South Pasadena • Chemistry

Name_____
Period ___ Date ___/___/___

4 • Classifying Chemicals: Acids & Bases

VINEGAR TITRATION

Introduction:

The label on a bottle of commercial white vinegar will state, by law, the % by mass of acetic acid ($HC_2H_3O_2$). Usually it is 5% (5 grams $HC_2H_3O_2$ per 100 grams vinegar solution). Some brands may be as low as 3%.
The vinegar we are testing is labeled as : _____

Equipment:

50 mL Erlenmeyer flask
Distilled water bottle
Dropper bottle with vinegar & phenolphthalein indicator
Dropper bottle with _____ M NaOH solution

We will roughly test to see whether the label is correct. Perform four trials of a titration (as demonstrated in class). Use the designated amount of Vinegar. Fill in the Data Table below:

DATA

Trial #	Drops of Vinegar	Drops of NaOH(aq)
1	10	
2	10	
3	30	
4	30	

CALCULATIONS

Calculated [Vinegar]

Questions:

1. Calculate the concentration of the vinegar solution in each of the four trials. Fill in the Calculation Table above. Use the equation: $V_a \underline{M}_a = V_b \underline{M}_b$.

2. What is the average of your four trials? [Vinegar] = _____

3. We are using 5% vinegar. This means there should be ____ g $HC_2H_3O_2$ in 100 g of vinegar solution. How many grams of $HC_2H_3O_2$ would be in 1000 g of vinegar solution? _____

4. How many *moles* of $HC_2H_3O_2$ would be in 1000 g of vinegar solution? _____
   Show your line equation (with units):

5. The density of vinegar is 1.08 g/mL. Using density as a conversion factor, calculate the volume of 1000 g of vinegar solution (in Liters). Show work:

   1000 g vinegar x ————— x ————————— =

6. Using answers from 4 & 5, calculate the concentration (M) of a vinegar solution labeled "5% acidity". Show work.

7. According to your data, is this vinegar *at least* 5% acidity? _____
   Suggest two ways this experiment could be carried out more carefully:
   -
   -

Practice Problems:

In an experiment very much like the "Vinegar Titration," a student tests the concentration of another bottle of vinegar. This bottle says that it has been diluted with water to a strength of 4% (by mass).

1) What is the molarity (M) of acetic acid in this new vinegar?
(Show your work.)

2) Using a standardized NaOH solution of 0.650 M, the student does the following dropwise titrations.

Trial #	Drops of Acid	Drops of Base	[Vinegar]
1	50	53	
2	50	55	
3	100	109	
4	100	111	

Determine from this data:
a) the concentration of acid for each trial (show work for Trial 1)

b) the average concentration of the vinegar. _____
Would your evidence suggest that this vinegar is "legal" according to the label? _____

3) Now let's use some 1.00 M HCl and test the concentration of household ammonia (actually NH_4OH).
In each of the following trials, we measure out about 10 mL of HCl and add our "ammonia" until we reach the endpoint.

DATA

Trial #	Volume of HCl (mL)	Volume of NH_4OH (mL)	$[NH_4OH]$
1	10.00	25.72	
2	10.34	28.59	
3	10.58	27.76	

Calculate the concentration of ammonium hydroxide in each of the three trials. (Show your work for trial 1.)