Chem 303 Exam 1. March 8, 2006. In-Class Test
Name_____

Useful Information: , FW of potassium hydrogen phthalate = 204.23 g/mol, pH = -log[H_3O^+], $pH = pKa + \log\frac{[base]}{[acid]}$. $K_a \bullet K_b = K_w$, See problem 5 for color indicator information.

(1) (30 pts) Student 1 weighs 0.423 g of dried potassium hydrogen phthalate (KPH, FW = 204.23 g/mol) from the dessicator into a flask. The acid was then dissolved in 50 mL of dilute HCl and a drop of crystal violet solution was added. A NaOH solution is added to a dried buret and the acid is titrated. The initial volume of the buret was 5.04 mL, the final volume was 40.34 mL. After finding the number of moles of KHP

$$\frac{0.432\text{ g}}{204.23\text{ g / mol}} = 0.00212\text{ mol}$$

The concentration of the base is found by

$$\frac{0.00212\text{ mol}}{35.30\text{ mL}} = 6.01\times10^{-5}\text{ M}$$

Student 2 weighs 0.705 g of KHP from the bottle on the shelf into a flask followed by 50 mL of dilute HCl and a drop of thymolpthalein. A buret was washed with the unknown NaOH solution several times before being filled. The initial volume was 19.10 mL and the final volume was 59.90 mL. After finding the number of moles of KHP

$$\frac{0.705\text{ g}}{204.23\text{ g / mol}} = 0.00354\text{ mol}$$

The concentration of the base was found by

$$\frac{0.00354\text{ moles}}{58.90\text{ mL}} = 6.01\times10^{-5}\text{M}$$

(a) List all of the determinant errors in the above procedure.

(b) List 5 instances with indeterminant error in the above procedure and state what the indeterminant error is.

(c) Explain how you could correct two of the determinant errors above.

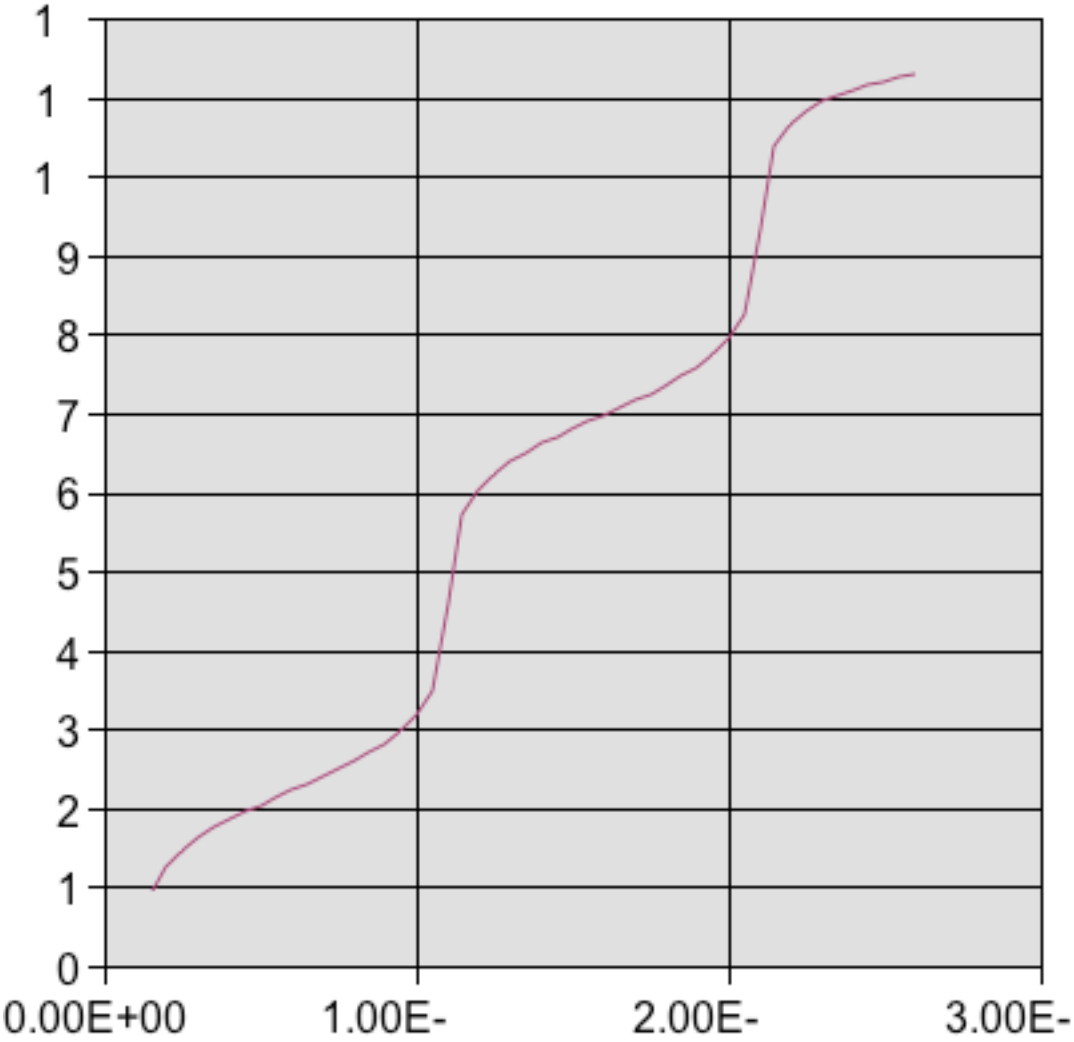
(2)(20 points) Analyses are often reported to the 95% confidence limit. What does that mean? If the two students above averaged their concentrations and found the concentration of their solution as $6.01 \times 10^{-5} \pm 1 \times 10^{-7}$ M at the 95% CL does this mean that there is a 95% chance that their concentration IS 6.01×10^{-5} M(to three sig figs)? In other words, what do theses statistical errors account for?

(3)(20 points) What is the “activity” of an ion in solution? What affects the activity? When can activity be neglected and why?

(4)(a) (15 points) What is buffer capacity? How does buffer capacity limit the useful range of pH's of any specific buffer system?

(b)(15 pts) If 10.0 mL of 0.100 M HCl is added to 90.0 mL of distilled water (pH = 7.00), what is the change in pH? If 10.0 mL of 0.100 M HCl is added to 90.0 mL of a pH = 7.0 buffer (0.0500 M KH_2AsO_4/0.0500 M K_2HAsO_4 K_{a2} for H_3AsO_4 = 1.0 x 10^{-7}), what is the change in pH?

(5)(15 points) A pH monitored titration is shown below)pH on y-axis)



Indicator	pH of Transition
Crystal Violet	0.1-2.0
Congo Red	3.0-5.0
Bromcresol Green	3.8-5.3
Methyl Red	4.8-6.0
Phenol Red	6.4-8.0
Thymolphtalein	8.3-10.5
Alizarin Yellow	10.1-12.0

Given the data above, choose a set of color indicators that will let you determine the two endpoints for the titration. Explain why these are the best indicators and how you would use them.