ E) 2.3 × 10 ⁻³ 2) Which of the following is NOT a conjugate acid-base pair? A) C ₂ H ₃ O ₂ -/HC ₂ H ₃ O ₂ B) H ₂ SO ₃ /HSO ₃ - C) NH ₄ */NH ₃ D) H ₃ O*/OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO ₃ ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O* D) H ₂ O E) CO ₃ 2- 4) Calculate the concentration of H ₃ O* in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. 4) [H ₃ O+][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M							
B) 6.8 × 10 ⁻¹¹ C) 2.3 × 10 ⁻¹¹ D) 3.1 × 10 ⁻¹⁰ E) 2.3 × 10 ⁻³ 2) Which of the following is NOT a conjugate acid-base pair? A) C ₂ H ₃ O ₂ ⁻ /HC ₂ H ₃ O ₂ B) H ₂ SO ₃ /HSO ₃ ⁻ C) NH ₄ ⁺ /NH ₃ D) H ₃ O ⁺ /OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO ₃ ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ² 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. {[H ₃ O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		,					
D) 3.1 × 10-10 E) 2.3 × 10-3 2) Which of the following is NOT a conjugate acid-base pair? A) C ₂ H ₃ O ₂ ⁻ HC ₂ H ₃ O ₂ B) H ₂ SO ₃ /HSO ₃ ⁻ C) NH ₄ ⁺ /NH ₃ D) H ₃ O ⁺ /OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO ₃ ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ² 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5 × 10-5 M OH ⁻ at 25°C. {[H ₃ O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		·					
E) 2.3 × 10 ⁻³ 2) Which of the following is NOT a conjugate acid-base pair? A) C ₂ H ₃ O ₂ -/HC ₂ H ₃ O ₂ B) H ₂ SO ₃ /HSO ₃ - C) NH ₄ +/NH ₃ D) H ₃ O+/OH- E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO ₃ -? A) OH- B) H ₂ CO ₃ C) H ₃ O+ D) H ₂ O E) CO ₃ ² - 4) Calculate the concentration of H ₃ O+ in a solution that contains 5.5 × 10 ⁻⁵ M OH- at 25°C. {[H ₃ O+][OH-] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		•			•		
2) Which of the following is NOT a conjugate acid-base pair? A) C2H3O2^HC2H3O2 B) H2SO3/HSO3^- C) NH4 ⁺ /NH3 D) H3O ⁺ /OH E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO3 ⁻ ? A) OH ⁻ B) H2CO3 C) H3O ⁺ D) H2O E) CO3 ² - 4) Calculate the concentration of H3O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. {[H3O ⁺][OH ⁻] = 1.0 x 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		D) 3.1×10^{-10}					
A) C2H3O2 ⁻ /HC2H3O2 B) H2SO3/HSO3 ⁻ C) NH4 ⁺ /NH3 D) H3O ⁺ /OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO3 ⁻ ? A) OH ⁻ B) H2CO3 C) H3O ⁺ D) H2O E) CO3 ² - 4) Calculate the concentration of H3O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. {[H3O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		E) 2.3×10^{-3}					
C) NH ₄ ⁺ /NH ₃ D) H ₃ O ⁺ /OH ⁻ E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO ₃ ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ² 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. {[H ₃ O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M	2)			gate acid-base pairí	•		2)
D) H ₃ O ⁺ /OH ⁻ E) All of the above are conjugate acid—base pairs. 3) What is the conjugate acid of HCO ₃ ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ² 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. 4) [H ₃ O ⁺][OH ⁻] = 1.0 x 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		B) H ₂ SO ₃ /HSO ₃ ⁻					
E) All of the above are conjugate acid-base pairs. 3) What is the conjugate acid of HCO3 ⁻ ? A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ²⁻ 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5 × 10 ⁻⁵ M OH ⁻ at 25°C. {[H ₃ O ⁺][OH ⁻] = 1.0 × 10 ⁻¹⁴ } A) 1.8 × 10 ⁻¹⁰ M B) 9.2 × 10 ⁻¹ M C) 9.2 × 10 ⁻² M D) 1.8 × 10 ⁻¹² M		C) NH ₄ +/NH ₃					
3) What is the conjugate acid of HCO3 $^-$? A) OH $^-$ B) H2CO3 C) H3O $^+$ D) H2O E) CO3 2 4) Calculate the concentration of H3O $^+$ in a solution that contains 5.5×10^{-5} M OH $^-$ at 25 $^\circ$ C. 4) {[H3O $^+$][OH $^-$] = 1.0 x 10 $^{-14}$ } A) 1.8 x 10 $^{-10}$ M B) 9.2 x 10 $^{-1}$ M C) 9.2 x 10 $^{-2}$ M D) 1.8 x 10 $^{-12}$ M		D) H ₃ O ⁺ /OH ⁻					
A) OH ⁻ B) H ₂ CO ₃ C) H ₃ O ⁺ D) H ₂ O E) CO ₃ ²⁻ 4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5×10^{-5} M OH ⁻ at 25° C. 4) {[H ₃ O ⁺][OH ⁻] = 1.0×10^{-14} } A) 1.8×10^{-10} M B) 9.2×10^{-1} M C) 9.2×10^{-2} M D) 1.8×10^{-12} M		E) All of the above	e are conjugate aci	d-base pairs.			
4) Calculate the concentration of H ₃ O ⁺ in a solution that contains 5.5×10^{-5} M OH ⁻ at 25°C. 4) $\{[H_3O^+][OH^-] = 1.0 \times 10^{-14}\}$ A) 1.8×10^{-10} M B) 9.2×10^{-1} M C) 9.2×10^{-2} M D) 1.8×10^{-12} M	3)	What is the conjugate	e acid of HCO3 ⁻ ?				3)
$\{[H_3O^+][OH^-] = 1.0 \times 10^{-14}\}$ A) $1.8 \times 10^{-10} M$ B) $9.2 \times 10^{-1} M$ C) $9.2 \times 10^{-2} M$ D) $1.8 \times 10^{-12} M$		A) OH-	B) H ₂ CO ₃	C) H ₃ O ⁺	D) H ₂ O	E) CO ₃ 2-	
$\{[H_3O^+][OH^-] = 1.0 \times 10^{-14}\}$ A) $1.8 \times 10^{-10} M$ B) $9.2 \times 10^{-1} M$ C) $9.2 \times 10^{-2} M$ D) $1.8 \times 10^{-12} M$	4)	Calculate the concent	tration of H2O+ in	a solution that cont	ains 5.5 × 10 ⁻⁵ M OF	H⁻ at 25°C.	4)
A) $1.8 \times 10^{-10} \text{ M}$ B) $9.2 \times 10^{-1} \text{ M}$ C) $9.2 \times 10^{-2} \text{ M}$ D) $1.8 \times 10^{-12} \text{ M}$	-/						, <u> </u>
B) 9.2×10^{-1} M C) 9.2×10^{-2} M D) 1.8×10^{-12} M		•	.0 A 10 ,				
C) 9.2×10^{-2} M D) 1.8×10^{-12} M					•		
D) $1.8 \times 10^{-12} \mathrm{M}$		•			•		
·		•					
		E) 5.5×10^{-10} M					

5) Identify the dipro	otic acid.				5)	
A) HClO ₄						
В) СН3СООН	•					
C) HNO3						
D) HCl						
E) H ₂ SO ₄						
	_				-	
6) Which of the follo	owing solutions is a	good buffer system?			6) _	
A) A solution t	hat is 0.10 M H Cl a	nd 0.10 M NH4 ⁺				
B) A solution t	hat is 0.10 M H F an	id 0.10 M Na C2H3O	2			
C) A solution t	hat is 0.10 M Na OF	I and 0.10 M K OH				
D) A solution to	hat is 0.10 M H C ₂ H	I3O2 and 0.10 M Li C	C2H3O2			
E) None of the	above are buffer sy	rstems.				
7) Calculate the nOF	in an aqueous solt	ution with a pH of 9.8	35 at 25°C. (nH + n	OH = 14	7)	
A) 2.15	B) 4.00	C) 4.15	D) 3.15	E) 5.15	- /	

1. Circle the Weak Base among the following: (5 pts)

Sr(OH)₂ NaOH NH₃ k

KOH CO₃²

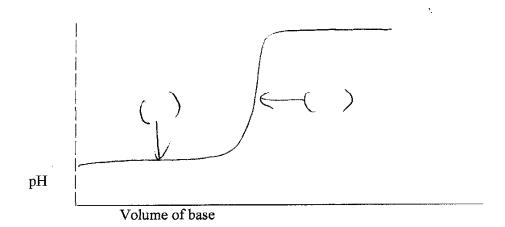
2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

 $H F (aq) + H_2O (l) \rightarrow$ _____ +

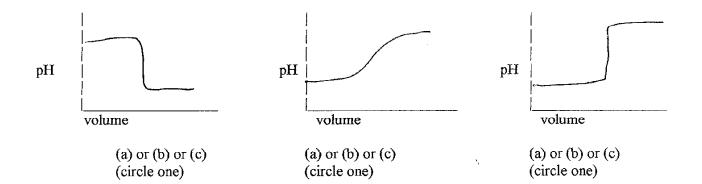
3. What is the pH of a HNO₃ (strong acid) with a concentration of 0.630 M? Please show work for partial credit & full credit. $\{pH = -\log [H^+]\}$ (6 pts)

 $[H^{+}] = [H_{3}O^{+}] =$ pH = _____

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) M = (# moles acid - # moles base) / total volume (b) M = (# moles base - # moles acid) / total volume (c) $[H^+] = [H_3O^+] = [HA]$ (HA is a generic strong acid) (d) pH = 7 (3 pts each, 6 pts)



- 5 Match the titration curves with the letters shown by circling the matching letter under all diagrams.
- (a) strong acid to which you add a strong acid (b) a weak acid to which you add a strong base titration
- (c) strong base to which you add a strong acid (One letter matches one titration curve.) (2 pts each, 6 pts)



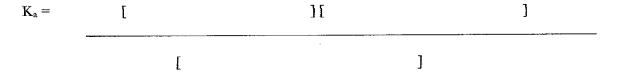
5. For the reaction Al (OH)₃ (s) \rightarrow Al⁺³ + 3 OH give the expression for Ksp

Ksp =		(6	nts	(;
rzsh —		, U	Pu	"

- 7 What is the $[H_3O^+]$ at equilibrium of 3.5 M of HF dissolved in water? The K_a of HF is 3.5 x 10^{-4} . (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)
 - a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[HF]	[H ₃ O ⁺]	[F]	
Initial				
Change				
Equilibrium				

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)



1. Calculate the pH of a buffer solution with a concentration of 0.15 M CH₃COOH and 0.25 M CH₃COO Na. pKa of CH₃COOH is 4.74. Use the Henderson Hasselbalch: $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$

2. In a titration, if you add 10.0 mL of a strong base (Li OH) with a concentration of 0.15 M to a 10.0 mL solution of a strong acid (HBr) of concentration of 0.50 M, what is the [H₃O⁺]? (This is a before equivalence point problem.) (15 pts)

Exam III	General Chemistr	y II (CHEM 102	2) Form A	1/10/13 11:30 au	n MWF Dr. H	Iahn Exam #	7-3
Name			(p:	rint) Name			(sign)
questions		dit. Please w				wer Questions. Mult f I cannot read your w	
pH + p	OH = 14 pKa	+ pKb = 14	KaxKh:	= 1.0 x 10-14	[H ₃ O ⁺][OH	$] = 1.0 \times 10^{-14} = k_{W}$	тр
(anythin	g) = - log (anythin	pH = pK	a + log { [l	pase] / [acid] }	M = molarit	y = moles / liter	-
	MULTIPLE CHOICI uestion, 28 pts pts t		one alternat	tive that best co	mpletes the sta	tement or answers th	ne question. (4
1) Which of the follow	wing solutions i	s a good but	ffer system?			1)
	A) A solution th B) A solution th			-			
	C) A solution th						
	D) A solution th	at is 0.10 M H (C2H3O2 and	1 0.10 M Li C ₂ H	3O ₂		
	E) None of the a	above are buffe	r systems.				
2)) What is the conjug	ate base of H ₂ F	PO ₄ -?				2)
	A) H ₃ O ⁺	B) OH	C) HPO ₄ 2-	D) PO ₄ 3-	E) H ₃ PO ₄	
3)) Calculate the pOH	in an aqueous	solution wit	h a pH of 9.85 a	t 25°C. { pH +	pOH = 14 }	3)
0,	A) 4.00	B) 4.15) 5.15	D) 3.15	E) 2.15	
					4.0	14)	
4)	Determine the K _b	for CN ⁻ at 25°C	The K _a fo	r HCN is 4.9 × 1	0^{-10} . {K _a x K	$C_b = 1.0 \times 10^{-14}$	4)
	A) 4.9×10^{-14}	•					
	B) 2.3 × 10 ⁻⁹						•
	C) 1.4×10^{-5}						
	D) 3.7×10^{-7}						
	E) 2.0×10^{-5}						
5)	Calculate the conce	entration of OH	in a solutio	on that contains	3.9 x 10 ⁻⁴ M H ₃	3O+ at 25°C.	5)
	${[H_3O^+][OH^-]} =$	1.0 x 10 ⁻¹⁴ }		•			
	A) 3.9×10^{-4} M						
	B) 2.7×10^{-3} M						
	C) 2.6 × 10-11 M	ſ					
	D) 2.7×10^{-2} M						
	E) 2.6 × 10-12 M						

6) Which of the follo	wing is NOT a conju	gate acid-base pair:			0)	
A) C2H3O2 ⁻ /H	C2H3O2					
B) NH ₄ +/NH ₃						
C) H ₃ O ⁺ /OH ⁻			•			
D) H ₂ SO ₃ /HSO)3-					
E) All of the ab	ove are conjugate ac	id-base pairs.				
7) Identify the tripro	tic acid.				7)	
A) H2SO3	B) HClO4	C) HNO3	D) H2SO4	E) H2PO4		

1.

Circle the Weak Acid among the following: (5 pts)

HBr

CH₃COOH H₂SO₄ HF

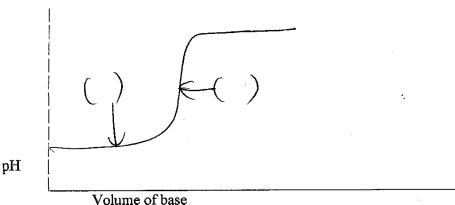
Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

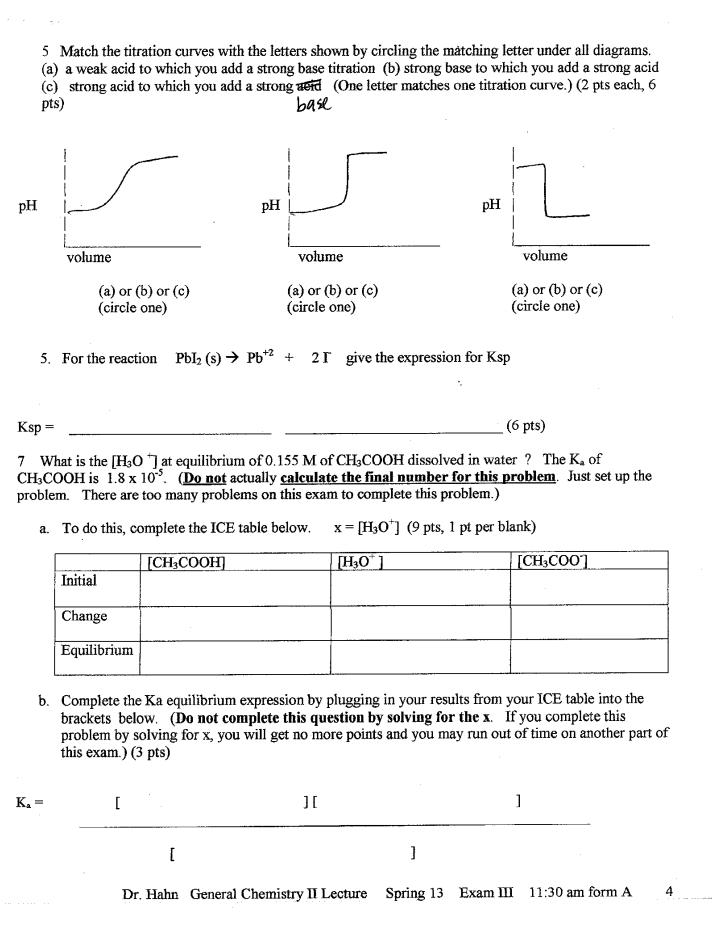
 $CH_3COOH(aq) + H_2O(1) \rightarrow$

What is the pH of a H I solution (strong acid) with a concentration of 0.115 M? Please show 3. work for partial credit & full credit. $\{pH = -\log [H^{+}]\}\$ (6 pts)

 $[H^{+}] = [H_3O^{+}] =$

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) M = (# moles base - # moles acid) / total volume (b) $[H^{+}] = [H_3O^{+}] = [HA]$ (HA is a generic strong acid) (c) pH = 7 (d) M = (#moles acid - # moles base) / total volume (3 pts each, 6 pts)





1. Calculate the pH of a buffer solution with a concentration of 0.50 M H F and 0.25 M Na F. pK_a of H F is 3.46 Use the Henderson Hasselbalch: $pH = pK_a + log \{ [base] / [acid] \} (10 pts)$

2. In a titration, if you add 20.0 mL of a strong base(K OH) with a concentration of 0.20 M to a 50 mL solution of a strong acid (HNO3) of concentration of 0.45 M, what is the [H₃O⁺]? (This is a before equivalence point problem.) (15 pts)

Name		(print) Name		(sign)
questions have no pa		ong Answers and in some of tite anything you want grad	f the Short Answer Questions. Med legibly. If I cannot read you	Multiple choice ar work, I obviously
pH + pOH = 14	pKa + pKb = 14	$K_a \times K_b = 1.0 \times 10^{-14}$	$[H_3O^+][OH^-] = 1.0 \times 10^{-14} =$	k _W p
(anything) = - log	(anything) $pH = pK_a$	+ log { [base] / [acid] }	M = molarity = moles / liter	
Part I MULTIPLE (ots per question, 28		one alternative that best co	mpletes the statement or answer	rs the question. (4
1) Calculate t	he concentration of OH	in a solution that contains	$3.9 \times 10^{-4} \text{ M H}_3\text{O}^+$ at 25°C.	1)
{[H ₃ O ⁺][$OH-] = 1.0 \times 10^{-14}$			
A) 3.9 ×	10−4 M			
B) 2.7 ×	10-2 M			
C) 2.6 ×	$10^{-12}{ m M}$			
D) 2.7 ×	10-3 M			
E) 2.6 ×	$10^{-11} \mathrm{M}$			
2) Determine	e the Kb for CN ⁻ at 25°C	. The K_a for HCN is 4.9×1	0^{-10} . { K _a x K _b = 1.0 x 10-14	} 2)
A) 2.0 ×	10-5			
B) 1.4 ×	10-5			
C) 2.3 ×	10^{-9}			
D) 4.9 ×	10-14			
E) 3.7 ×	10-7			
3) Which of t A) A sol	he following solutions is lution that is 0.10 M Na	s a good buffer system? OH and 0.10 M K OH	`,	3)
B) A sol	lution that is $0.10~\mathrm{M}~\mathrm{H}~\mathrm{C}$	I and 0.10 M NH ₄ +		
C) A sol	lution that is 0.10 M H F	and 0.10 M Na C2H3O2		
D) A sol	lution that is 0.10 M H C	C2H3O2 and 0.10 M Li C2H	₃ O ₂	
E) None	e of the above are buffer	r systems.		
4) Calculate t	he pOH in an aqueous s	solution with a pH of 9.85 at	t 25°C. { pH + pOH = 14 }	4)

C) 4.00

B) 4.15

A) 2.15

D) 5.15

E) 3.15

5) Which of the follow	ving is NOT a conjug	gate acid-base pair:			³⁾
A) NH4+/NH3					
B) H3O+/OH-					
C) C ₂ H ₃ O ₂ ⁻ /H	C2H3O2				
D) H ₂ SO ₃ /HSO	3				
E) All of the abo	ove are conjugate aci	d-base pairs.			
6) What is the conjug	ate base of H2PO4"	?			6)
A) H ₃ O ⁺	B) H3PO4	C) HPO4 ² -	D) PO4 ³⁻	E) OH-	
7) Identify the triprot A) HClO4	ic acid. B) H3PO4	C) H2SO4). D) H ₂ SO ₃	E) HNO3	7)

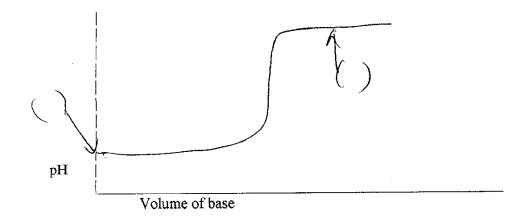
- 1. Circle the Strong Work Acid among the following: (5 pts)

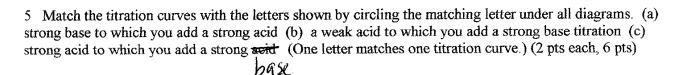
 HBr CH₃COOH H₂SO₄ HF H₂SO₄ H NO₃
- 2. Write the reaction equation for the acid / base reaction of the weak acid with water by filling in the products in the equation below. (3 pts each, 6 pts)

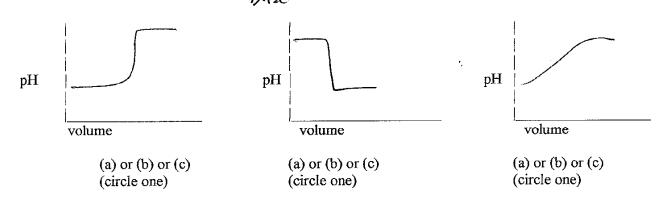
 $H CN (aq) + H₂O (l) \rightarrow$

3. What is the pH of a HBr (strong acid) solution with a concentration of 0.095 M? Please show work for partial credit & full credit. $\{pH = -\log [H^+]\}$ (6 pts)

4. Match the titration curve for a strong acid being titrated by adding a strong base with the statements below. You may use the letters one time, no time or many times. (a) pH = 7 (b) $M = (\# \text{ moles base} - \# \text{ moles acid}) / \text{ total volume (c) } [H^+] = [H_3O^+] = [HA]$ (HA is a generic strong acid) (d) M = (# moles base) / total volume (3 pts each, 6 pts)







5. For the reaction $Ag_2 SO_4$ (s) $\rightarrow 2 Ag^+ + SO_4^{-2}$ give the expression for Ksp

Ksp =	(6 pts)
rrop	

7 If the K_a of H CN is 4.9×10^{-10} , find the [H₃O ⁺] at equilibrium if the initial concentration of H CN is 5.55 M. (**Do not** actually **calculate the final number for this problem**. Just set up the problem. There are too many problems on this exam to complete this problem.)

a. To do this, complete the ICE table below. $x = [H_3O^+]$ (9 pts, 1 pt per blank)

	[HCN]	[H ₃ O ⁺]	[CN]
Initial			
Change			
Equilibrium			

b. Complete the Ka equilibrium expression by plugging in your results from your ICE table into the brackets below. (**Do not complete this question by solving for the x**. If you complete this problem by solving for x, you will get no more points and you may run out of time on another part of this exam.) (3 pts)

1. Calculate the pH of a buffer solution with a concentration of $0.25 \, \text{M}$ H C₂H₃O₂ and $0.50 \, \text{M}$ NaC₂H₃O₂. pK_a of HC₂H₃O₂ is 4.74 Use the Henderson Hasselbalch: pH = pK_a + log { [base] / [acid] } (10 pts)

2. In a titration, if you add 35.5 mL of a strong base(Li OH) with a concentration of 0.25 M to a 25.0 mL solution of a strong acid (HCl) of concentration of 0.20 M, what is the [OH]? (This is an after equivalence point problem.) (15 pts)