Procedure: Titration of vinegar with standard NaOH (known molarity).

1) Based on the titration result find the moles of \textbf{NaOH} used in each of the trial:
   Don't forget to convert the volume of NaOH which added from the buret to liters!
   \[
   \text{(Used volume of NaOH in Liter)} \times \frac{\text{moles}}{L}
   \]

2) Balance the chemical reaction for the titration:
   \[
   \text{HA} + \text{NaOH} \rightarrow \text{NaA} + \text{H}_2\text{O}
   \]
   Because the relationship of sodium hydroxide and acetic acid (\textbf{HA}) in this reaction is 1 to 1, the moles of acetic acid will be the same as the moles of sodium hydroxide.

3) \text{moles of HA} = \text{moles of NaOH}

4) Now, you have number of moles for the HA, you know the volume of vinegar, calculate the molarity (M) of HA

5) Given the moles of acetic acid and the volumes of the vinegar sample for each trial, calculate the molarities for the each trial.
   Don't forget to convert the volume of vinegar which used in titration into liters.
   \[
   \frac{\text{moles of HA}}{\text{Volume of vinegar (L)}} = M \text{ of vinegar}
   \]

6) Calculate mass of HA per liter:
   \[
   \text{moles} = \frac{\text{mass}}{M.W}
   \]
   \[
   \text{mass} = \text{moles} \times (M.W.)
   \]
   \[
   \frac{\text{mass}}{L} = \frac{\text{moles}}{L} \cdot \frac{M.W}{1}
   \]
   \[
   \frac{\text{mass}}{L} = M \cdot (M.W)
   \]

7) In general the vinegar is mixture of the acetic acid and water, therefore you need the density of vinegar to calculate percent of mass for the HA:

8) If density of vinegar is 1.005 g/mL, calculate mass of one liter vinegar:
   \[
   d = \frac{m}{mL} = 1.005 = \frac{1.005 \text{ g}}{1 \text{ mL}}
   \]
9) The percent by mass of "HA" in vinegar means the following proportionality:

\[
\frac{1005 \text{ g vinegar}}{\alpha \text{ g HA}} = \frac{100}{?}
\]

\[
? = \left( \frac{\text{mass of HA}}{\text{mass of vinegar}} \right) \times 100
\]