Grades		Grader/s
Pre-lab (100 pts)		

PRE-LAB EXERCISE (*E1*)

Name: 肖陆逆 Section: 11

*Please finish the following exercises before conducting the experiment and bring the answers to the lab section (hard copy). These exercises consist of 5 questions and are worth a total of 100 points, counted as **2%** of the course grade. These pre-lab exercises cover contents of Experiment E1. Please study the corresponding lab manual carefully before doing these exercises. Please turn in the hard copy (double-sided printing) either typed or hand-written at the start of your scheduled lab session. No late submission will be accepted.*

Question 1 (20 points)

Briefly explain the underlined words in BACKGROUND section in manual.

classical (Arrhenius): "acid" as a compound that contains hydrogen and reacts with water to form hydrogen ions and a "base" as a compound that produces hydroxide ions in water.

Brønsted-Lowry: an acid is a proton donor; a base is a proton acceptor.

Lewis: a Lewis acid is an electron pair acceptor; a Lewis base is an electron pair donor.

electrolytes: subtance that conducts electricity by the migration of ions.

Question 2 (10 points) acid-base indicator: an indicator changes colour with pH.

If the concentration of H_3O^+ is 1.66×10^{-10} (mol/L) in a solution, determine its pH.

$pH = -\log[H_3O^+] \approx 9.78$

Therefore, its pH is about 9.78

Question 3 (10 points)

Given solutions of the same concentration, which would you expect to have a lower pH, a strong or weak base?

Because they have the same concentration, the $[OH^-]$ of a strong base is larger than the one of a weak base. Therefore, a weak base has a lower pH.

Question 4 (10 points)

In this experiment you will be calculating the concentration of an unknown sample of acetic acid using the pH of the sample and the K_a for acetic acid. Use your textbook to find the K_a for acetic acid. Be sure to record this value in your notebook so you will have it available during the experiment.

$K_a = 1.8 \times 10^{-5}$

Question 5 (50 points)

You will be performing a titration of vinegar (an aqueous solution of acetic acid, CH_3COOH) in this laboratory experiment. To prepare you for this titration, please read the section on acid – base titrations in your textbook and then finish the following questions:

a) Write the balanced **molecular equation** and the **net ionic equation** for the neutralization reaction between aqueous acetic acid and aqueous sodium hydroxide. (20pts)

$$CH_3COOH + NaOH \rightarrow NaCH_3COO + H_2O$$

$$CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$$

b) You place 10.00 mL of CH_3COOH solution of unknown concentration (mol/L) in a flask and add a few drops of indicator. You then titrate the acid with 0.24 M NaOH. If the initial reading on the burette was 0.19 mL and the final reading was 27.39 mL, what is the concentration of the CH_3COOH solution? (15pts)

$$V_{NaOH} = 27.39 - 0.19 = 27.2\ mL = 0.0272\ L$$

$$n_{NaOH} = M_{NaOH} \cdot V_{NaOH} = 0.24\ M \times 0.0272\ L = 6.528 \times 10^{-3}\ mol$$

for $CH_3COOH + NaOH \rightarrow NaCH_3COO + H_2O$

$$n_{CH_3COOH} = n_{NaOH} = 0.01088\ mol$$

$$M_{CH_3COOH} = \frac{n_{CH_3COOH}}{V_{CH_3COOH}} = \frac{6.528 \times 10^{-3}\ mol}{0.01\ L} = 0.6528\ M$$

Therefore, the concentration of the CH_3COOH solution is 0.6528 M.

c) Some solutions (such as vinegar) are commonly reported in terms of percent by mass. Assuming the density of the acetic acid solution you found in question b) is the same as the density of pure water at 25^oC, determine the percent by mass of the vinegar in the sample. (15pts)

$$\rho_{all} = \rho_0 = 1\ g/cm^3$$

$$V_{all} = 10\ mL = 10\ cm^3$$

$$m_{all} = \rho V = 10\ g$$

$$m_{CH_3COOH} = M_{CH_3COOH} \cdot V_{all} \cdot 60 = 0.6528 \times 0.01 \times 60 = 0.3918\ g$$

$$CH_3COOH\ \% = \frac{m_{CH_3COOH}}{m_{all}} = 3.918\ \%$$