NAME: .............................................



**Chemistry**

# **CRITERIA: K, IP & EC**

School: **530 Year 12, Term 3 - 2011**

Subject: **040 Instrument 4***–***Extended Experimental Investigation**

Panel: **A44 Equilibrium – Swimming Pool Chemistry**

**Rough Draft Due:** Week 7

**Due Date: Week 9**

**Length:**

* Introduction – approx 600 words
* Discussion/Conclusion – 1000 – 1500 words.

##### **Key Concepts**

S2-Materials can be categorised and represented symbolically and their macroscopic properties can be explained and predicted from understandings about electronic structure and bonding.

R1-Specific criteria can be used to classify chemical reactions

R2- Chemical reactions involve energy changes

R3-The mole concept and stoichiometry enable the determination of quantities in chemical processes

R4-Specialised qualitative and quantitative techniques are used to determine the quantity, composition and type of material

R5-Chemical reactions are influenced by the conditions under which they take place and, being reversible, may reach a state of equilibrium

**Task**

You will be required to **design** and **perform** experiments to test how external factors such as temperature, time, amount of sunlight, stabiliser, pH, etc. can affect the equilibrium and concentration of chlorine (or another disinfectant) in swimming pool water. You must write a scientific report explaining your findings and make recommendations based on what you find out.

You may like to choose how one of these factors affects;

* The concentration of hypochlorite as dependent on UV exposure and pH
* The concentration of hypochlorite as dependent on UV exposure and temperature
* The concentration of hypochlorite as dependent on UV exposure and chlorine stabiliser
* The concentration of hypochlorite as dependent on pH and stabiliser
* Other combinations of variables
* Or any other experiment that involves the chorine stability and equilibrium in swimming pool water.

You will work ***individually*** or ***in pairs*** to conduct your experiments. Your report must be written individually.

**Phases of the Experimental Investigation**

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| --- | --- | --- | --- |
| Phase | Description | Due Date | Signature |
| 1. Research | 1. Ongoing Phase  * Evidence of research related to topic * Formulation of justified question/hypothesis * Explore chemistry of equilibrium in a pool * Kept in log book  1. Bibliography | ongoing |  |
| 1. Planning | 1. Clarify:  * The chemical principles * Measurement techniques  1. Plan your approach 2. Decide what initial trials you will undertake, how many trials etc. Consider the isolation and selection of variables and chosen values 3. Complete a **Research Proposal** sheet for your teacher to review and give approval. 4. Complete the **Risk Assessment** sheet for your teacher to review and give approval. 5. Locate/design/book any equipment necessary. | Week 5 |  |
| 1. Experimentation | 1. Experimenting / Performing 2. Data Collection and measurements, observations 3. Problems / solutions / modifications & justifications | Week 6 |  |
| 1. (a) Draft Report | 1. Analysis of data and final conclusions MUST be evident at this stage. It must not contain plagiarised material – this also includes copying large sections of the report from other members in your group. | Week 7 |  |
| 1. (b) Final Report | 1. Follows set headings | Week 9 |  |

##### **Getting Started**

Your initial research should be focussed on chlorine equilibrium chemistry, stabilisers, pH effects, UV effects, temperature effects, measuring techniques and procedures, Le Chatelier’s principle.

These should be explained in enough detail in your introduction so the reader has sufficient background information to understand why you performed the specific technique that you chose.

Conduct research on your chosen topic to determine a suitable experimental technique and to find a general idea of the results you expect.

Write out your experimental technique, an appropriate risk assessment and give to your teacher before starting any experimentation.

**Lab Work**

Conduct all experimental procedures listed above. Repeat the experiments a number of times to ensure that your collected data is valid.

You will have approximately **one week of class time** to conduct these experiments. Additional after school time will be available by appointment.

##### **Logbooks**

##### Throughout the task you should keep a logbook to write rough notes on each part of your experiment.

You will need to submit your logbook, and your draft report along with your final report. The logbook, and

draft\* will not be assessed but are your way of providing evidence that *you engaged in the research process* and

that the report is *your own work*.

\* In the event that your final report is not submitted on time, your draft report will be assessed.

# **Writing the Report**

The report should be structured as shown below. It is to be written in passive voice, past tense.

(Refer to the document “*How to Write a Deadly EEI*” for more specific, detailed instructions)

**Title page**

Subject, assessment task type, title, your name, date, teacher’s name.

**Abstract**

A paragraph, that if read by itself, summarises the project in the least possible words (usually 50 – 200). It should include the aim, principles/techniques employed and a very brief statement of your results and conclusions.

**Introduction:**

Research Question and Aim you have posed and the Hypothesis to be tested.

The Research Question should obviously be in the form of a question, eg “What factors influence the flight of an arrow? How is the corrosion of a shipwreck influenced by …?

The Aim should be in the form of an explicit statement relating to your variables, eg: “To investigate the effect of (manipulated variable) on (dependent variable) when (controlled variables) are kept constant.

**Hypothesis and Justification of hypothesis.** The Hypothesis is your predicted outcome of the investigation. It should be in the form: “The relationship between (manipulated variable) and the (dependent variable) is … (appropriate mathematical proportionality stated)”.

You will need to justify your hypothesis by referring to relevant scientific (chemistry) principles from your library research. You will need to reference your sources.

**Theory review:** This will be used to tell a story that generates interest in the reader for the field of your research and link to the practical investigation to follow. It will draw on your library research and will be referenced.

Orientation of the reader to the overall design, and the reasons for performing particular steps in the method.

**Method.**

What you did. Diagrams, photos as necessary.

A description of what was done in the final practical tasks; this includes how raw data is to be treated ie. what formulae are applied. You should do this in the traditional form (a replicable, stepwise description in passive voice, past tense. This applies to all other parts of the report such as discussion and conclusion as well). ‘Replicable’ means that someone else could repeat the experiment by following your method.

**Results.**

The collected results should be displayed in forms that are appropriate to your data; eg tables, graphs, photos. Calculations such as averages, substitution into equations, gradients, intercepts - and so on - may be shown as necessary. You should show examples of calculations (eg rate of change, solutions concentrations etc) but not all calculations need be shown. All tables, graphs pictures etc should be numbered and given a comprehensive title.

**Analysis, Discussion and Interpretation of Data.**

You will need to show *evidence of critical thinking* in interpreting your data in relation to your hypothesis and theory presented in your introduction. This is an opportunity to identify any trends or patterns in your data, examine any mathematical relationships in your data, to critically discuss various aspects of the experiment, such as: what generalisations can be made to support or refute your hypothesis, how the results relate to the theory, the limitations of the result, the method used and possible improvements, which measured quantities limited the accuracy of the result, further related investigations that this experiment could lead to (and why). (NB. Discussions must relate the experimental issues to chemistry theory.)

**Conclusion.**

You should state very briefly the essential conclusion or conclusions you have drawn from the experiment. It should satisfy the statement set out in the Aim at the beginning and must clearly address the stated hypothesis. Be sure to include any conditions that apply to your result (eg ‘at constant temperature’). It is important not to overstate what you can rightly claim as a result of the experiment. Statements like ‘the results supported…’ are more justifiable than ‘the results proved…’. You should not introduce any new material in this section.

**Bibliography.**

Guidelines for a bibliography and referencing can be found in the school diary.

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| **Phase Two: EEI Initial Proposal. Name:** |
| Researchable question and proposed hypothesis:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Identified chemical concepts involved:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Overview of the project (What do you intend to do and how will this be achieved?)  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Equipment Required:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Timeline:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

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| Criteria | Focus | **A** | **B** | **C** | **D** | **E** |
| Reproduction and interpretation of complex and challenging concepts, theories and principles  (K.C.U.) | Introduction | The student has been able to clearly and concisely explain scientific definitions and complex chemical principles relating to chemical equilibrium and analysis techniques. | The student has been able to explain scientific definitions and chemical principles relating to chemical equilibrium and analysis techniques. | The student has been able to describe scientific definitions and chemical principles relating to chemical equilibrium and analysis techniques. | The student has been able to state scientific definitions and/ or chemical principles relating to chemical equilibrium and analysis techniques. | The student has been able to state simple definitions or chemical principles relating to chemical equilibrium and analysis techniques. |
| Application of algorithms to find solutions in complex and challenging situations.  (K.C.U.) | Analysis | The student has been able to correctly select and apply algorithms for the calculations of molarity, percent solutions, dilutions, pH and others where required. | The student has been able to select and apply algorithms for the calculations of molarity, percent solutions, dilutions, pH and others where required, with minor errors. | The student has been able to select and apply algorithms for some calculations. | The student has been able to perform simple calculations by selecting and applying algorithms. | The student has been able to perform simple calculations by applying algorithms that were given. |
| Formulation of justified hypothesis for the design and management of investigations  (I.P.) | Aim  Hypothesis  Materials  Method | Student has proposed a realistic hypothesis to investigate. The student has designed and modified if necessary, valid experiments for the efficient testing of the hypothesis. | Student has proposed a suitable hypothesis to investigate. The student has designed experiments to test the hypothesis. | Student has written a hypothesis that could be tested by the experiments. However errors were evident in some of the experimental designs. | Student attempted to design experiments. However they did not adequately relate to the hypothesis. | Student failed to design experiments or write a hypothesis that could be tested. |
| Appropriate assessment of risk, safe selection and adaptation of equipment. Application of technology to gather, record and process data.  (I.P.) | Risk assessment  Performing task  Results  Tables  Logbook | Risk assessment is completed and suitable for each experiment, highlighting all important hazards. Independent use of scientific equipment is well-selected, highly skilled and safe in all circumstances.  Data is recorded clearly and logically using appropriate format. Logbook is used effectively throughout expt. | Risk assessment is completed and suitable for each experiment. Independent use of scientific equipment is highly skilled and safe in all circumstances.  Data is recorded in a well-structured format. Logbook is used throughout experiment. | Risk assessment is completed for each experiment. Independent use of scientific equipment is satisfactorily demonstrated and safe in all circumstances.  Data is recorded in an appropriate format. Logbook has been used to record expt. results | Risk assessment has been attempted for each experiment. Minimal independent use of scientific equipment is demonstrated, but safe in most circumstances.  A suitable attempt is made to present data.  Logbook is used to record basic information | Risk assessment has not been completed. Independent use of scientific equipment is not demonstrated, but safe in most circumstances.  Data is not recorded appropriately.  Logbook has not been used or not submitted. |
| Systematic analysis of primary data to identify patterns, trends, errors and anomalies  (I.P.) | Results  Discussion | Analysis is thorough, logical and precise with well thought out identification of relationships between observations, calculations and chemical concepts.  Errors have been clearly accounted for throughout the report. | Analysis is thorough and precise. Relationships between observations, calculations and chemical concepts are identified. Most errors have been accounted for throughout the report. | Analysis shows an understanding of the relationships between calculations and chemical concepts.  Errors in some experiments have been accounted for. | Analysis shows little understanding of the relationships between calculations and chemical concepts.  Errors in some experiments have been listed. | Analysis does not relate the calculations to the purpose of the task.  Little attempt has been made to account for experimental errors. |
| Analysis and evaluation of complex scientific interrelationships  (E.C.) | Discussion  Conclusion | Extensively evaluates the importance of the titration making clear links between the factor tested and the use of this knowledge in society. | Evaluates the importance of the titration making links between the factor tested and the use of this knowledge in society. | Demonstrates some understanding of how the factor tested could be of use in society. | Recalls a basic knowledge of how the factor tested could be of use in society. | Makes no reference as to how the factor tested could be of use in society. |
| Exploration of scenarios and possible outcomes with justification of conclusions and recommendations  (E.C.) | Discussion  Conclusion | Errors, anomalies or limitations in the experimental data or procedure have been recognised and fully explained, with detailed proposals made to overcome these.  Student has fully justified their recommendations to society for maintaining swimming pool disinfection and chemical safety. Ideas for future experimental investigations have been justified | Errors, anomalies or limitations in the experimental data or procedure have been recognised, with some explanation. Proposals made to overcome these.  Student has explained their recommendations to society for maintaining swimming pool disinfection and chemical safety. Ideas for future experimental investigations have been explained | Some errors, anomalies or limitations in the experimental data or procedure have been recognised. Simple solutions to these are proposed.  Student has described their recommendations to society for maintaining swimming pool disinfection and chemical safety. Ideas for future experiments have been described but not explained. | Some errors, anomalies or limitations in the experimental data or procedure have been recognised.  Student has identified a method to maintain swimming pool disinfection and chemical safety, or a satisfactory possible future investigation. | Errors, anomalies or limitations in the experimental data or procedure have not been recognised.  Student has stated how the levels of chlorine (or other disinfectant) changed or a possible future investigation. |
| Discriminating selection and presentation of scientific data and ideas to make meaning accessible to the intended audience  (E.C.) | Abstract  Presentation | Student has fully understood the concepts of the investigation and has been able to translate this into a concise well-written abstract.  All spelling and grammar throughout the report is correct. All information is suitably referenced. Correct experimental report format is used throughout. | Student has understood the concepts of the investigation and has been able to make this clear in the abstract.  Spelling and grammar throughout the article is of a high standard. Most information is suitably referenced. Experimental report format contains minor errors. | Student has a basic understanding of the investigation which has been presented in the abstract.  Spelling and grammar throughout the article is of a good standard. Most information is referenced. Experimental report format is of a satisfactory standard. | Student has failed to understand the concepts of the investigation and has not successfully described this in the abstract.  Spelling and grammar throughout the article is of a satisfactory standard. Some information is referenced.  Experimental report format contains many errors throughout the task. | Student has made little or no attempt to write an abstract.  Little care has been taken in the article to ensure correct spelling, grammar and referencing.  Experimental report format has not been followed. |