CH1010 Exam 3 Name_____Key_____

November 29, 2000 SSN_____Seat No_____

In solving problems, you must show all work. Little or no credit will be given for a correct answer with no work shown.

1. a. Given the following acids and their K_as, arrange the acids in order of increasing acidity. (5%)

Acid	K_a
HNO_2	4.47×10^{-4}
H_2CO_3	4.45×10^{-7}
HCOOH	1.78×10^{-4}

H_2CO_3 HNO_2 HCOOH

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increasing acidity

b. Calculate the pK_a of HCOOH (5%)

$pK_a = - \log[K_a] = - \log[1.78 \times 10^{-4}] = 3.75$

c. Write the equation for the acid-base reaction which occurs when HNO_2 is dissolved in water. Identify the acids (A), bases (B), conjugate acids (CA), and conjugate bases (CB) by putting the appropriate symbol under the reactant or product. (5%)

$$\underset{\text{A}}{HNO_2} + \underset{\text{B}}{H_2O} \rightleftharpoons \underset{\text{CB}}{NO_2^-} + \underset{\text{CA}}{H_3O^+}$$

d. Write the equation for the acid-base reaction of HCOOH with excess KOH. (5%)

$HCOOH + KOH \text{ ------> } HCOO^- K^+ + H_2O$

e. NO_2^- is a base. Write the equation for its reaction with water. (5%)

$$NO_2^- + H_2O \rightleftharpoons HNO_2 + {}^-OH$$

f. Write the expression for the K_b of NO_2^-. (5%)

$$K_b = \frac{[HNO_2][^-OH]}{[NO_2^-]}$$

g. Calculate the K_b of NO_2^-. (5%)

$K_b = K_w/K_a = 1x10^{-14}/4.47x10^{-4} = 2.24x10^{-11}$

2. a. Calculate the pH of a $2.17x10^{-3}$ M solution of HCl in water. (5%)

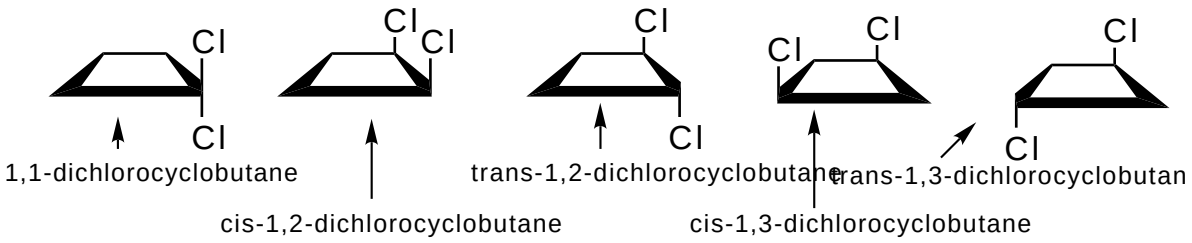
$pH = -\log[H_3O^+] = -\log[2.17x10^{-3}] = 2.66$

b. Calculate how many mL of .01 M KOH will be required to neutralize 100 mL of the above HCl solution. (5%)

(100 mL) x $(2.17x10^{-3})$ = (mL KOH) x (.01)

mL KOH = 2.17

3. Draw 3 dimensional representations of all the isomeric dichlorocyclobutanes (don't forget cis and trans forms). (10%)



4. a. Write the equation for the production of ozone in the stratosphere. (4%)

$$O + O_2 \longrightarrow O_3$$

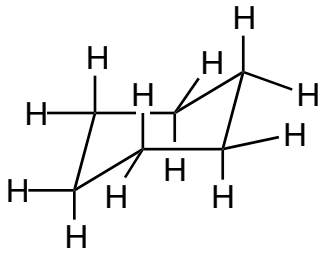
b. Write the equations for the destruction of ozone by CCl_2F_2 in the stratosphere. (6%)

$$CCl_2F_2 \xrightarrow{h\nu} CCF_2 + Cl$$

$$Cl + O_3 \longrightarrow ClO + O_2$$

$$ClO + O \longrightarrow O_2 + Cl$$

5. Draw the 3 dimensional structure of cyclohexane showing all the carbon-hydrogen bonds. (5%)



Chair cyclohexane

6. a. Calculate the molarity of a solution of 2.7 g of sodium acetate (Na^+ CH_3COO^-) in 1 L water. (5%)

2.7g/82g/mol/1L = 0.033 M

b. When 3.4 g of acetic acid (CH_3COOH) is added to the above solution, what is the molarity of the acetic acid. (5%)

3.4g/60g/mol/1L = 0.0566 M

c. A solution prepared in this way is a buffer solution. Given the fact that acetic acid has $pK_a = 4.76$, calculate the pH of this buffer. (5%)

$$pH = pK_a + \log[CH_3COO^-]/[CH_3COOH]$$
$$pH = 4.76 + \log[0.033]/[0.0566] = 4.53$$

7. a. Carbon-14 is a β emitter. Write the equation for this nuclear reaction. (5%)

$$^{14}_{6}C \longrightarrow {}^{0}_{-1}e + {}^{14}_{7}N$$

b. Carbon-14 has a half-life of 5730 years, Calculate the percent of carbon-14 remaining in a sample after 25,000 years. (10%)

percent remaining = $100\% \times (1/2)^n$

$n = 25000/5730 = 4.36$

$100\% \times (1/2)^{4.36} = 4.86\%$

1. a-d _____ 1. e-g _____

2. _____ 3-5 _____

6. _____ 7. _____

Total minus _____ Grade _____

Name _____