

Chemistry 2019 v1.4

IA3: Sample assessment instrument

Research investigation (20%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name

Student number

Teacher

Issued

Due date

Marking summary

Criterion	Marks allocated	Provisional marks
Research and planning	6	
Analysis and interpretation	6	
Conclusion and evaluation	6	
Communication	2	
Overall	20	

Conditions

Technique	Research investigation
Unit	Unit 4: Structure, synthesis and design
Topic/s	Topic 1: Properties and structure of organic materials Topic 2: Chemical synthesis and design
Duration	10 hours class time
Mode/length	Written (e.g. scientific essay): 1500–2000 words
Individual/group	Individual
Resources	School library (online: internet and school intranet, databases, journals)

Context

Investigate one of the following claims:

- Plastics are bad for the environment.
- Natural shampoos are better than commercial shampoos.
- Green chemistry is clean chemistry.

You may identify an alternative claim in consultation with your teacher. This claim must be related to Unit 4 subject matter.

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. empirical essay.

Checkpoints

- Week 1: Select claim and develop research question.
- Week 2: Identify sources and conduct research.
- Week 3: Analyse and evaluate evidence.
- Week 4: Submit draft.
- Week 5: Submit final response.

Authentication strategies

- The teacher will provide class time for task completion.
- Students will provide documentation of their progress at indicated checkpoints.
- The teacher will collect and annotate one draft.
- The teacher will conduct interviews or consultations with each student as they develop the response.
- Students will use plagiarism-detection software at submission of the response.
- Students must acknowledge all sources.

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: Plastics are bad for the environment.

Research question: What effect do catalysts have on the chemical recycling of polyethylene terephthalate (PET) by glycolysis?

Developing the research question:

1. Identify the key (important) terms in the claim.
 - a. 'plastics', 'bad', 'environment'
2. Propose refining questions that need to be addressed to refine key terms and narrow the focus of the claim.
 - a. Which plastic will I investigate?
 - b. Why did I choose this plastic?
 - c. What do I mean by 'bad' for the environment in chemical terms?
3. Provide an example of how one of the claims could be developed into a research question. Conduct research to gather information to address the refining questions.
 - a. The plastic that will be investigated is PET.
 - b. PET's structural and chemical properties make it a high-demand plastic that is not biodegradable. Therefore, it is an environment problem if not recycled.

- c. PET can be recycled by a chemical process called glycolysis, which requires a catalyst.
 - d. Products from chemically recycling PET can be used as feedstock (raw materials) for other products.
4. Draft the research question to address the claim.
 - a. How does chemically recycling PET help the environment?
 5. Refine and focus the research question.
 - a. How does chemically recycling PET by glycolysis help the environment?
 - b. What factors affect the chemical recycling of PET by glycolysis?
 6. Present the research question to the teacher for approval.
 - a. What effect do catalysts have on the chemical recycling of polyethylene terephthalate (PET) by glycolysis?

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

Instrument-specific marking guide (IA3): Research investigation (20%)

Criterion: Research and planning

Assessment objectives

2. apply understanding of the properties and structure of organic materials or chemical synthesis and design to develop research questions
5. investigate phenomena associated with the properties and structure of organic materials or chemical synthesis and design through research

The student work has the following characteristics:	Marks
<ul style="list-style-type: none">informed application of understanding of the properties and structure of organic materials or chemical synthesis and design demonstrated by a considered rationale identifying clear development of the research question from the claimeffective and efficient investigation of phenomena associated with the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">a specific and relevant research questionselection of sufficient and relevant sources.	5–6
<ul style="list-style-type: none">adequate application of understanding of the properties and structure of organic materials or chemical synthesis and design demonstrated by a reasonable rationale that links the research question and the claimeffective investigation of phenomena associated with the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">a relevant research questionselection of relevant sources.	3–4
<ul style="list-style-type: none">rudimentary application of understanding of the properties and structure of organic materials or chemical synthesis and design demonstrated by a vague or irrelevant rationale for the investigationineffective investigation of phenomena associated with the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">an inappropriate research questionselection of insufficient and irrelevant sources.	1–2
<ul style="list-style-type: none">does not satisfy any of the descriptors above.	0

Criterion: Analysis and interpretation

Assessment objectives

- analyse research evidence about the properties and structure of organic materials or chemical synthesis and design
- interpret research evidence about the properties and structure of organic materials or chemical synthesis and design

The student work has the following characteristics:	Marks
<ul style="list-style-type: none">systematic and effective analysis of qualitative data and/or quantitative data within the sources about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">the identification of sufficient and relevant evidencethorough identification of relevant trends, patterns or relationshipsthorough and appropriate identification of limitations of evidenceinsightful interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by justified scientific argument/s.	5–6
<ul style="list-style-type: none">effective analysis of qualitative data and/or quantitative data within the sources about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">the identification of relevant evidenceidentification of obvious trends, patterns or relationshipsbasic identification of limitations of evidenceadequate interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by reasonable scientific argument/s.	3–4
<ul style="list-style-type: none">rudimentary analysis of qualitative data and/or quantitative data within the sources about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">the identification of insufficient and irrelevant evidenceidentification of incorrect or irrelevant trends, patterns or relationshipsincorrect or insufficient identification of limitations of evidenceinvalid interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by inappropriate or irrelevant argument/s.	1–2
<ul style="list-style-type: none">does not satisfy any of the descriptors above.	0

Criterion: Conclusion and evaluation

Assessment objectives

- interpret research evidence about the properties and structure of organic materials or chemical synthesis and design
- evaluate research processes, claims and conclusions about the properties and structure of organic materials or chemical synthesis and design

The student work has the following characteristics:	Marks
<ul style="list-style-type: none">insightful interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by justified conclusion/s linked to the research questioncritical evaluation of the research processes, claims and conclusions about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">insightful discussion of the quality of evidenceextrapolation of credible findings of the research to the claimsuggested improvements and extensions to the investigation that are considered and relevant to the claim.	5–6
<ul style="list-style-type: none">adequate interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by reasonable conclusion/s relevant to the research questionbasic evaluation of the research processes, claims and conclusions about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">reasonable description of the quality of evidenceapplication of relevant findings of the research to the claimsuggested improvements and extensions to the investigation that are relevant to the claim.	3–4
<ul style="list-style-type: none">invalid interpretation of research evidence about the properties and structure of organic materials or chemical synthesis and design demonstrated by inappropriate or irrelevant conclusion/ssuperficial evaluation of the research processes, claims and conclusions about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">cursory or simplistic statements about the quality of evidenceapplication of insufficient or inappropriate findings of the research to the claimineffective or irrelevant suggestions.	1–2
<ul style="list-style-type: none">does not satisfy any of the descriptors above.	0

Criterion: Communication

Assessment objectives

7. communicate understandings and research findings, arguments and conclusions about the properties and structure of organic materials or chemical synthesis and design

The student work has the following characteristics:	Marks
<ul style="list-style-type: none">• effective communication of understandings and research findings, arguments and conclusions about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">– 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
<ul style="list-style-type: none">• adequate communication of understandings and research findings, arguments and conclusions about the properties and structure of organic materials or chemical synthesis and design demonstrated by<ul style="list-style-type: none">– competent use of scientific language and representations– use of basic genre conventions– use of basic referencing conventions.	1
<ul style="list-style-type: none">• does not satisfy any of the descriptors above.	0



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