**Unit 2 Chemistry SAC task : Critique of an experiment design**

**Title:** Critique of a titration

**Background**

A titration can be performed to determine the concentration of an acid or base solution. The solution in question is titrated against a standard solution. The higher the volume of standard solution required, the higher the concentration of the acid or base you are investigating.

In most chemistry classes, the teacher has thought through the procedure in advance and has selected an appropriate indicator and suitable concentrations for both the acid and the base solutions. For this experiment, the pre-planning has not been done and the results obtained are likely to lack precision. It will be your task to critique the procedure used and to make design changes. You will then test the effectiveness of your changes.

**Part A: Initial titration**

**Materials**

burette

20 mL pipette

100 mL conical flasks

methyl red indicator

commercial vinegar

0.20 M NaOH solution

**Procedure**

Add 20 mL of NaOH to a conical flask

Fill the burette with vinegar

Add 5 drops of methyl red indicator

Conduct a titration

**Equation**  1 mark

Write a balanced equation for the reaction between ethanoic acid and sodium hydroxide.

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**Measurements and calculations** 2 + 3 = 5 marks

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**Observations and commentary** 5 marks

The procedure you followed had some limitations. Can you identify what these ‘limitations’ are?

List any relevant observations you made or issues you think this procedure might have.

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**Precision**

Have each group in the class write the concentration they obtained for the ethanoic acid on the board.

What conclusion can you make about the precision of your class’s results? 2 marks

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**Design changes**

Consider each facet of this titration Changes can be made to improve the titre obtained.

List possible changes.

For each suggested change, explain why you are anticipating a better result. 6 marks

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**Part B: Second titration**

Repeat your titration, incorporating any improvements that are practical.

**Measurements** 2 marks

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**Report** (to be completed under test conditions)

Use your titre results to determine the ethanoic acid concentration for your vinegar sample. 3 marks

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Each group in the class to place their result on the board. Comment on how the precision for the second titration compares to the original. 2 marks

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Indicator choice: Nominate an appropriate indicator to use for this experiment and explain why you have chosen this indicator. 3 marks

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List two other adjustments you made that you think helped your result. Explain why each improves the precision.

 4 marks

Change 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Change 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Rinsing: What should you rinse each of the following with? 3 marks

Burette: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pipette: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Conical flask: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Total: 36 marks**

 **Teacher Guide**

**Title**: Critique of a titration

**Suited to**: Unit 2: Area of Study 2

***Study design references***

Analysis for acids and bases

* volume-volume stoichiometry (solutions only) and application of volumetric analysis, including the use of indicators, calculations related to the preparation of standard solutions, dilution of solutions, and use of acid-base titrations (excluding back titrations) to determine the concentration of an acid or a base in a water sample.

**Scope of task**

This task would ideally be covered over the course of two double periods, one week apart.

Week 1: Conduct the initial titration.

During the week – review the results and have students complete their design changes sheet above.

Week 2 – perform titration 2 and sit report under test conditions.

**Titration 1** **Limitations**:

* Methyl red is not a suitable indicator to use for the titration of a weak acid and strong base. Phenolphthalein is more appropriate. The transition is prolonged and difficult to discern if methyl red is used.



* Vinegar should be diluted. Typical commercial vinegars are 0.85 M. A better result will be obtained if a concentration closer to that of the base is used. The endpoint will occur too quickly.
* Multiple runs. A titration should be repeated until concordant results are obtained.

**Rinsing:**

Burette: vinegar Pipette: NaOH Conical flask: deionised water