Unit 12 Sample Test

The test will follow the usual format. There will be 5 multiple choice questions, two required problems, one option, two net-ionic equations to write and one essay.

The following are representative of typical multiple choice questions but do not necessarily indicate topics to be addressed on your actual test.

_____ 1. In the reaction:
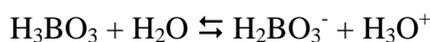
$$H_3BO_3 + H_2O \leftrightarrows H_2BO_3^- + H_3O^+$$

an acid-conjugate base or base-conjugate acid pair is
     a. H_3BO_3, H_2O
     b. H_2O, $H_2BO_3^-$
     c. $H_2BO_3^-$, H_3O^+
     d. H_3O^+, H_2O

_____ 2. The $[H_3O^+]$ of a solution is 2.3×10^{-4} M. The pH of the solution lies between
     a. 1 and 2   b. 2 and 3   c. 3 and 4   d. 4 and 5

_____ 3. Which of the following statements concerning bases is *false*?
     a. strong base solutions feel slippery
     b. bases taste bitter
     c. bases are non-electrolytes
     d. strong bases react with weak acids to give a final pH greater than 7
     e. bases change litmus dye from red to blue

_____ 4. A buffer solution with pH > 7 might result from mixing appropriate concentrations of
     a. $NaCl + NaOH$
     b. $HCl + NaOH$
     c. $NaCH_3COO + CH_3COOH$
     d. $NH_3 + NH_4Cl$

_____ 5. In an acid-base titration
     a. the pH at the endpoint is always 7
     b. the endpoint is reached when equal volumes of acid and base are added
     c. the amount of water used after sample measurement is not critical
     d. the equivalence point is reached when equal moles of acid and base are added

The next section consists of representative problems which might be found in the required section.

6. Formic acid, $HCHO_2$, has a K_a of 1.78×10^{-4}. For a 0.12 M solution of formic acid calculate the *equilibrium* values for: [*be sure to show your check calculation for determining whether the quadratic equation is required in this problem*]

a. $[H_3O^+]$, $[CHO_2^-]$, $[HCHO_2]$ and $[OH^-]$

b. the pH and pOH

c. the % dissociation

7. K_a for the weak acid nitrous acid, HNO_2 is 4.5×10^{-4}.

a. Consider the indicators listed below and select one that would probably be suitable to indicate the endpoint of a titration of HNO_2 with sodium hydroxide. *Briefly* explain your choice.

methyl orange: RED below pH 3.1   YELLOW above pH 4.4
bromcresol purple: YELLOW below pH 5.2   PURPLE above pH 6.8
phenolphthalein: COLORLESS below pH 8.3   PINK between 8.3-10

_____

_____

_____

b. How many grams of solid $NaNO_2$ must be added to 1.0 L of 0.15 M HNO_2 solution in order to produce a buffer solution with a pH of 4.0? (assume that the added solid does not change the volume).

c. The "capacity" of this buffer will be limited. Explain why briefly.

_____

_____

d. To produce a buffer using $NaNO_2$ and HNO_2 that has a better centered "range", what is a more reasonable pH to aim for?

The next section consists of representative problems such as might be found in the "options" section. Each student is expected to select one problem from this section to work on.

8. Red rhubarb stalks (which some people make into pies) derive some of their tart flavor from oxalic acid. Oxalic acid is also used as a wood bleach in furniture refinishing. It is a *diprotic* acid (i.e., it has two hydrogens which can be neutralized). A 0.0211 g sample of the acid was titrated with 31.2 mL of .015 M NaOH. What is the molar mass of oxalic acid?

9. Consider the diagram at the right. It shows the change in pH as 100.0 mL of ?M NH_3 is titrated with 0.10 M HCl. Estimate, by calculation, the concentration of the ammonia.
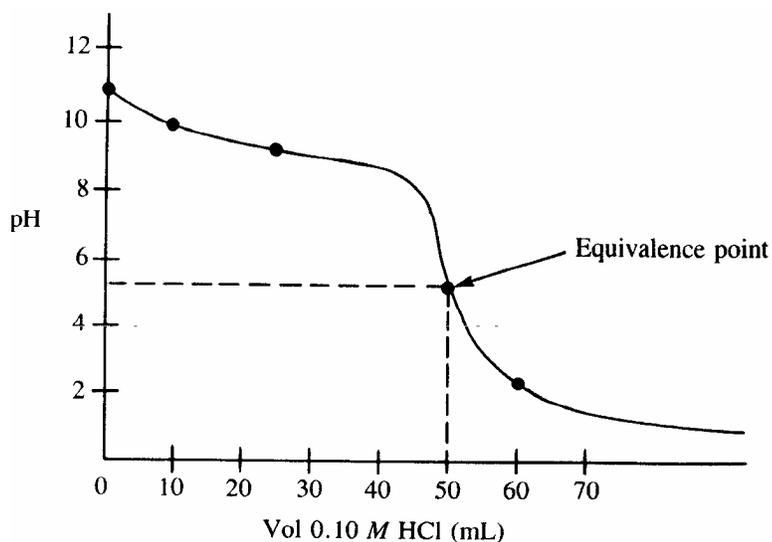
Why is the equivalence point not at pH 7.0?

_____

_____

_____

10. Identify the acids and bases from which the following salts were formed, classify each as strong or weak, and predict the pH of the salt solutions (<7, =7, >7):

a. Na_3PO_4

b. NH_4Br

c. KNO_3

The next section consists of representative reactions to complete and write balanced net-ionic equations for. Note that some reactions do not occur in aqueous solution and thus molecular equations are all that would be needed. In some cases no reaction may occur, based on either solubility rules or the activity series. In those cases, no products are required in the reaction. NR written to the right of the arrow will suffice. Each student is expected to choose two from this section. **Phase symbols ((s), (aq) etc.) are required**.

11. phosphoric acid + calcium nitrate →_____

_____

_____

type:_____

12. potassium sulfide + copper(II) nitrate → _____

_____

_____

type:_____

13. copper + lead(II) nitrate →_____

_____

_____

type:_____

14. bromine gas reacts with sulfur dioxide gas in acidic solution; sulfate ions and bromide ions are among the products

_____

_____

_____

The final section of the test will consist of one essay question selected from the following topics:

— molar mass determination by acid-base titration
— acid-base titration technique
— buffer solutions
— hydrolysis

Answers