



Notice of Assessment Task
Year 12 Chemistry
Depth Study

Date of initial notification: Monday 26 February 2024 Week 5, Term 1	Date of submission of task: Tuesday 26 March 2024 Week 9, Term 1
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Teacher: Mrs Maynard	Task Number: 2
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Time Allowed: 6 Weeks	Weighting of task: 35%
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Course Component/Focus area/topic/module: Module 6: Acid/Base Reactions

<p>Task Description</p> <p>Acids/bases and their reactions are used extensively in everyday life and the human body. In this Depth Study, students will measure the quantity of acid or base present in common household substances using volumetric analysis and produce a scientific report.</p> <p>This task has the following parts:</p> <p>Task A – Research Task (not-assessed formally) Task B – Performing First-Hand Investigations (25 marks) Task C – Writing a Scientific Report (38 marks) Task D – Research Questions (7 marks) TOTAL 70 Marks</p> <p>You will be provided with products such as monoprotic acid (vinegar) and polyprotic citric acid (bottled drink) by your teacher. You will need to compare and analyse their acid concentrations in mol/L, percentage %v/v and %w/v.</p> <p>Your teacher will mark your scientific report based on your research and the first-hand investigations you completed in your 10 hours of allocated class time.</p>

<p>Outcomes/Competencies to be assessed in this task:</p> <p>CH11/12-1 develops and evaluates questions and hypotheses for scientific investigation</p> <p>CH11/12-2 designs and evaluates investigations in order to obtain primary and secondary data and information</p> <p>CH11/12-3 conducts investigations to collect valid and reliable primary and secondary data and information</p> <p>CH11/12-4 selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media</p> <p>CH11/12-5 analyses and evaluates primary and secondary data and information</p> <p>CH11/12-6 solves scientific problems using primary and secondary data, critical thinking skills and scientific processes</p>

CH11/12-7 communicates scientific understanding using suitable language and terminology for a specific audience or purpose

CH12-13 describes, explains and quantitatively analyses acids and bases using contemporary models

Feedback: How will I receive feedback on this task?

Written

Verbal

You could use the following question bank table to help find more information for your research.

Question word	Fill in your keywords (or variations of your keywords) into the blank spaces.	Possible questions for background research.	Is it relevant? Y/N
Why	Why does _____ happen? Why does _____ _____?		
How	How does _____ happen? How does _____ work? How does _____ detect _____?		
Who	Who needs _____? Who discovered _____? Who invented _____?		
What	What causes _____ to increase/decrease? What is the composition of _____?		
When	When was _____ discovered?		

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Where	Where does _____ occur?		
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Task A – Research Task (not assessed formally)

- What is acid-base titration or volumetric analysis?
- Describe the steps involved in preparing a primary standard solution.
- Describe the steps to prepare glassware for use in titration.
- Describe the steps in an acid-base titration, and how to calculate the concentration of an unknown based on data collected in a titration.
- How do you choose the correct indicator for titration?
- Explain why it matters if an acid or base is poly-protic?
- Research the two products provided by your teacher e.g., the vinegar and the bottled drink containing lemon juice.
- Why do solutions in titrations need diluting?
- How do you calculate concentrations using %w/v and %v/v?

You will need to maintain a logbook throughout this task. Before you start your research, read the following instructions about maintaining a logbook.

How to maintain a logbook:

To help your planning and work during the project you will need to keep a logbook. This is a record of what you do each time you work on your project.

Here are some suggestions for your logbook:

- Your logbook must be dated, and you should record how long you work on every entry. Begin your logbook with an outline of what your project is about – information provided by the teacher; what you want to investigate; what activities you think you will carry out; why you have chosen this topic.
- Record the details of all books, magazines, websites, etc., while using them so it is easy to complete a bibliography.

Second-Hand Data Analysis: Evaluating the Sources

Collecting data is useful, but analysing how valuable data is, is becoming increasingly important. Data can be analysed by determining the reliability and validity of the data to make an evaluation.

Reliability

To determine if the information you are gathering is reliable, you must consider or evaluate the following: whether the site or publication is reputable.

- Whether it is current (check the date) and it includes the latest findings.
- Was it written by an expert in the area you are investigating, without bias, and is it in a reputable publication?
- What data was collected and has all relevant data been used?

Validity

To determine if the information you are gathering is valid, you must consider the following:

- Whether the information relates to the problem or hypothesis being investigated.
- If the data/information has been collected in a scientific manner.
- The data provider's purpose - Is there a possibility of bias?

Evaluation

Make a judgement based on criteria.

- Is the information relevant to your specific question?
- Is the information/data applicable to your question?

After researching, you need to use your second-hand information to plan, design and conduct experiments.

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Task B – Conducting Titrations (25 marks)

Before performing the titration, you will need to complete a risk assessment and show it to your teacher for approval. When your teacher has approved the risk assessment, you can perform your titration. This section can be performed in groups.

Task B1 (5 marks)

The first step in acid-base volumetric analysis involves the preparation of a solution of known concentration. This solution is prepared using a primary standard. In this experiment, you will prepare a primary standard solution of $0.0100 \text{ mol L}^{-1}$ concentration using potassium hydrogen phthalate.

Task B2 (8 marks)

The base used in this experiment is sodium hydroxide which reacts with carbon dioxide in the air. Therefore, a sodium hydroxide solution gradually alters in concentration over time. You will measure accurately the concentration of a sodium hydroxide solution which is approximately 0.1 mol/L . This is done by titrating the solution against the prepared primary standard. You need to dilute sodium hydroxide to perform the titrations.

Task B3 (12 marks)

In this experiment, you will measure the concentration of acid in two common household chemicals, vinegar, and citric acid (lemon juice). This is done by titrating each with the standard sodium hydroxide solution prepared in the previous experiment. You need to use diluted vinegar and citric acid to perform the titrations.

Task C – Writing a Scientific Report (38 marks)

After completing the research and practicals you will need to write a scientific report. The aim of the task is to compare and analyse the acid concentrations of the vinegar and lemon drink in mol/L, percentage %v/v and %w/v.

Use the checklist below to guide you in writing a scientific report.

Title <ul style="list-style-type: none">— A single sentence, which is specific (not vague) and related to what the experiment is investigating.
Aim <ul style="list-style-type: none">— A sentence or two specifically stating the purpose of the experiment, which specifically refers to both the independent and dependent variables.— Begins with: To investigate, to find, to compare, determine the effect...
Introduction <ul style="list-style-type: none">— Demonstrates extensive knowledge of the underlying chemistry.— Explanation relates cause and effect; makes the relationships between things evident and provides why and/or how.— All references are appropriately provided in a separate reference list.— All terms in equations are clearly defined, all correctly balanced, and with correct state symbols.
Variables <ul style="list-style-type: none">— Correctly identifies the independent variable as the variable which is changed.— Correctly identifies the dependent variable as the variable which is measured.— Correctly identifies all significant variables held constant as variables that are kept the same.
Hypothesis <ul style="list-style-type: none">— The statement clearly states how the independent variable affects the dependent variable and links to background research.
Risk Assessment <ul style="list-style-type: none">— All relevant risks stated in sufficient detail explaining potential harm and all relevant precautions stated in sufficient detail.
Equipment list <ul style="list-style-type: none">— All equipment stated as referred to in the method.— Equipment includes details of measurement accuracy (e.g +/- 0.05ml) .
Method- <ul style="list-style-type: none">— Is provided in a numbered format— Each sentence starts with a verb— Is concise with easy-to-follow steps— Is complete for all steps performed

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<ul style="list-style-type: none"> — Includes a section for dilution calculations and any other relevant calculations/workings necessary to re-perform the procedure — Is a true reflection of the procedure — Refers to all equipment stated in the materials/equipment list — Includes specific quantitative amounts (volume, mass) — Does not include any personal language
<p>Results Table-</p> <ul style="list-style-type: none"> — Logically formatted with headings containing units. — Include an average column/row with the correct calculation of the average if the experiment was repeated. — Include qualitative observations where appropriate.
<p>Discussion</p> <ul style="list-style-type: none"> — Discussion of results – Succinctly and logically communicates interpretation of results, showing extensive linkage to background research. — Discussion of accuracy. Extensive discussion of relevant equipment and limitations in accuracy. — Discussion of reliability. Extensive discussion of reliability with specific reference to results — Discussion of validity. Succinct and logical discussion of validity with specific reference to experimental method, design, and variables.
<p>Conclusion</p> <ul style="list-style-type: none"> — Uses consistent wording as the hypothesis and states whether the hypothesis was met.
<p>Evaluation</p> <ul style="list-style-type: none"> — Provides extensive evaluation after the investigation. — Improvements in the experiment. Communicates succinctly and logically an understanding of mistakes, accuracy, reliability and validity, and potential improvements to each of these.
<p>Reference</p> <ul style="list-style-type: none"> — Correct references should be included.

Task D - Research Questions (7 marks)

Answer the questions below to improve your understanding of titration:

- Describe the difference between an analyte and a titrant.
- Describe the differences between a standard solution and a primary standard.
- Distinguish between the endpoint and equivalence point in a titration.
- How should you use pH graphs for acid-base titrations to select an appropriate indicator?
- Describe applications of acid-base titration.

Marking Guidelines: Scientific Report

Task B1- Preparing Primary standard

Total marks 5

Section	0	1	2
Validity CH12-3	<i>Errors in experimental procedure/design/execution that limit validity.</i>	<i>Succinct and logical experimental procedure for preparing primary standards.</i>	
Reliability CH12-3	<i>Errors in experimental procedure/design/execution that limit reliability.</i>	<i>Experiment is performed in such a way as to ensure consistent reliability.</i>	
Risk Assessment CH12-3 designs	<i>Limited assessment of risks/hazards given.</i>	<i>Some relevant risks are stated with basic detail explaining potential harm and some relevant precautions are stated with detail.</i>	<i>All relevant risks are stated in sufficient detail explaining potential harm and all relevant precautions are stated in sufficient detail.</i>
Cleaning CH12-3	<i>Glassware is not washed, or not clearly explained.</i>	<i>All glassware is washed using the correct procedure, to obtain a reliable titre value.</i>	

Task B2 -Standardisation of 0.1M NaOH solution

Total marks 8

Section	0	1	2
Validity CH12-3	<i>Errors in experimental procedure/design/execution that limit the validity.</i>	<i>Succinct and logical experimental procedure to standardise NaOH.</i>	
Reliability CH12-3	<i>Errors in experimental procedure/design/execution that limit reliability.</i>	<i>Experiment is performed in such a way as to ensure consistent reliability.</i>	
Indicators CH12-3 designs	<i>Incorrect indicator(s) selected.</i>	<i>An appropriate indicator is used for titrations and a satisfactory explanation of why the indicator was used.</i>	
Dilutions CH12-3 designs	<i>No dilution shown.</i>	<i>Dilution of NaOH is shown without justification.</i>	<i>Dilution of NaOH is shown with justification.</i>
Risk Assessment CH12-3	<i>Limited assessment of risks/hazards given.</i>	<i>Some relevant risks are stated with basic detail explaining potential harm and some relevant precautions stated with detail.</i>	<i>All relevant risks stated in sufficient detail explaining potential harm and all relevant precautions stated in sufficient detail.</i>
Cleaning CH12-3 designs	<i>Glassware is not washed, or not clearly explained.</i>	<i>All glassware is washed using the correct procedure, to obtain a reliable titre value.</i>	

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Task B3 -Analysis of acid concentrations in given samples.

Vinegar and Citric acid

Total marks 12

Section	0	1	2
Validity CH12-3	<i>Errors in experimental procedure/design/execution that limit the validity.</i>	<i>Succinct and logical experimental procedure for analysing vinegar or citric acid.</i>	<i>Succinct and logical experimental procedure for analysing vinegar and citric acid.</i>
Reliability CH12-3	<i>Errors in experimental procedure/design/execution that limit reliability.</i>	<i>Experiment is performed in such a way as to ensure consistent reliability.</i>	<i>Correct table and all correct steps to calculate the concentration.</i>
Indicators CH12-3	<i>Incorrect indicator(s) selected.</i>	<i>Appropriate indicators are used for titrations for one sample and a satisfactory explanation of why the indicator was used.</i>	<i>Appropriate indicators are used for both sample titrations and a satisfactory explanation of why the indicator was used.</i>
Dilutions CH12-3	<i>No dilution was shown.</i>	<i>Dilution of one sample is shown with some justification.</i>	<i>Dilution of both samples are shown with a detailed explanation.</i>
Risk Assessment CH12-3	<i>Limited assessment of risks/hazards given.</i>	<i>Some relevant risks are stated with basic detail explaining potential harm and some relevant precautions are stated with detail.</i>	<i>All relevant risks are stated in sufficient detail explaining potential harm and all relevant precautions are stated in sufficient detail.</i>
Cleaning CH12-3	<i>Glassware is not washed, or not clearly explained.</i>	<i>All glassware is washed using the correct procedure, to obtain a reliable titre value for one sample.</i>	<i>All glassware is washed using the correct procedure, to obtain a reliable titre value for both samples.</i>

Task C Report

Total marks 4

	0	1	2
Aim	<i>Improperly structured aim.</i>	<i>Specific aim giving some detail of the purpose of the experiment.</i>	<i>Specific aim giving a detailed explanation of the purpose of the experiment mentioning the concentration of acetic acid and citric acid.</i>
Hypothesis	<i>No clear statement in the hypothesis.</i>	<i>Develops a statement that states how the independent variable affects the dependent variable.</i>	<i>Develops a statement that states how the independent variable affects the dependent variable and links it to background research.</i>

Task C Report Practical Design

Total marks 4

Section	0	1	2
Variables	<i>No variables are identified.</i>	<i>Some appropriate variables are identified.</i>	<i>All variables are correctly identified and ensures a valid procedure is developed to collect reliable data.</i>
Equipment	<i>Equipment list is not provided.</i>	<i>Basic list of equipment without details.</i>	<i>Extensive list of equipment with details including size and accuracy.</i>

Task C Report Data Collection**Total marks 8**

<i>Section</i>	0	1	2
Task B1 Data Collection	<i>Incorrect table</i>	<i>Shows some understanding of tabulating the data collected.</i>	<i>Correct table with headings and units and averages shown for preparing the primary standard.</i>
Task B2 Data Collection	<i>Incorrect table</i>	<i>Shows some understanding of tabulating the data collected.</i>	<i>Correct table with headings and units and averages shown for standardising NaOH.</i>
Task B Data Collection 3 Acetic Acid	<i>Incorrect table and calculation</i>	<i>Shows some understanding of tabulating the data collected.</i>	<i>Correct table with headings and units and averages shown for analysing the concentration of acetic acid.</i>
Task B Data Collection 3 Citric Acid	<i>Incorrect table and calculation</i>	<i>Shows some understanding of tabulating the data collected.</i>	<i>Correct table with headings and units and averages shown for analysing the concentration of citric acid.</i>

Task C Report Analysis**Total marks 12**

<i>Section</i>	0	1	2
Validity CH12-5	<i>Not mentioned</i>	<i>A simple discussion of the relevance of validity.</i>	<i>Extensively assess the relevance of validity.</i>
Reliability CH12-5	<i>Not mentioned</i>	<i>A simple discussion of the relevance of reliability.</i>	<i>Extensively assess the relevance of reliability.</i>
Accuracy CH12-5	<i>Not mentioned</i>	<i>A simple discussion of relevant equipment and limitations in accuracy.</i>	<i>Extensive discussion of relevant equipment and limitations in accuracy.</i>
Improvements CH12-5	<i>Not mentioned</i>	<i>Communicates mistakes basically in the titration process and how to improve on accuracy, reliability, and validity.</i>	<i>Communicates succinctly and logically an understanding of mistakes in the titration process and how to improve on accuracy, reliability, and validity.</i>
Evaluation CH12-5	<i>No evaluation given</i>	<i>Provides basic evaluation by comparing the acid concentrations in one sample.</i>	<i>Provides extensive evaluation by comparing the acid concentrations in both samples.</i>
Errors	<i>No errors mentioned</i>	<i>Some explanation of any calculation errors.</i>	<i>A satisfactory explanation of any calculation errors showing some workings.</i>

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Task C report Problem Solving
Total marks 10

	0	1	2
Calculation of concentration using molL⁻¹ CH12-6	<i>Incorrect concentration given</i>	<i>Basic calculation to show the concentrations of potassium hydrogen phthalate.</i>	<i>Shows all steps involved in calculating the concentration of potassium hydrogen phthalate with correct units.</i>
Calculation of concentration CH12-6	<i>Incorrect concentration given</i>	<i>Basic calculation to show the concentrations of NaOH.</i>	<i>Shows all steps involved in calculating the exact concentration of NaOH with correct units.</i>
Calculation of concentration molL⁻¹ CH12-6	<i>Incorrect concentration given</i>	<i>Some steps are shown in calculating the concentration of acetic acid or citric acid using mol/L.</i>	<i>Shows all steps involved in calculating the concentration of Acetic acid and citric acid using mol/L.</i>
Concentration %v/v and %w/v acetic acid CH12-6	<i>Incorrect or no acid concentration found</i>	<i>Some steps are shown in calculating the concentrations using %v/v or %w/v for acetic acid.</i>	<i>Shows all steps involved in calculating the concentrations using %v/v and %w/v for acetic acid.</i>
Concentration %v/v and %w/v acetic acid CH12-6	<i>Incorrect or no acid concentration found</i>	<i>Some steps are shown in calculating the concentrations using %v/v or %w/v for citric acid.</i>	<i>Shows all steps involved in calculating the concentrations using %v/v and %w/v for citric acid.</i>

Task D Report Communication
Total marks 7

	0	1	2
Conclusion	<i>Conclusion not included or limited.</i>	<i>Gives a statement that links the hypothesis and/or experimental results.</i>	<i>Clearly gives a statement that links the hypothesis, experimental results, and background research is given.</i>
Presentation	<i>The scientific report is typed, without proper headings /subheadings, and visually not organised to represent the content.</i>	<i>The scientific report is typed, uses headings /subheadings, and visually organised to represent content.- Used the checklist to write the report.</i>	
References	<i>References are given in an inappropriate format.</i>	<i>References are provided with mostly in appropriate format.</i>	<i>All references are appropriately provided in the scientific report using appropriate referencing.</i>
Evaluation of second-hand sources	<i>No evaluation given</i>	<i>Basic evaluation of 2 sources.</i>	<i>Evaluation of 2 sources using reliability and validity of data.</i>

Mapping Grid - Quantitative Analysis

Question	Marks	Syllabus Outcomes	Syllabus Content	Targeted performance bands
TASK A: <i>Questioning and Predicting</i>	0	CH12-13, CH12-1	Quantitative Analysis- develops and evaluates questions and hypotheses for scientific investigation.	3-5
TASK B1: <i>Preparing Primary standard</i>	5	CH12-13, CH12-3	Quantitative Analysis- conducts investigations to collect valid and reliable primary and secondary data and information.	4-6
Task B2: <i>Standardisation of 0.1M NaOH solution</i>	8	CH12-13, CH12-3	Quantitative Analysis- conducts investigations to collect valid and reliable primary and secondary data and information.	3-6
Task B3: Analysis of acid concentrations in given samples	12	CH12-13, CH12-3	Quantitative Analysis - conducts investigations to collect valid and reliable primary and secondary data and information.	3-6
Task C: Report Aim and Hypothesis	4	CH12-2	Quantitative Analysis - designs and evaluates investigations in order to obtain primary and secondary data and information.	3-6
Task C: Report practical design	4	CH12-2	Quantitative Analysis - designs and evaluates investigations in order to obtain primary and secondary data and information	4 - 6
Task C: Report data collection	8	CH12-4	Quantitative Analysis- selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media.	3-6
Task C: Report analysis	12	CH12-5	Quantitative Analysis-analyses and evaluates primary and secondary data and information.	3 - 6
Task C: Report problem solving	10	CH12-6	Quantitative Analysis- solves scientific problems using primary and secondary data, critical thinking skills and scientific processes.	4-6
Task D: Report communication	7	CH12-7	Quantitative Analysis- communicates scientific understanding using suitable language and terminology for a specific audience or purpose.	3-6

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