

Please see guide below for plan and design. Note that you have to think as to how to make the plan and design relevant to your assigned practical. This guide will not exactly tell you what to write. You will have to use your critical thinking and learning skills.

We would like to also see your shortcomings in your plan and designs so your submission will give us insight into this. We will then discuss ways to improve. Thus assistance would not be provided at this stage.

- 1) **Date and other relevant headings**
- 2) **Problem statement** : Students were given green limes and yellow limes and asked which limes would have the highest level of acidity
- 3) **Hypothesis** : Yellow limes have the highest level of acidity
- 4) **Aim** : (based on procedure used) : To measure the pH level of lime juice obtained from yellow limes and from green limes (*this would be appropriate if the procedure involved the use of a pH meter*) To measure the volumes of standard NaOH solution used in titration between the NaOH and the lime juice from each colour lime (*appropriate if the procedure involved in a titration*)
- 5) **Apparatus and Materials** : list all apparatus and materials that would be used based on the procedure e.g. with the lab using a pH meter would involve pH meter, measuring cylinders, beakers, lime juice from different colour limes.
- 6) **Method** : Instructional manner, logical sequence, feasible
- 7) **Variables** : Controlled – volume of lime juice used, manipulated – types of limes used, pH reading
- 8) **Expected Results** : Lime juice from yellow limes would give the lower pH reading
- 9) **Treatment of Results** (linking expected results to hypothesis) : If lime juice from yellow limes give the lower pH reading, then the lime juice of yellow limes is more acidic and the hypothesis is correct.
- 10) **Chemical Principles (connect methodology to problem statement)** : lime juice contain citric acid which are weak acids and thus contain free hydrogen ions when dissolved in water. A higher level of acidity means a higher concentration of hydrogen ions present in the aqueous solution. pH is related to hydrogen ion concentration via the formula $\text{pH} = -\log [\text{H}^+]$. This means the higher the hydrogen ion concentration, the lower the pH value.
- 11) **Source of errors / Assumptions / Limitations** : Limitations are not always recognizable depending on the type of P & D lab, therefore the markers/moderators are not stringent. Assumption – there are no other substance besides citric acid present affects the acidity of the lime juice. Source of Error – Not rinsing the pH meter thoroughly between testing of lime juice from different colour limes.