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| Assessment Cover Sheet – Year 11  Instrument Number 2 | | | Term 2 | | 2023 |
| Student Name: | | Handout Date: | | 28/04/2023 | |
| Teacher Name: | | Draft Date: | | 12/05/2023 | |
| Student Number: |  | Due Date: | | 23/05/2023 | |

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| Subject | Chemistry | | | | |
| Technique | Research investigation | | **Weighting** | | 20 |
| Unit | Unit 1: Chemical fundamentals — structure, properties and reactions | | | | |
| Topic | Unit 1 Topic 2: Properties and Structure of Materials  Unit 1 Topic 3: Chemical reactions — reactants, products and energy change | | | | |
| Conditions | | | | | |
| Duration | 10 hours class time | | | | |
| Mode | Written response — scientific essay | Length | | 1500–2000 words | |
| Individual/  group | Individual | Other | | - | |
| Resources available | School library (online: internet and school intranet, databases, journals) | | | | |
| Context | | | | | |
| Investigate one of the following claims:   * Nanomaterials are the future of chemistry * Radioactive material is harmful to humans * Biofuels are more efficient and have less environmental impact than fossil fuels. * Using fossil fuels cause environmental problems. * The more exothermic a reaction, the more useful it is.   You may identify an alternative claim in consultation with your teacher. | | | | | |
| Task | | | | | |
| Gather secondary evidence related to a research question in order to evaluate the claim. Develop your research question based on a number of possible claims provided by your teacher.  Obtain evidence by researching scientifically credible sources, such as scientific journals, books by well-credentialed scientists and websites of governments, universities, independent research bodies, or science and technology manufacturers. You must adhere to research conventions. | | | | | |
| To complete this task, you must: | | | | | |
| • select a claim to be evaluated  • identify the relevant scientific concepts associated with the claim  • pose a research question addressing an aspect of the claim  • conduct research to gather scientific evidence that may be used to address the research question and subsequently evaluate the claim  • analyse the data to identify sufficient and relevant evidence  • identify the trends, patterns or relationships in the evidence  • analyse the evidence to identify limitations• interpret the evidence to construct justified scientific arguments  • interpret the evidence to form a justified conclusion to the research question  • discuss the quality of the evidence  • evaluate the claim by extrapolating the findings of the research question to the claim  • suggest improvements and extensions to the investigation  • communicate findings in an appropriate scientific genre, i.e. scientific essay. | | | | | |
| **Stimulus** | | | | | |
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| Checkpoints  Insert or delete due dates and sign-off as required. Insert a maximum of five checkpoint rows | | | | | |
| ☐ Week 3 : Select claim and develop research question. | | | | | |
| ☐ Week 3 : Identify sources and conduct research. | | | | | |
| ☐ Week 4 : Analyse and evaluate evidence. | | | | | |
| ☐ Week 4 : Submit draft. | | | | | |
| ☐ Week 6: Submit final response. | | | | | |

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| Assessment objective/s | Marks |
| **Research and planning**  Assessment objectives 2, 5 | /6 |
| **Analysis and interpretation**  Assessment objectives 3, 4 | / 6 |
| **Conclusion and evaluation**  Assessment objectives 4, 6 | / 6 |
| **Communication**  Assessment objective 7 | / 2 |
| **Total** | **/20** |
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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. | |
| 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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| Scaffolding |
| The response must be presented using an appropriate scientific genre (i.e. scientific essay) and contain:  • a claim  • a research question  • a rationale for the investigation  • justified scientific arguments using evidence  • a conclusion to the research question based on the interpretation of the evidence  • evaluation of the claim and suggestions of improvements and extensions to the investigation  • a reference list.  An example of how one of the claims could be developed into a research question  Claim: Biofuels are more efficient and have less environmental impact than fossil fuels. |

**Research question**: Is the combustion of biodiesel more efficient than petroleum-based diesel in terms of energy output (enthalpy) and CO2 emissions?

**Developing the research question**:

1. Identify the key (important) terms in the claim.

a. biofuels

b. more efficient

c. fossil fuels

2. Propose questions that need to be addressed to refine key terms and narrow the focus of the claim.

a. What are biofuels?

b. Which biofuels and fossil fuels will be investigated?

c. What does ‘more efficient’ mean in relation to energy output and greenhouse gas emissions?

d. How do energy output and greenhouse gas emissions link to the chemistry of fuels, exothermic reactions and enthalpy?

3. Conduct research to gather information to address the questions.

a. How will energy output be compared/evaluated?

b. Which greenhouse gases are produced as a by-product of combustion of biofuels and fossil fuels?

c. How will greenhouse gases be compared/evaluated?

d. What data will be collected for energy output and greenhouse gas emissions?

e. What is the chemistry related to energy production and greenhouse gases produced from the combustion of biofuels and fossil fuels?

4. Draft the research question to address the claim.

a. Do biofuels produce fewer greenhouse gases and more energy than fossils fuels?

5. Refine and focus the research question.

a. Focus on products of combustion: energy output (enthalpy) and CO2 produced.

b. Focus on biodiesel and petroleum-based diesel.

c. Define efficiency in terms of higher energy output and lower CO2 emissions.

6. Present the research question to the teacher for approval.

a. Is the combustion of biodiesel more efficient than petroleum-based diesel in terms of energy output (enthalpy) and CO2 emissions?

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

**Instrument-specific marking guide – Research Investigation**

The following table summarises the criteria, assessment objectives and mark allocation for the research investigation.

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| * **Criterion** | * **Objectives** | * **Marks** |
| * Research and planning | * 2, 5 | * **6** |
| * Analysis and interpretation | * 3, 4 | * **6** |
| * Conclusion and evaluation | * 4, 6 | * **6** |
| * Communication | * 7 | * **2** |
| * **Total** | | * **20** |

**Note:** Unit objective 1 is not assessed in this instrument.

**Instrument-specific marking guide**

**Criterion: Communication**

Assessment objective

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

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| * **The student work has the following characteristics:** | **Marks** | * **Definitions** |
| * effective communication of understandings and research findings, arguments and conclusions about properties and structure of materials, or Chemical reactions (reactants products and energy change), 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 * **concise** – expressing much in few words; giving a lot of information clearly and in a few words; brief, comprehensive and to the point; succinct, clear, without repetition of information * **appropriate** – acceptable; suitable or fitting for a particular purpose, circumstance, context etc. |
| * adequate communication of understandings and research findings, arguments and conclusions about properties and structure of materials, or Chemical reactions (reactants products and energy change), 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 |  |

**Criterion: Research and planning**

Assessment objectives

2. apply understanding of about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions to develop research questions

5. investigate phenomena associated with about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions through research

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| * **The student work has the following characteristics:** | **Marks** | * **Definitions** |
| * informed application of understanding of the properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by a * considered rationale identifying clear development of the research question from the claim * effective and efficient investigation of phenomena associated with TOPIC demonstrated by   + a specific and relevant research question   + selection of sufficient and relevant sources. | 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) * **consistent** – agreeing or accordant; compatible; not self-opposed or self-contradictory, constantly adhering to the same principles; acting in the same way over time, especially so as to be fair or accurate; unchanging in nature, standard, or effect over time; not containing any logical contradictions (of an argument); constant in achievement or effect over a period of time * **clear** – free from confusion, uncertainty, or doubt; easily seen, heard or understood * **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, 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 properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by a * reasonable rationale that links the research question and the claim * effective investigation of phenomena associated with TOPIC demonstrated by   + a relevant research question   + selection of relevant sources. | 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  **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 properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * a vague or irrelevant rationale for the investigation * ineffective investigation of phenomena associated with TOPIC demonstrated by   + an inappropriate research question   + selection of insufficient and irrelevant sources. | 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 * **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 * **inappropriate** – not suitable or proper in the circumstances * **insufficient** – not enough; inadequate for the purpose |
| * does not satisfy any of the descriptors above. | 0 |  |

**Criterion: Analysis and interpretation**

Assessment objectives

1. analyse research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions
2. interpret research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions

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| * **The student work has the following characteristics:** | **Marks** | * **Definitions** |
| * systematic and effective analysis of qualitative data and/or quantitative data within the sources about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by   + the identification of sufficient and relevant evidence   + thorough identification of relevant trends, patterns or relationships   + thorough and appropriate identification of limitations of evidence * insightful interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * justified scientific argument/s. | 5–6 | **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  **sufficient** – enough or adequate for the purpose  **relevant** – bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on  **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.   **appropriate** – acceptable; suitable or fitting for a particular purpose, circumstance, context etc  **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 |
| * effective analysis of qualitative data and/or quantitative data within the sources about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by   + the identification of relevant evidence   + identification of obvious trends, patterns or relationships   + basic identification of limitations of evidence * adequate interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * reasonable scientific argument/s. | 3–4 | * **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 * **obvious** – clearly perceptible or evident; easily seen, recognised or understood   **basic** – fundamental   * **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 |
| * rudimentary analysis of qualitative data and/or quantitative data within the sources about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by   + the identification of insufficient and irrelevant evidence   + identification of incorrect or irrelevant trends, patterns or relationships   + incorrect or insufficient identification of limitations of evidence * invalid interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * inappropriate or irrelevant argument/s. | 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 * **insufficient** – not enough; inadequate for the purpose * **irrelevant** – not relevant; not applicable or pertinent; not connected with or relevant to something * **incorrect** – not conforming to fact or truth * **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 |
| * does not satisfy any of the descriptors above. | 0 |  |

**Criterion: Conclusion and evaluation**

Assessment objectives

4. interpret research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions

1. evaluate research processes, claims and conclusions about properties and structure of materials, or Chemical reactions (reactants products and energy change), or Rates of Chemical reactions

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| * **The student work has the following characteristics:** | **Marks** | * **Definitions** |
| * insightful interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change demonstrated by * justified conclusion/s linked to the research question * critical evaluation of the research processes, claims and conclusions about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by   + insightful discussion of the quality of evidence   + extrapolation of credible findings of the research to the claim   + suggested improvements and extensions to the investigation that are considered and relevant to the claim. | 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 * **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 * **extrapolation** – extension of a conclusion to a new situation with the assumption that existing trends will continue * **credible** – capable or worthy of being believed; believable; convincing * **considered** – formed after careful and deliberate thought * **relevant** – bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on |
| * adequate interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * reasonable conclusion/s relevant to the research question * basic evaluation of the research processes, claims and conclusions about TOPIC demonstrated by   + reasonable description of the quality of evidence   + application of relevant findings of the research to the claim   + suggested improvements and extensions to the investigation that are relevant to the claim. | 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 |
| * invalid interpretation of research evidence about properties and structure of materials, or Chemical reactions (reactants products and energy change), demonstrated by * inappropriate or irrelevant conclusion/s * superficial evaluation of the research processes, claims and conclusions about TOPIC demonstrated by   + cursory or simplistic statements about the quality of evidence   + application of insufficient or inappropriate findings of the research to the claim   + 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 * **irrelevant** – not relevant; not applicable or pertinent; not connected with or relevant to something   **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 |  |