Review #4 – Acids

1. A 0.0150 M solution of a monoprotic acid has a pH of 2.78. Calculate its K_a.

2. A 1.00 g impure sample of $Ca(OH)_2$ was added to a flask together with 25 mL of water. In a titration, 28.65 mL of 0.600 M HCl was required to reach the endpoint. Calculate the % purity of the sample.

3. How many moles of potassium hydrogen sulphide, KHS, must be dissolved in 300 mL of water in order to produce a pH of 10.40?

4. The oxide ion, O^{2-}, is a strong base in aqueous solution. Write the reaction equation showing the oxide ion acting as a base and calculate the pH of a 3.0×10^{-3} M solution of barium oxide, BaO.

5. What is the resulting pH when 75.0 mL of 0.400 M KOH is added to 60.0 mL of 0.240 M H_2SO_4?

6. Grapes grown in B.C. frequently produce wine that is too acidic. A common method of reducing acidity in wine is to add $CaCO_{3(s)}$. Explain why this method works using appropriate equations.

7. A 2.0 M solution of an unknown monoprotic acid has a pH of 1.43. Use the K_a table to identify the acid.

8. HCl gas is bubbled through 2.00 L of an HCl solution. How many moles of HCl gas would have to dissolve to lower the pH from 3.00 to 2.00?

9. A 0.60 M base solution, $NaX_{(aq)}$ is found to have a [OH^-] of 0.12 M. Determine the value of K_b for the base.

10. Discuss, in terms of hydrolysis, the use of sodium acetate, $NaCH_3COO$, to produce the vinegar flavour on some potato chips.

11. Calculate the [H_3O^+] in 0.25 M NH_4NO_3.

Chemistry 12
Review #4

1. $HA + H_2O$ ----> $A^- + H_3O^+$
$K_a = [A^-][H_3O^+] / [HA]$

$[H_3O^+]$ = antilog -2.78 = 1.66×10^{-3} M
$[A^-] = 1.66 \times 10^{-3}$ M
$[HA] = 0.0150$M - 1.66×10^{-3} M = 0.01334

Ka = $(1.66 \times 10^{-3})^2 / (0.0133)$
= 2.1×10^{-4}

2. $Ca(OH)_2$ <-----> $Ca^{2+} + 2OH^-$
$OH^- + H^+$ <-----> H_2O
mols of H^+ = 0.600M x 28.65mL = 17.19 mmols
mols of OH^- =17.19 mmols
mols of $Ca(OH)_2$ = 17.19 mmols OH^- x 1 mol $Ca(OH)_2$/ 2 mol OH^-
= 8.595 mmols
$Ca(OH)_2$ = 4.01 + 2(16.0 + 1.0) = 74.1 g/mol
8.595×10^{-3} mol x 74.1 g/mol = 0.637g
% purity = 0.637g/ 1.00g = 63.7%

3. $HS^- + H_2O$ <----> $H_2S + OH^-$
$K_b = [OH^-][H_2S] / [HS^-]$
= $1.00 \times 10^{-14} / 9.1 \times 10^{-8}$
= 1.10×10^{-7}
$[OH^-]$ = antilog (-3.60) = 2.51×10^{-4}M
Let $[HS^-] = x - 2.51 \times 10^{-4}$
$(2.51 \times 10^{-4})^2 / (x - 2.51 \times 10^{-4}) = 1.10 \times 10^{-7}$
$x - 2.51 \times 10^{-4} = 0.574$
x = 0.574M
mols of HS^- = 0.574M x 0.300L = 0.17 mol

4. $O^{-2} + H_2O$ ---> $2OH^-$
$[O^{-2}] = 3.0 \times 10^{-3}$ M
$[OH^-] = 3.0 \times 10^{-3}$ M x 2 = 6.0×10^{-3}M
pOH = $-(\log 6.0 \times 10^{-3})$ = 2.22
pH = 14 - 2.22 = 11.78

5. mols of OH^- = 0.400M x 75.0mL = 30.0mmol
mols of H^+ = 0.240 x 2 x 60.0mL = 28.8 mmol
OH^- in excess : 30.0 - 28.8 = 1.20 mmol
$[OH^-]$ = 1.2 mmol/ (75.0 + 60.0) = 8.9×10^{-3}M

pOH = 2.05 pH=11.95