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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 reactions  Unit 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 Reactions  Unit 2 Topic 1: Intermolecular forces and gases  Unit 2 Topic 2: Aqueous solutions and acidity  Unit 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 Planning  Assessment objectives 2,5 | | | | | /6 |
| **Analysis of evidence**  Assessment objectives 2, 3, 5 | | | | | /6 |
| **Interpretation and evaluation**  Assessment objectives 4, 6 | | | | | /6 |
| Communication  Assessment 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. |
| * You will submit your response using Turnitin (plagiarism-detection software) |
| * You must acknowledge all sources. |
| * You will be provided class time for task completion. |
| * Your teacher will ensure class cross-marking occurs. |
| * Your teacher will compare the responses of students who have worked together in groups. |
| 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:**   |  |  | | --- | --- | | **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. | 0 |  |

##### 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. | 0 |  |

##### 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. | 0 |  |

##### 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. | 0 |  |