

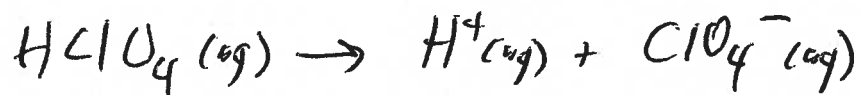
CHEMISTRY 1220

CHAPTER 16 PRACTICE EXAM



1. The pH of a 0.10 M solution of NH_3 containing 0.10 M NH_4Cl is 9.20. What is the $[\text{H}_3\text{O}^+]$?
a) 1.6×10^{-5} b) 1.0×10^{-1} c) 6.3×10^{-10} d) 1.7×10^{-10} e) 2.0×10^{-9}

2. Calculate the pH of an aqueous solution which is 0.0020 M HClO_4 .
a) 1.30 b) 1.70 c) 2.30 d) 2.70 e) 2.00



Strong acid, fully dissociates

$$[\text{H}^+] = 0.0020 \text{ M}$$

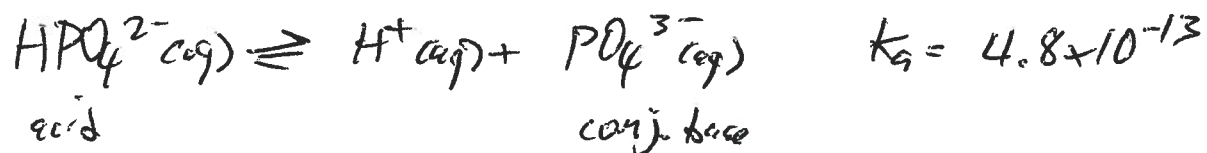
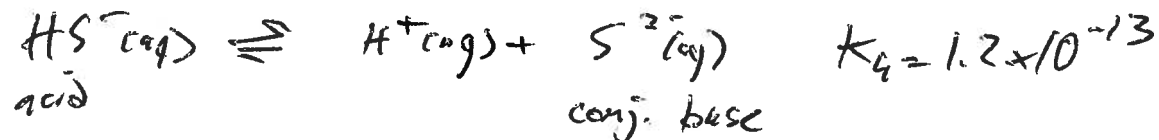
$$\text{pH} = -\log [\text{H}^+]$$

$$\text{pH} = -\log [0.0020]$$

$$\boxed{\text{pH} = 2.70}$$

5. The K_a values for HS^- and HPO_4^{2-} are 1.2×10^{-13} and 4.8×10^{-13} respectively. Therefore it follows the HS^- is a acid than HPO_4^{2-} and S^{2-} is a base than PO_4^{3-} .

a) stronger, stronger b) stronger, weaker **c) weaker, stronger** d) weaker, weaker



$K_a \text{ HPO}_4^{2-} > K_a \text{ HS}^- \therefore \text{HPO}_4^{2-}$ is a stronger acid than HS^-
 PO_4^{3-} is a weaker conj. base than S^{2-}

6. What is the ionization constant of an acid if the hydronium ion concentration of a 0.500 M solution is 1.70×10^{-4} M?

a) 3.62×10^{-7} b) 2.89×10^{-8} **c) 5.80×10^{-8}** d) 1.16×10^{-7} e) 1.70×10^{-3}

7. Consider the following salts. Which one(s) when dissolved in water will produce an acidic solution?

1) NH_4Cl 2) KHSO_4 3) NaCN

a) only 1 b) only 2 c) only 3 d) 1 and 2 e) 2 and 3

8. A 0.010 M solution of HNO_2 is 19% ionized. What is the K_a ?

a) 4.5×10^{-4} b) 3.9×10^{-4} c) 3.6×10^{-4} d) 5.0×10^{-4} e) 5.4×10^{-4}

9. What is the pH of a 0.20 M NH_4Cl solution ($K_b: \text{NH}_3 = 1.8 \times 10^{-5}$)?
a) 2.72 b) 3.11 c) 4.98 d) 5.12 e) 7.61

10. Ascorbic acid, $\text{H}_2\text{C}_6\text{H}_6\text{O}_2$, is a diprotic acid. The K_1 and K_2 values are 7.9×10^{-5} and 1.6×10^{-12} respectively. What is the $\text{C}_6\text{H}_6\text{O}_2^{2-}$ ion concentration in a 0.10 M solution of ascorbic acid?
a) 1.6×10^{-6} b) 1.6×10^{-12} c) 7.9×10^{-12} d) 2.8×10^{-3} e) 5.6×10^{-3}

11. What is the pH of a solution of 0.31 M acid and 0.65 M of its conjugate base if the ionization constant, K_a , is 5.22×10^{-7} ?

- a) 6.60 b) 6.81 c) 7.00 d) 7.21 e) 7.42

12. Rubidium hydroxide is a strong base. Compute $[Rb^+]$ and $[OH^-]$ for a solution that is prepared by dissolving 2.0 g of RbOH in enough water to make 200.0 mL of solution. (atomic weights: Rb = 85.47, O = 16.00, H = 1.008)

a) 1.9×10^{-2} , 1.9×10^{-2}

b) 1.9×10^{-2} , 5.3×10^{-13}

c) 5.3×10^{-13} , 1.9×10^{-2}

d) 9.8×10^{-2} , 9.8×10^{-2}

e) 9.8×10^{-1} , 9.8×10^{-1}

$$2.0 \text{ g RbOH} \times \frac{1 \text{ mol RbOH}}{102.47 \text{ g}} \times \frac{1 \text{ mol Rb}^+}{1 \text{ mol RbOH}} = \frac{0.019518 \text{ mol Rb}^+}{0.2000 \text{ L}} = \underline{\underline{9.8 \times 10^{-2} \text{ M}}}$$

$$2.0 \text{ g RbOH} \times \frac{1 \text{ mol RbOH}}{102.47 \text{ g}} \times \frac{1 \text{ mol OH}^-}{1 \text{ mol RbOH}} = \frac{0.019518 \text{ mol OH}^-}{0.2000 \text{ L}} = \underline{\underline{9.8 \times 10^{-2} \text{ M}}}$$

13. You are given two solutions: 0.50 M HCl (aq) and 0.50 M Ca(OH)₂(aq). What is the [H⁺] in the HCl solution? What is the [OH⁻] in the Ca(OH)₂ solution? (The solutions are NOT mixed together).

[H⁺] [OH⁻]

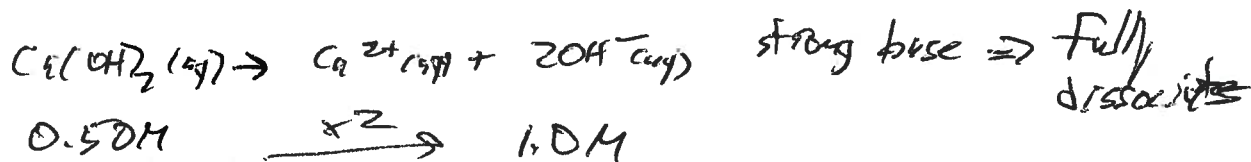
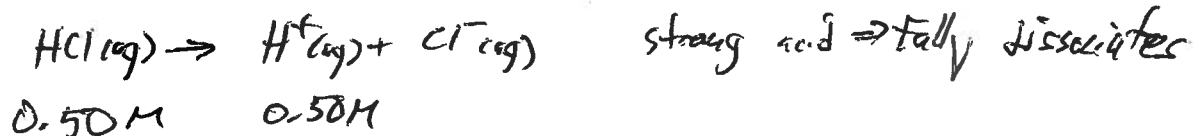
a) [H⁺] = 0.50 M, [OH⁻] = 0.50 M

b) [H⁺] = 0.25 M, [OH⁻] = 1.0 M

c) [H⁺] = 0.50 M, [OH⁻] = 0.25 M

d) [H⁺] = 0.25 M, [OH⁻] = 0.25 M

e) [H⁺] = 0.50 M, [OH⁻] = 1.0 M



14. How many grams of phosphoric acid are there in 175 mL of a 3.5 M solution of phosphoric acid (MW 98.00 g/mol)?

a) 0.61 g

b) 60 g

c) 21 g

d) 4.9 g

e) 610 g

$$3.5 \text{ mol H}_3\text{PO}_4 \times 0.175 \cancel{\text{L}} + \frac{98.00 \text{ g}}{1 \text{ mol H}_3\text{PO}_4} = \underline{\underline{60.03 \text{ g}}}$$

15. A solution is prepared by dissolving 516.5 mg of oxalic acid ($C_2H_2O_4$, 90.00 g/mol) to make 100.0 mL of solution. A 10.00 mL portion is then diluted to 250.0 mL. What is the molarity of the final solution?

a) $2.295 \times 10^{-3} M$

b) $6.341 \times 10^{-2} M$

c) $3.172 \times 10^{-3} M$

d) $4.685 \times 10^{-2} M$

e) $1.889 \times 10^{-3} M$

$$0.5165 \text{ g } C_2H_2O_4 \times \frac{1 \text{ mol}}{90.00 \text{ g}} = \frac{0.005739 \text{ mol}}{0.1000 \text{ L}} = 0.05739 \text{ M}$$

$$0.05739 \frac{\text{mol}}{\text{L}} \times 0.010 \text{ L} = \frac{5.739 \times 10^{-4} \text{ mol}}{0.250 \text{ L}} = \underline{2.296 \times 10^{-3} M}$$

16. What is the conjugate base of methylamine, CH_3NH_2 ?

a) CH_3NH^+

b) CH_3NH^-

c) $CH_3NH_2^+$

d) $CH_3NH_2^-$

e) $CH_3NH_3^+$

17. What is the conjugate acid of methylamine, CH_3NH_2 ?

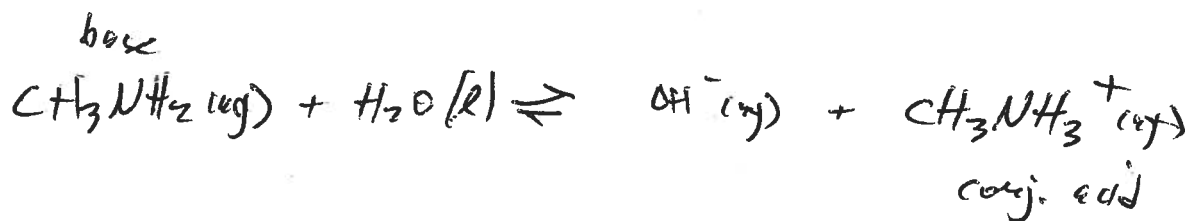
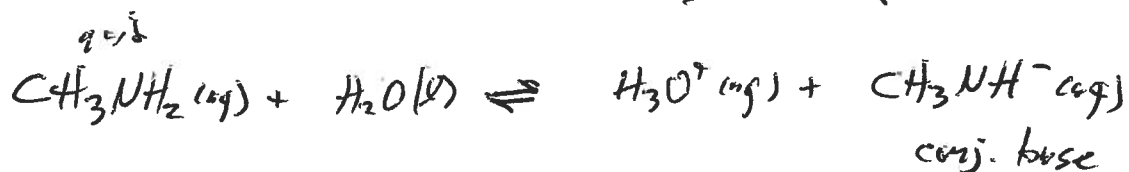
a) CH_3NH^+

b) CH_3NH^-

c) $CH_3NH_2^+$

d) $CH_3NH_2^-$

e) $CH_3NH_3^+$



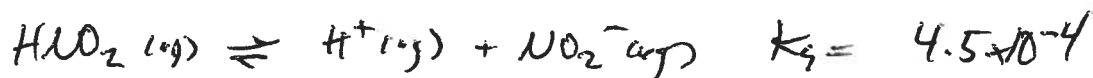
18. The K_a values for HCNO and HNO₂ are 2.2×10^{-4} and 4.5×10^{-4} respectively. Therefore it follows the HCNO is a ___ acid than HNO₂ and CNO⁻ is a ___ base than NO₂⁻.

a) stronger, stronger

b) stronger, weaker

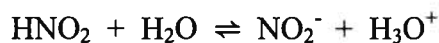
c) weaker, stronger

d) weaker, weaker



K_a for HCNO is less than HNO₂ ∴ HCNO is weaker
weaker the acid (HCNO) the stronger the conj. base (CNO⁻)
weaker

19. What change will be observed for the following reaction if a few drops of NaOH are added?



a) a decrease in the fraction of acid dissociated

b) an increase in the fraction of acid dissociated

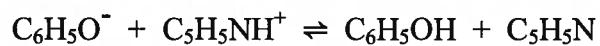
c) no change in the fraction of acid dissociated

OH⁻ will neutralize H₃O⁺, which will

↓ [H₃O⁺] and the Eq. will shift (R)

This increases the fraction of acid dissociated.

20. Given K_a values of 1.0×10^{-10} and 6.8×10^{-8} for C_6H_5OH and $C_5H_5NH^+$ respectively, calculate the equilibrium constant for the following reaction.



- a) 6.8×10^2 b) 0.15 c) 1.5×10^{-3} d) 6.8×10^{-2} e) 6.8×10^{-8}

21. The value of K_a in water at $25^\circ C$ for benzoic acid ($C_6H_5CO_2H$) is 6.46×10^{-5} M. Calculate the pH of an aqueous solution with a total concentration of benzoic acid equal to 0.025 M.

- a) 1.29 b) 2.09 c) 2.90 d) 3.10 e) 3.90

22. The value of K_a in water at 25°C for chloroacetic acid is 1.35×10^{-3} M. Calculate the pH of an aqueous solution with an initial concentration of chloroacetic acid equal to 0.10 M.

- a) 1.35 b) 1.96 c) 2.14 d) 3.65 e) 3.35

23. Consider the following salts. Which one(s) when dissolved in water will produce an acidic solution?

- 1) NH_4Cl 2) KHSO_4 3) NaCN

- a) only 1 b) only 2 c) only 3 d) 1 and 2 e) 2 and 3

24. A 1.50 g sample of Vitamin C is dissolved in 100.0 mL of water and titrated with 0.250 M NaOH to the methyl orange equivalence point. The volume of the base used is 34.1 mL. What is the molecular weight of Vitamin C assuming one dissociable proton per molecule?

- a) 176 b) 164 c) 152 d) 146 e) 139

25. A 25.00 mL sample of 0.100 M HCl is titrated with 0.100 M NaOH. What is the pH of the solution at the points where 24.9 and 25.1 mL of NaOH have been added.

- a) 3.00, 11.00
b) 3.30, 10.70
c) 3.30, 10.30
d) 3.70, 10.30
e) 3.70, 10.70

26. What is the pH of a solution of 0.65 M acid and 0.51 M of its conjugate base if the pK_a is 5.30?

- a) 5.19 b) 5.41 c) 5.62 d) 5.85 e) 6.05

27. Hydrosulfuric acid (H_2S) has $K_1 = 1.1 \times 10^{-7}$ and $K_2 = 1.0 \times 10^{-13}$. What is the HS^- ion concentration of a 0.10 M solution of H_2S ?

- a) 1.0×10^{-4} b) 1.0×10^{-5} c) 3.3×10^{-4} d) 3.3×10^{-5} e) 1.1×10^{-7}

28. A 0.0184 M solution of HCNO is 12.8% ionized. What is the K_a ?

- a) 1.1×10^{-3} b) 1.5×10^{-3} c) 1.9×10^{-3} d) 3.5×10^{-4} e) 2.9×10^{-4}

29. Given the following K_a values, determine which species is the strongest base.

- HF 6.8×10^{-4} HNO₂ 4.5×10^{-4} HCNO 2.2×10^{-4}
a) F⁻ b) NO₂⁻ c) CNO⁻ d) HF e) HCNO

↑ $K_a =$ ~~weaker~~ stronger the acid
↳ weaker conj. base

↓ $K_a =$ weaker the acid
↳ stronger conj. base

HCNO has smallest K_a of the three

↳ weakest acid

↳ strongest base

30. A 25.00 mL sample of 0.100 M $\text{CH}_3\text{CO}_2\text{H}$ is titrated with 0.100 M NaOH. What is the pH of the solution at the points where 25.0 and 25.5 mL of NaOH have been added? ($K_a = 1.8 \times 10^{-5}$)

- a) 8.72, 11.00 b) 8.72, 9.85 c) 7.00, 10.00 d) 7.00, 9.85 e) 7.00, 8.00

Exam #1

2, 3, 4, 5, 12, 13, 14, 15, 16, 17,

18, 19, ~~20~~, 29

