

Exam Three
CHM 205 (Dr. Mattson)
21 February 2005

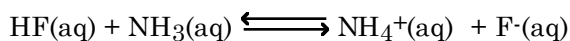
Academic Integrity Pledge:

In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

Signature:

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. **BOX YOUR ANSWERS!**

1. (4 pts) Circle the two Bronsted-Lowry acids in the following equilibrium. Put a box around the two Bronsted-Lowry bases. Draw lines that connect each acid with its conjugate base.



2. (5 pts) Complete the following table that lists conjugate pairs of weak acids and bases.

Acid	Base
$\text{HC}_2\text{H}_3\text{O}_2$	
	CN^-
H_2PO_4^-	
HClO_2	
	NH_3

3. (3 pts) What is the pH of a 0.044 M nitric acid solution?

4. (3 pts) What is the pH of a solution prepared by dissolving 0.0473 g KOH in enough water to make 500.0 mL solution? [Given: MM 56.1 g KOH/mol]

5. (3 pts) What is the pH that results from diluting 40.0 mL of a pH = 3.50 solution with enough water to make 250 mL?

6. (2 pts) Which the following four solutions is most acidic? Circle your answer. Draw a box around the most basic.

$$\text{pH} = 3.00$$

$$\text{pOH} = 12$$

$$[\text{H}_3\text{O}^+] = 4 \times 10^{-5}$$

$$[\text{OH}^-] = 2.2 \times 10^{-9}$$

Show work

7. (a) (2 pts) Write the equilibrium expression that shows how formic acid, HCO_2H , behaves in water. Use appropriate long/short arrows.

7. (b) (3 pts) A 0.400 M solution of formic acid has a pH of 2.07. Determine the K_a for formic acid.

8. (3 pts) A weak acid, HA, has $K_a = 7.3 \times 10^{-6}$. Determine the pH of a 0.550 M solution of HA.

9. (4 pts) Given $K_a = 6.5 \times 10^{-5}$ for benzoic acid, $\text{HC}_6\text{H}_5\text{O}_2$, determine the pH of a 0.25 M solution of sodium benzoate, $\text{NaC}_6\text{H}_5\text{O}_2$.

10. (7 pts) Identify each of the following substances as strong acid (SA), weak acid (WA), neutral (N), weak base (WB) or strong base (SB) in aqueous solution.

HOCl	SA	WA	N	WB	SB
KBr	SA	WA	N	WB	SB
NaOCl	SA	WA	N	WB	SB
NaOH	SA	WA	N	WB	SB
NH_3	SA	WA	N	WB	SB
HCl	SA	WA	N	WB	SB
NH_4Cl	SA	WA	N	WB	SB

11. (2 pts) Which of the following solutions would most likely require the use of the quadratic formula in order to correctly calculate the pH for the solution?

0.010 M HBrO	$K_a = 2.06 \times 10^{-6}$
0.100 M HIO_3	$K_a = 1.69 \times 10^{-1}$
0.001 M HCN	$K_a = 4.93 \times 10^{-10}$

12. (a) (3 pts) Telluric acid, H_2TeO_4 is a diprotic acid with $\text{p}K_a$ values of 7.68 and 11.29. Write the two equilibrium equations, complete with appropriate arrows and the appropriate K_a expression for each including its numerical value.

12. (b) (3 pts) Sodium hydrogen tellurate, NaHTeO_4 could behave either as an acid or base in water. Write the two equilibrium equations showing it doing each. Again, use appropriate arrows. Write the K_a or K_b expression as appropriate and include a numerical value for each.

12. (c) (3 pts) Is sodium hydrogen tellurate, NaHTeO_4 a better weak acid or weak base? Determine the pH of a 0.100 M solution of sodium hydrogen tellurate.

13. (BONUS 1 point) Print your name here:

(For DocM's use)

Your exam score (50 possible): _____

Bonus pts: Max: _____ Earned: _____

Total Score (50 maximum) _____

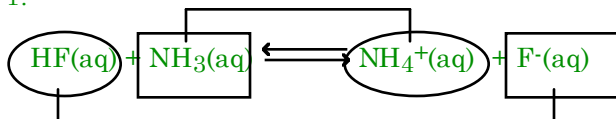
Determine your grade:

A \geq 46.5; B+ \geq 43.5; B \geq 41.0;

C+ \geq 37.5; C \geq 34.00; D \geq 30.00

Answers:

1.



2.

Acid	Base
HC ₂ H ₃ O ₂	C ₂ H ₃ O ₂ ⁻
HCN	CN ⁻
H ₂ PO ₄ ⁻	HPO ₄ ⁻²
HClO ₂	ClO ₂ ⁻
NH ₄ ⁺	NH ₃

3. 1.36

4. 11.23

5. 4.30

6. most acidic: pOH = 12

most basic: [OH⁻] = 2.2 x 10⁻⁹

7. (a):



7. (b) K_a = 1.85 x 10⁻⁴

8. 2.70

9. 8.79

10.

HOCl	WA
KBr	N
NaOCl	WB
NaOH	SB
NH ₃	WB
HCl	SA
NH ₄ Cl	WA

11. 0.100 M HIO₃

12.



$$K_{a1} = \frac{[\text{H}_3\text{O}^+][\text{HTeO}_4^-]}{[\text{H}_2\text{TeO}_4]} = 2.1 \times 10^{-8}$$



$$K_{a2} = \frac{[\text{H}_3\text{O}^+][\text{TeO}_4^{2-}]}{[\text{HTeO}_4^-]} = 5.1 \times 10^{-12}$$

12.



$$K_{a2} = \frac{[\text{H}_3\text{O}^+][\text{TeO}_4^{2-}]}{[\text{HTeO}_4^-]} = 5.1 \times 10^{-12}$$



$$K_b = \frac{[\text{OH}^-][\text{TeO}_4^{2-}]}{[\text{H}_2\text{TeO}_4]}$$

$$= \frac{K_w}{K_{a1}} = 4.8 \times 10^{-7}$$

12. better base; pH = 10.34