CHEM 102/112, SPRING 2011
Exam #2 Mar 25th 2011 (1 hr 40 min)

DO NOT BEGIN TO WORK ON THE EXAMINATION UNTIL
THE PROCTOR TELLS YOU TO DO SO!

INSTRUCTIONS: Before you begin the examination, please fill-in the identification information requested on the answer sheet. **You must use a No. 2 pencil** to fill in this information. In the STUDENT ENROLLMENT SHEET section of the form, fill in the I.D. NUMBER (your person number, format = 12345678--, *i.e., left adjusted with one blank space on the right*), NAME (your *last name, first name, M.I.*), and CODE (your recitation section code, format = *01*) fields. Be sure to fill in the correct circles completely. Your examination score cannot be credited to the correct person if the computer cannot read the *bubbled in* information. In the SCORE SHEET section of the form, sign your name on the line for NAME on side 1.

For each question you are to fill in the circle on the answer sheet that corresponds to the BEST answer. Make sure the answer number used is the same as the question number! **Use a No. 2 pencil; make heavy marks that FILL the circle**; erase completely any answer you wish to change. Questions with more than one answer marked will be graded as incorrect. **The only answers that will be accepted are those which appear on the bubble sheet.**

Check that you have a complete examination (**10 pages – including Formula Sheet and Periodic Table**). Please place your name on the top of every page. Do not leave any answers blank. Do not make any stray marks on the answer sheet! Use the space between the problems on the examination pages for your scratch work. Raise your hand if you have a question or need a pencil.

PLEASE READ AND SIGN THE ACADEMIC HONESTY STATEMENT BELOW.

I hereby certify that the answers given represent my own unaided work.

Signed _____ Key #1 Person Number ___ ___ - ___ ___ ___ ___

Printed Name _____ Recitation Section Code ___ ___
first last

Name _____

Information About This Examination
Each of the 25 multiple choice questions is worth 4 points, for a total of 100 points.

Instructions: Choose the **BEST answer (A - E)** to each of the questions below and record your answer on the separate "SCANTRON" form provided.

1. $\mathbf{K_a}$ for aspirin (acetylsalicyclic acid) is **3.0 x 10^{-4}** at 25°C. What is the K_b at 25°C for the acetylsalicylate anion, the conjugate base of aspirin?

A. 3.3×10^{-11}

B. 3.5

C. 3.0×10^{10}

D. 10

E. There is insufficient data to calculate K_b

$K_W = K_a \times K_b$

$K_b = \frac{K_W}{K_a} = \frac{1.0 \times 10^{-14}}{3.0 \times 10^{-4}} = 3.3 \times 10^{-11}$

2. Which of the following is the **most important factor** when comparing the relative **acid strengths** of the species H_nX? (X is ***any member*** of a ***specific periodic group*** in the periodic table.)

A. Electron withdrawing effects

B. Percent ionic character of the H-X bond

C. Solubility of H_nX in water

D. Le Châtelier's principle

E. Strength of the H-X bonds

3. Which list (below) shows the correct order for *increasing acid strength*?

A. $HOBr < HBrO_3 < HBrO_2$

B. $HOBr < HBrO_2 < HBrO_3$

C. $HBrO_2 < HOBr < HBrO_3$

D. $HBrO_3 < HOBr < HBrO_2$

E. $HBrO_3 < HBrO_2 < HOBr$

↑ # of O atoms in oxo-acids or oxy-acids, STRONGER!!!

4. What is the pH of a 0.20M NH_4Cl solution? (K_b for NH_3 = **1.8 x 10^{-5}**)

A. 3.74
B. 10.25
C. 6.53
D. 4.98
E. 9.02

$NH_4Cl \longrightarrow NH_4^+ + Cl^-$

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

$K_a = \frac{[NH_3][H_3O^+]}{[NH_4^+]_{eq}} = \frac{(x)(x)}{0.20M - x}$

$x = [H_3O^+] = 1.05 \times 10^{-5} M$

$\boxed{pH = 4.98}$

$K_{a_{NH_4^+}} = \frac{K_w}{K_{b_{NH_3}}}$

$K_a = 5.56 \times 10^{-10}$ — TOO LOW!

YOU MAY ASSUME x to be NEGLIGIBLE! BUT IT IS SAFER TO USE QUADRATIC EQ.

5. Which of the following 0.10M solutions will have the ***highest*** pH?

HERE, YOU CAN ASSUME x VALUES - NEGLIGIBLE (Because we are just comparing!)

$K_a = \frac{x^2}{[acid]}$ $\quad K_b = \frac{x^2}{[base]}$

A. KCN [K_a (HCN) = 4.0 x 10^{-10}] — $K_b = 2.5 \times 10^{-5}$ HIGHEST K_b VALUE!
B. NH_4NO_3 [K_b (NH_3) = 1.8 x 10^{-5}]
C. $NaCH_3CO_2$ [K_a (CH_3CO_2H) = 1.8 x 10^{-5}] — $K_b = 5.56 \times 10^{-10}$
D. NaClO [K_a (HClO) = 3.2 x 10^{-8}] — $K_b = 3.125 \times 10^{-7}$
E. NaHS [K_b (HS^-) = 1.8 x 10^{-7}]

↓ WILL PRODUCE ↑ $[OH^-]$, MORE BASIC.... ↑ pH

OR..... YOU CAN JUST compare all K_b values!!!

look at the reactants only!

6. Which statement is true for the reaction: **CaO (s) + SO_2 (g) ⇆ $CaSO_3$ (s)**

(O^{2-}: e⁻ rich; S atom in SO_2: e⁻ deficient!)

A. O^{2-} acts as a Lewis base; SO_2 acts as a Lewis acid.
B. Ca^{2+} acts as a Lewis base; SO_3^{2-} acts as a Lewis acid.
C. SO_3^{2-} acts as a Lewis base; SO_2 acts as a Lewis acid.
D. SO_2 acts as a Lewis base; O^{2-} acts as a Lewis acid.
E. SO_2 acts as a Lewis base; Ca^{2+} acts as a Lewis acid.

7. A 0.0012 M solution of barium hydroxide ($Ba(OH)_2$) at 25°C has:

A) $[OH^-]$ = 0.0006, pH = +11.38
B) $[OH^-]$ = 0.0012, pH = +2.62
C) $[OH^-]$ = 0.0024, pH = +11.38
D) $[OH^-]$ = 0.0024, pH = +2.62
E) $[OH^-]$ = 0.0012, pH = +11.38

↳ STRONG BASE

$Ba(OH)_2 + H_2O \longrightarrow Ba^{2+} + 2OH^-$

$[OH^-] = 2 \times 0.0012M$
$= 0.0024M$

$pOH = 2.62$

$\boxed{pH = 11.38}$