Problem Set #1 for lessons 1-3

ALL work must be shown in all problems for full credit.

PS26.1. For aqueous solutions of the following substances, write the dissociation reaction and indicate whether the substance behaves as an Arrhenius acid or base.

a) $HF(aq)$

b) $HC_6H_5O(aq)$

c) $Ba(OH)_2(aq)$

d) $LiOH(aq)$

e) $H_2O(aq)$

f) $H_2CO_3(aq)$

PS26.2. Calculate the pH and pOH in each of the following aqueous solutions. In each case, indicate whether the solution is acidic or basic.

a) $[H^+] = 1.4 \times 10^{-3}$ M

b) $[OH^-] = 2.08 \times 10^{-7}$ M

c) $[OH^-] = 6.44 \times 10^{-14}$ M

d) $[H^+] = 7.11 \times 10^{-11}$ M

e) $[H^+] = 4.0$ M

f) $[OH^-] = 10.1$ M

PS26.3. Calculate the $[H^+]$ and $[OH^-]$ in each of the following aqueous solutions.

a) pH = 7.41

b) pH = 11.0

c) pOH = 0.230

d) pOH = 7.00

e) pH = 14.9

f) pH = -0.543

PS26.4. For each of the following acids, write the formula for the conjugate base.

a) $H_2PO_4^-$ c) H_2O e) OH^-

b) $HClO_2$ d) $CH_3NH_3^+$ f) NH_4^+

PS26.5. For each of the following bases, write the formula for the conjugate acid.

a) OH^- c) CO_3^{2-} e) $CH_3CH_2NH_2$

b) Cl^- d) H_2O f) $(CH_3)_3N$

PS26.6. For the following compounds, write the reaction with water and indicate the Bronsted acids, bases, the conjugate acid and conjugate base.

a) $HCl(g)$

b) $NH_3(g)$

c) $HCN(g)$

d) $HC_6H_5O(s)$

e) $CH_3CH_2NH_2(l)$

PS26.7. Determine the equilibrium constant for the following solutions. (Work includes: ICE Table and justification of need or no need for quadratic equation!)

a) 0.100 M $HC_2H_3O_2$ whose pH = 2.87.

b) 0.812 M NH_3 whose pH = 11.58.

c) 0.500 M B whose pH = 10.67

d) 0.0751 M HA whose pH = 4.00.

PS26.8. Given the following substances and their initial concentration:

Answer the following,

i) identify each as an acid, base or neutral substance.

ii) list the K_a value for each acid and K_b value for each base.

iii) identify each substance as strong or weak.

iv) calculate the $[H^+]$ and the pH of each of the solutions.

v) rank all substances from strongest acid...weakest acid...neutrals..

...weakest base...strongest base.

a) 0.100 M HNO_3
b) 55.5 M H_2O
c) 0.100 M NaOH
d) 0.100 M $C_2H_5NH_2$
e) 0.100 M HF
f) 0.100 M HNO_2
g) 0.100 M CH_3NH_2
h) 0.100 M C_5H_5N
i) 0.100 M HC_6H_5O
j) 0.100 M $Ba(OH)_2$
k) 0.00491 M HF
l) 0.100 M HOCl

List letters in order according to part 5 of directions:

Problem Set #2 for lessons 4-6

ALL work must be shown in all problems for full credit..

PS27.1. Ascorbic acid, $H_2C_6H_6O_6$, is a diprotic acid.
a) The equilibrium constant for the first dissociation is $K_{a1} = 8.0 \times 10^{-5}$. Assuming the initial concentration of $H_2C_6H_6O_6$ is 0.100 M, calculate $[H^+]$ assuming only the first dissociation occurs.

b) Now consider the second dissociation equation for which $K_{a2} = 1.6 \times 10^{-12}$. What is the initial concentration of $[HC_6H_6O_6^-]$? What is the initial concentration of $[H^+]$? Calculate the final $[H^+]$ assuming the second dissociation occurs.

PS27.2. Calculate the pH of a 0.100 M H_2S. Calculate the $[S^{2-}]$ in the solution.

PS27.3. Predict the products of the following neutralization reactions.

a) $HCl(aq) + NaOH(aq) \rightarrow$
b) $HNO_3(aq) + Ba(OH)_2(aq) \rightarrow$
c) $NaOH(aq) + H_2CO_3(aq) \rightarrow$
d) $NH_3(aq) + H_2SO_4(aq) \rightarrow$
e) $HC_6H_5O(aq) + NaOH(aq) \rightarrow$
f) $HCN(aq) + KOH(aq) \rightarrow$

PS27.4. Given a solution containing the following ions (neglect the counter-ion for the moment), write a reaction (with water) and indicate whether the ion acts as an acid or as a base.

a) $F^-(aq)$
b) $ClO_2^-(aq)$
c) $NO_2^-(aq)$
d) $NH_4^+(aq)$
e) $CH_3NH_3^+(aq)$
f) $C_2H_5NH_3^+(aq)$

PS27.5. Can you make any generalizations about the acid-base character of the ions in Problem #27.4? If so, state them.

PS27.6. Indicate an acid and a base which could react, in a neutralization reaction, to form each of the following salts. In some cases water will be present as another product.

a) $KC_2H_3O_2$*(aq)*
b) KClO*(aq)*
c) $C_2H_5NH_3NO_3$*(aq)*
d) NH_4Cl*(aq)*
e) KCl*(aq)*
f) $(NH_4)_2SO_4$*(aq)*

PS27.7. If each salt in Problem 27.6 is added to water, indicate whether the resulting solution is acidic, basic or neutral.

PS27.8. Calculate the pH of the following salt solutions (refer to lesson #73 for your set up strategy)

a) 0.355 M KClO (K_a HClO = 2.95×10^{-5})

b) 0.777 M NH_4Cl (K_b NH_3 = 1.77×10^{-5})

c) 0.0345 M KCl

d) 0.411 M $KC_2H_3O_2$ (K_a CH_3COOH = 1.75×10^{-5})

e) 1.00 M $NaHSO_4$

PS27.9. In the series of oxyacids, XOH, OXOH, and O_2XOH, list the acids in order of increasing acid strength. Justify your answer.

PS27.10 Please rank the following in order of increasing basicity: $Mg(OH)_2$, NaOH, CH_3OH, $Al(OH)_3$. Justify your answer.

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