

# Physics 2019 v1.2

## Unit 1 sample assessment instrument

August 2018

### Research investigation

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

Schools develop internal assessments for each senior subject, based on the learning described in Units 1 and 2 of the subject syllabus. Each unit objective must be assessed at least once.

### Unit objectives

This assessment instrument is used to determine student achievement in the following objectives:

2. apply understanding of heating processes, ionising radiation and nuclear reactions, and electrical circuits
3. analyse evidence about heating processes, ionising radiation and nuclear reactions, and electrical circuits
4. interpret evidence about heating processes, ionising radiation and nuclear reactions, and electrical circuits
5. investigate phenomena associated with heating processes, ionising radiation and nuclear reactions, and electrical circuits
6. evaluate processes, claims and conclusions about heating processes, ionising radiation and nuclear reactions, and electrical circuits
7. communicate understandings, findings, arguments and conclusions about heating processes, ionising radiation and nuclear reactions, and electrical circuits.

**Note:** Objective 1 is not assessed in this instrument.

<b>Subject</b>	Physics		
<b>Technique</b>	Research investigation		
<b>Unit</b>	Unit 1: Thermal, nuclear and electrical physics		
<b>Topic</b>	Topic 1: Heating processes Topic 2: Ionising radiation and nuclear reactions Topic 3: Electrical circuits		
<b>Conditions</b>			
<b>Duration</b>	10 hours class time		
<b>Mode</b>	Written response — scientific essay	<b>Length</b>	1500–2000 words
<b>Individual/ group</b>	Individual	<b>Other</b>	—
<b>Resources available</b>	School library (online: internet and school intranet, databases, journals)		
<b>Context</b>			
<p>Investigate one of the following claims:</p> <ul style="list-style-type: none"> <li>• Scientists will soon be able to cool substances to absolute zero.</li> <li>• Climate change can be easily modelled using an understanding of the transfer of energy in to and out of systems.</li> <li>• Mobile phones cause cancer.</li> <li>• Ceiling insulation can reduce energy consumption for heating and cooling by up to 45%, resulting in lower energy bills.</li> </ul> <p>You may identify an alternative claim in consultation with your teacher. This claim must be related to Unit 1 subject matter.</p>			
<b>Task</b>			
<p>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.</p> <p>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.</p>			
<b>To complete this task, you must:</b>			
<ul style="list-style-type: none"> <li>• select a claim to be evaluated</li> <li>• identify the relevant scientific concepts associated with the claim</li> <li>• pose a research question addressing an aspect of the claim</li> <li>• conduct research to gather scientific evidence that may be used to address the research question and subsequently evaluate the claim</li> <li>• analyse the data to identify sufficient and relevant evidence</li> <li>• identify the trends, patterns or relationships in the evidence</li> <li>• analyse the evidence to identify limitations</li> <li>• interpret the evidence to construct justified scientific arguments</li> <li>• interpret the evidence to form a justified conclusion to the research question</li> <li>• discuss the quality of the evidence</li> <li>• evaluate the claim by extrapolating the findings of the research question to the claim</li> <li>• suggest improvements and extensions to the investigation</li> <li>• communicate findings in an appropriate scientific genre, i.e. scientific essay.</li> </ul>			

<b>Stimulus</b>
—
<b>Checkpoints</b>
<input type="checkbox"/> Week 1: Select claim and develop research question.
<input type="checkbox"/> Week 2: Identify sources and conduct research.
<input type="checkbox"/> Week 3: Analyse and evaluate evidence.
<input type="checkbox"/> Week 4: Submit draft.
<input type="checkbox"/> Week 5: Submit final response.
<b>Feedback</b>
<b>Authentication strategies</b>
• 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 drafts.
• 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.
• The teacher will conduct interviews after submission to clarify or explore aspects of the response (as required).

## 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:** Scientists will soon be able to cool substances to absolute zero.

**Research question:** Is the existence of an absolute zero temperature consistent with the laws of thermodynamics (namely, the zeroth, first, second and third law)?

### Developing the research question:

Description	Example
<b>Break down the claim.</b> Identify the key terms of the claim.	Key terms: absolute zero, cool
<b>Question the key elements of the claim.</b> Generate questions that help clarify the key terms as they relate to the unit of study.	<ul style="list-style-type: none"><li>• How is 'absolute zero' defined?</li><li>• What is the coldest known substance on Earth?</li><li>• What is the physics behind refrigeration?</li><li>• How can absolute zero be measured?</li></ul>
<b>Pose possible research questions.</b> Extend the questions from step 2 to ask how the key terms could be linked.	<ul style="list-style-type: none"><li>• What is the most effective refrigeration technique known to scientists?</li><li>• Is there a place in the universe that has a temperature of absolute zero?</li><li>• Is absolute zero real?</li></ul>
<b>Critique the questions.</b> Examine the possible research questions for their suitability to the task: <ul style="list-style-type: none"><li>• Do they only consider one independent variable?</li><li>• Do they include an element that can be measured using data?</li><li>• Is the scope suitable to allow for a detailed answer of 1500–2000 words?</li></ul>	<ul style="list-style-type: none"><li>• Is there a place in the universe that has a temperature of absolute zero?<ul style="list-style-type: none"><li>– Not relevant to the claim.</li></ul></li><li>• What is the most effective refrigeration technique known to scientists?<ul style="list-style-type: none"><li>– Will not be directly relevant to addressing the claim that a substance can be cooled to absolute zero.</li></ul></li><li>• Is absolute zero real?<ul style="list-style-type: none"><li>– This is relevant; however, some more parameters around the scope of the inquiry need to be in place.</li></ul></li></ul>
<b>Finalise the research question.</b> Use the results of the critique to select and finalise the research question.	Is the existence of an absolute zero temperature consistent with the laws of thermodynamics (namely, the zeroth, first, second and third law)?

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