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| Student Name |  | Student Number |  |
| Handout Date | 24/07/2023 |
| Teacher Name | Mr Gillis, Mr Turner | Draft Date | 11/08/2023 |
| Due Date | 25/08/2023 |

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| Instrument Number | 3 | Term 3 | 2023 |
| Technique | Student experiment  | Weighting | 20 |
| Unit | Unit 1 : Chemical fundamentals – structure, properties and reactionsUnit 2 : Molecular interactions and reactions |
| Topic | Unit 1 Topic 2: Properties and structure of materials Unit 1 Topic 3: Mole concept and conservation of mass, Exothermic and Endothermic ReactionsUnit 2 Topic 1: Intermolecular forces and gases Unit 2 Topic 2: Aqueous solutions and acidityUnit 2 Topic 3: Reaction Rates |
| Conditions |
| Duration | 10 hours class time | Length | 1500 to 2000 words |
| Mode | Written response — scientific report | Individual/Group | Group work with individual report |
| Resources Available | School science laboratory and library (online: internet and school intranet, databases, journals) |
| Assessment Objective | Marks |
| Research and PlanningAssessment objectives 2,5 | /6 |
| **Analysis of evidence** Assessment objectives 2, 3, 5 | /6 |
| **Interpretation and evaluation** Assessment objectives 4, 6  | /6 |
| CommunicationAssessment objective 7 | /2 |
| **Total** | **/20** |

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| **Acknowledgement of assessment responsibility** |
| I understand the consequences of plagiarism/cheating and confirm this is my own work.**Student Signature:**  | **Date:**  |

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| Context |
| You have completed the following practicals in class: * Mandatory practical : Determine the empirical formula of magnesium oxide.

 Conducted a calorimetry experiment to measure the enthalpy of a reaction Investigated the properties of strong and weak acids Investigated the rate of a chemical reaction  |
| Task |
| Modify (i.e. refine, extend or redirect) an experiment in order to address your own related hypothesis or question. You may use a practical performed in class, a related simulation, suggested research or another practical related to Unit 1 Topic 2,3 or Unit 2 Topics 1,2 (as negotiated with your teacher) as the basis for your methodology and research question. |
| To complete this task, you must: |
| * identify an experiment to modify\*
* develop a research question to be investigated\*
* research relevant background scientific information to inform the modification of the research question and methodology
* conduct a risk assessment and account for risks in the methodology\*
* conduct the experiment\*
* collect sufficient and relevant qualitative and/or quantitative data to address the research question\*
* process and present the data appropriately
* analyse the evidence to identify trends, patterns or relationships
* analyse the evidence to identify uncertainty and limitations
* interpret the evidence to draw conclusion/s to the research question
* evaluate the reliability and validity of the experimental process
* suggest possible improvements and extensions to the experiment
* communicate findings in an appropriate scientific genre, i.e. scientific report.

\* The steps indicated with an asterisk above will be completed in groups. All other elements must be completed individually |

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| Checkpoints |
| ☐ Term 3 Week 3: Select experiment and identify proposed modifications. Prepare Risk Assess.(allow at least two working days for preparation of equipment/chemicals to occur) |
| ☐ Term 3 Week 3/4: Perform experiment and process data. |
| ☐ Term 3 Week 5: Analyse and evaluate evidence. |
| ☐ Term 3 Week 5: Submit draft. |
| ☐ Term 3 Week 7: Submit final response. |

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| Authentication Strategies |

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| * Your teacher will collect and annotate 1 draft.
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| * You will submit your response using Turnitin (plagiarism-detection software)
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| * You must acknowledge all sources.
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| * You will be provided class time for task completion.
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| * Your teacher will ensure class cross-marking occurs.
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| * Your teacher will compare the responses of students who have worked together in groups.
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| Scaffolding |
| The response must be presented using an appropriate scientific genre (i.e. scientific report) and contain: * a research question
* a rationale for the experiment
* reference to the initial experiment and identification and justification of modifications to the methodology
* raw and processed qualitative and/or quantitative data
* analysis of the evidence
* conclusion/s based on the interpretation of the evidence
* an evaluation of the methodology and suggestions of improvements and extensions to the experiment
* a reference list.

**An example of how one of the practicals could be modified to develop a research question** **Practical that will be modified:** Investigate the effect of temperature on solubility. **Research question:** What effect does pH have on the solubility (and mass of precipitate formed) of calcium carbonate in aqueous solutions? **Developing the research question:**

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| **Description**  | **Example**  |
| Identify the independent variable to be investigated  | pH of calcium carbonate solution  |
| Identify the dependent variable  | mass of precipitate formed  |
| Identify the methodology to be used  | precipitation reactions to form insoluble salt at pH 7  |
| Draft research questions  | What effect does pH have on solubility?  |
| Refine and focus the research question  | * What substances are being investigated for their solubility? (Salts which are sparingly soluble or insoluble in water at pH 7)
* How will solubility be measured? (Mass of precipitate formed)
 |
| Present research question to teacher for approval  | What effect does pH have on the solubility (and mass of precipitate formed) of calcium carbonate in aqueous solutions?  |

**Note:** You cannot use this sample research question for your experiment. |

#### Instrument-specific marking guide – Student Experiment

##### Criterion: Research and planning

##### Assessment objectives

2. apply understanding of TOPIC to modify experimental methodologies and process primary data

5. investigate phenomena associated with TOPIC through an experiment

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| **The student work has the following characteristics:** | **Marks** | **Definitions** |
| * informed application of understanding of TOPIC dynamics to modify experimental methodologies demonstrated by
	+ a considered rationale for the experiment
	+ justified modifications to the methodology
* effective and efficient investigation of phenomena associated with TOPIC demonstrated by
	+ a specific and relevant research question
	+ a methodology that enables the collection of sufficient, relevant data
	+ considered management of risks and ethical or environmental issues.
 | 5–6 | **informed** – knowledgeable; learned; having relevant knowledge; being conversant with the topic; based on an understanding of the facts of the situation (of a decision or judgement)**modify** – change the form or qualities of; make partial or minor changes to something**considered** – formed after careful and deliberate thought**justified** – sound reasons or evidence are provided to support an argument, statement or conclusion**effective** – successful in producing the intended, desired or expected result; meeting the assigned purpose**efficient** – working in a well-organised and competent way; maximum productivity with minimal expenditure of effort; acting or producing effectively with a minimum of waste, expense or unnecessary effort**specific** – clearly defined or identified; precise and clear in making statements or issuing instructions; having a special application or reference; explicit, or definite**relevant** – bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on**sufficient** – enough or adequate for the purpose |
| * adequate application of understanding of TOPIC to modify experimental methodologies demonstrated by
	+ a reasonable rationale for the experiment feasible modifications to the methodology
* effective investigation of phenomena associated with TOPIC demonstrated by
	+ a relevant research question
	+ a methodology that enables the collection of relevant data
	+ management of risks and ethical or environmental issues.
 | 3–4 | **adequate** – satisfactory or acceptable in quality or quantity equal to the requirement or occasion**reasonable** – endowed with reason; having sound judgment; fair and sensible; based on good sense; average; appropriate, moderate**feasible** – capable of being achieved, accomplished or put into effect; reasonable enough to be believed or accepted; probable; likely**effective** – successful in producing the intended, desired or expected result; meeting the assigned purpose**relevant** – bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on |
| * rudimentary application of understanding of TOPIC to modify experimental methodologies demonstrated by
	+ a vague or irrelevant rationale for the experiment
	+ inappropriate modifications to the methodology
	+ ineffective investigation of phenomena associated with TOPIC demonstrated by an inappropriate research question
	+ a methodology that causes the collection of insufficient and irrelevant data inadequate management of risks and ethical or environmental issues.
 | 1–2 | **rudimentary** – relating to rudiments or first principles; elementary; undeveloped: involving or limited to basic principles; relating to an immature, undeveloped or basic form**vague** * not definite in statement or meaning; not explicit or precise; not definitely fixed, determined or known; not clear in thought or understanding;
* couched in general or indefinite terms; not definitely or precisely expressed; deficient in details or particulars’
* thinking or communication in an unfocused or imprecise way

**inappropriate** – not suitable or proper in the circumstances**ineffective** – not producing a result, or not producing any significant result; not producing the intended, desired or expected result**irrelevant** – not relevant; not applicable or pertinent; not connected with or relevant to something**inadequate** – not satisfactory or acceptable in quality and/or quantity to the requirements of the situation |
| * does not satisfy any of the descriptors above.
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##### Criterion: Analysis of evidence

##### Assessment objectives

apply understanding of TOPIC to modify experimental methodologies and process primary data

1. analyse experimental evidence about TOPIC

5. investigate phenomena associated with TOPIC through an experiment

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| **The student work has the following characteristics:** | **Marks** | **Definitions** |
| * appropriate application of algorithms, visual and graphical representations of data about TOPIC demonstrated by correct and relevant processing of data
* systematic and effective analysis of experimental evidence about TOPIC demonstrated by
	+ thorough identification of relevant trends, patterns or relationships
	+ thorough and appropriate identification of the uncertainty and limitations of evidence
* effective and efficient investigation of phenomena associated with TOPIC demonstrated by the collection of sufficient and relevant raw data.
 | 5–6 | **appropriate** – acceptable; suitable or fitting for a particular purpose, circumstance, context etc. **systematic*** done or acting according to a fixed plan or system; methodical; organised and logical;
* having, showing, or involving a system, method, or plan;
* characterised by system or method; methodical; arranged in, or comprising an ordered system

**effective** – successful in producing the intended, desired or expected result; meeting the assigned purpose**thorough*** carried out through, or applied to the whole of something, carried out completely and carefully; including all that is required.

complete with attention to every detail: not superficial or partial; performed or written with care and completeness; taking pains to do something carefully and completely.**efficient** – working in a well-organised and competent way; maximum productivity with minimal expenditure of effort; acting or producing effectively with a minimum of waste, expense or unnecessary effort |
| * adequate application of algorithms, visual and graphical representations of data about TOPIC demonstrated by basic processing of data
* effective analysis of experimental evidence about TOPIC demonstrated by
	+ identification of obvious trends, patterns or relationships
	+ basic identification of uncertainty and limitations of evidence
* effective investigation of phenomena associated with TOPIC demonstrated by the collection of relevant raw data.
 | 3–4 | **adequate** – satisfactory or acceptable in quality or quantity equal to the requirement or occasion**basic** – fundamental**effective** – successful in producing the intended, desired or expected result; meeting the assigned purpose**obvious** – clearly perceptible or evident; easily seen, recognised or understood |
| * rudimentary application of algorithms, visual and graphical representations of data about TOPIC demonstrated by incorrect or irrelevant processing of data
* ineffective analysis of experimental evidence about TOPIC demonstrated by
	+ identification of incorrect or irrelevant trends, patterns or relationships
	+ incorrect or insufficient identification of uncertainty and limitations of evidence
* ineffective investigation of phenomena associated with TOPIC demonstrated by the collection of insufficient and irrelevant raw data.
 | 1–2 | **rudimentary** – relating to rudiments or first principles; elementary; undeveloped: involving or limited to basic principles; relating to an immature, undeveloped or basic form**incorrect** – not conforming to fact or truth**irrelevant** – not relevant; not applicable or pertinent; not connected with or relevant to something**ineffective** – not producing a result, or not producing any significant result; not producing the intended, desired or expected result**insufficient** – not enough; inadequate for the purpose |
| * does not satisfy any of the descriptors above.
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##### Criterion: Interpretation and evaluation

Assessment objectives

4. interpret experimental evidence about TOPIC

1. evaluate experimental processes and conclusions about TOPIC

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| **The student work has the following characteristics:** | **Marks** | **Definitions** |
| * insightful interpretation of experimental evidence about TOPIC demonstrated by justified conclusion/s linked to the research question
* critical evaluation of experimental processes about TOPIC demonstrated by
	+ justified discussion of the reliability and validity of the experimental process
	+ suggested improvements and extensions to the experiment that are logically derived from the analysis of evidence.
 | 5–6 | **insightful** – showing understanding of a situation or process; understanding relationships in complex situations; informed by observation and deduction**justified** – sound reasons or evidence are provided to support an argument, statement or conclusion**link** – anything serving to connect one part or thing with another**critical** – involving skillful judgment as to trust, merit, etc.; involving the objective analysis and evaluation of an issue in order to form a judgment; expressing or involving an analysis of the merits and faults of a work of literature, music, or art; incorporating a detailed and scholarly analysis and commentary (of a text); rationally appraising for logical consistency and merit**justified** – sound reasons or evidence are provided to support an argument, statement or conclusion**logically** – according to the rules of logic or formal argument; in a way that shows clear, sound reasoning; in a way that is expected or sensible |
| * adequate interpretation of experimental evidence about TOPIC demonstrated by reasonable conclusion/s relevant to the research question
* basic evaluation of experimental processes about TOPIC demonstrated by
	+ reasonable description of the reliability and validity of the experimental process
	+ suggested improvements and extensions to the experiment that are related to the analysis of evidence.
 | 3–4 | **adequate** – satisfactory or acceptable in quality or quantity equal to the requirement or occasion**reasonable** – endowed with reason; having sound judgment; fair and sensible; based on good sense; average; appropriate, moderate**relevant** – bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on**basic** – fundamental |
| * invalid interpretation of experimental evidence about TOPIC demonstrated by inappropriate or irrelevant conclusion/s
* superficial evaluation of experimental processes about TOPIC demonstrated by
	+ cursory or simplistic statements about the reliability and validity of the experimental process
	+ ineffective or irrelevant suggestions.
 | 1–2 | **invalid** – not sound, just or well-founded; not having a sound basis in logic or fact (of an argument or point); not reasonable or cogent; not able to be supported; not legitimate or defensible; not applicable**inappropriate** – not suitable or proper in the circumstances**superficial** * concerned with or comprehending only what is on the surface or obvious; shallow; not profound, thorough, deep or complete;
* existing or occurring at or on the surface; cursory; lacing depth of character or understanding; apparent and sometimes trivial

**cursory** – hasty, and therefore not thorough or detailed; performed with little attention to detail; going rapidly over something, without noticing details; hasty; superficial**simplistic** – characterised by extreme simplification, especially if misleading; oversimplified**ineffective** – not producing a result, or not producing any significant result; not producing the intended, desired or expected result |
| * does not satisfy any of the descriptors above.
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##### Criterion: Communication

Assessment objective

1. communicate understandings and experimental findings, arguments and conclusions about TOPIC

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| **The student work has the following characteristics:** | **Marks** | **Definitions** |
| * effective communication of understandings and experimental findings, arguments and conclusions about TOPIC demonstrated by
	+ fluent and concise use of scientific language and representations
	+ appropriate use of genre conventions
	+ acknowledgment of sources of information through appropriate use of referencing conventions.
 | 2 | **effective** – successful in producing the intended, desired or expected result; meeting the assigned purpose**fluent** – spoken or written with ease; able to speak or write smoothly, easily or readily; articulate; eloquent; in artistic performance, characteristic of a highly developed and excellently controlled technique; flowing; polished; flowing smoothly, easily and effortlessly**appropriate** – acceptable; suitable or fitting for a particular purpose, circumstance, context etc. |
| * adequate communication of understandings and experimental findings, arguments and conclusions about TOPIC demonstrated by
	+ competent use of scientific language and representations
	+ use of basic genre conventions
	+ use of basic referencing conventions.
 | 1 | **adequate** – satisfactory or acceptable in quality or quantity equal to the requirement or occasion**competent** – * having suitable or sufficient skills, knowledge, experience, etc. for some purpose; adequate but not exceptional; capable; suitable or sufficient for the purpose
* having the necessary ability, knowledge or skill to do something successfully; efficient and capable (of a person); acceptable and satisfactory, though not outstanding

**basic** – fundamental |
| * does not satisfy any of the descriptors above.
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