



**GOLD COAST  
CHRISTIAN  
COLLEGE**

Christ Centred  
Service Oriented  
Innovative Learning

Gold Coast Christian College (Reedy Creek)

# Physics

AS U2 IA3

Student name

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Student number

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Teacher

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Issued

03/06/2025

Due date

29/07/2025

## Marking summary

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

# Conditions

<b>Technique</b>	Research investigation
<b>Unit/s</b>	Unit 2: Einstein's famous equation
<b>Topic/s</b>	Unit 2 — Topic 1: Special relativity Unit 2 — Topic 2: Ionising radiation and nuclear reactions Unit 2 — Topic 3: The Standard Model
<b>Duration</b>	10 hours class time
<b>Mode / length</b>	Written: 1500-2000words
<b>Individual / group</b>	Individual
<b>Resources</b>	School library, Online: internet, databases, journals

# Context

Investigate one of the following claims:

- Global navigation, such as GPS systems, would be ineffective without allowances for special relativity.
- In the future, nuclear energy is the best possible energy source for Australia.
- Radiometric dating is unable to reliably predict the age of natural objects.
- The human lifespan restrains us from visiting distant galaxies.
- Quantum and particle physicists have invented, not discovered, many particles.

You may identify an alternative claim in consultation with your teacher. This claim must be related to Unit 2 (Alternative Sequence) 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. scientific essay.

## Checkpoints

- ☐ Week 1: Select claim and develop a 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

- You will be provided class time for task completion.
- Your teacher will observe you completing work in class.
- Your teacher will collect copies of your response and monitor at key junctures.
- Your teacher will collect and annotate a draft.
- You must acknowledge all sources.
- You will provide documentation of your progress at each checkpoint.

## Scaffolding

The response must be presented using an appropriate scientific genre (i.e. empirical essay) and contain:

- a claim
- a research investigation
- 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, found in the QCAA sample task, is shown:

Claim: Bruce Banner absorbs ambient gamma radiation, converting its energy into mass during the transformation into the Hulk.

Step	Description	
1	<b>Break down the claim.</b> Identify the key terms of the claim.	<b>Claim:</b> Bruce Banner absorbs ambient gamma radiation, converting its energy into mass during the transformation into the Hulk. <b>Key Terms:</b> gamma radiation, convert energy to mass
2	<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 much ambient gamma radiation exists on Earth?</li> <li>• How much mass increase occurs during the transformation?</li> <li>• How much energy is equivalent to the mass increase?</li> </ul>
3	<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>• Is there a biological structure that can convert energy into mass?</li> <li>• How much energy is required to convert Bruce Banner's mass into the Hulk?</li> </ul>
4	<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 1500-2000 word answer?</li> </ul>	<ul style="list-style-type: none"> <li>• Is there a biological structure that can convert energy into mass? <ul style="list-style-type: none"> <li>– Not relevant to the unit topics.</li> </ul> </li> <li>• How much energy is required to convert Bruce Banner's mass into the Hulk? <ul style="list-style-type: none"> <li>– Not specific to the type of radiation in the claim.</li> <li>– Not specific to a version of the Hulk, e.g. the Incredible Hulk or Grey Hulk.</li> </ul> </li> </ul>
5	<b>Finalise the research question.</b> Use the results of the critique to select and finalise the research question.	<ul style="list-style-type: none"> <li>• Assuming there was a way to convert gamma radiation directly into mass, how much gamma radiation, and from what source, would change Bruce Banner's mass into the Incredible Hulk's mass?</li> </ul>

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

## Instrument-specific marking guide (AS U2 IA3): Research investigation (20%)

### Criterion: Research and planning

#### Assessment objectives

- apply understanding of special relativity, ionising radiation and nuclear reactions, or the Standard Model to develop research questions
- investigate phenomena associated with special relativity, ionising radiation and nuclear reactions, or the Standard Model through research

The student work has the following characteristics:	Marks
<ul style="list-style-type: none"> <li><u>informed application</u> of <u>understanding</u> of special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by a <u>considered rationale</u> identifying <u>clear</u> development of the <u>research question</u> from the <u>claim</u></li> <li><u>effective</u> and <u>efficient investigation</u> of phenomena associated with special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>a <u>specific</u> and <u>relevant</u> research question</li> <li><u>selection</u> of <u>sufficient</u> and relevant sources.</li> </ul> </li> </ul>	5–6
<ul style="list-style-type: none"> <li><u>adequate application</u> of <u>understanding</u> of special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by a <u>reasonable rationale</u> that <u>links</u> the <u>research question</u> and the <u>claim</u></li> <li><u>effective investigation</u> of phenomena associated with special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>a <u>relevant</u> research question</li> <li><u>selection</u> of relevant sources.</li> </ul> </li> </ul>	3–4
<ul style="list-style-type: none"> <li><u>rudimentary application</u> of <u>understanding</u> of special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by a <u>vague</u> or <u>irrelevant rationale</u> for the <u>investigation</u></li> <li><u>ineffective</u> investigation of phenomena associated with special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>an <u>inappropriate</u> <u>research question</u></li> <li><u>selection</u> of insufficient and irrelevant sources.</li> </ul> </li> </ul>	1–2
<ul style="list-style-type: none"> <li>does not satisfy any of the descriptors above.</li> </ul>	0

### Criterion: Analysis and interpretation

#### Assessment objectives

- analyse research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model
- interpret research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model

The student work has the following characteristics:	Marks
<ul style="list-style-type: none"> <li><u>systematic</u> and <u>effective analysis</u> of <u>qualitative data</u> and/or <u>quantitative data</u> within the sources about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>the <u>identification</u> of <u>sufficient</u> and <u>relevant evidence</u></li> <li><u>thorough</u> identification of relevant <u>trends</u>, <u>patterns</u> or <u>relationships</u></li> <li>thorough and <u>appropriate</u> identification of <u>limitations</u> of evidence</li> </ul> </li> <li><u>insightful interpretation</u> of <u>research</u> evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by <u>justified</u> scientific <u>argument/s</u>.</li> </ul>	5–6
<ul style="list-style-type: none"> <li><u>effective analysis</u> of <u>qualitative data</u> and/or <u>quantitative data</u> within the sources about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>the identification of <u>relevant evidence</u></li> <li>identification of <u>obvious trends</u>, <u>patterns</u> or <u>relationships</u></li> <li><u>basic</u> identification of <u>limitations</u> of evidence</li> </ul> </li> <li><u>adequate interpretation</u> of <u>research</u> evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by <u>reasonable</u> scientific <u>argument/s</u>.</li> </ul>	3–4
<ul style="list-style-type: none"> <li><u>rudimentary analysis</u> of <u>qualitative data</u> and/or <u>quantitative data</u> within the sources about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>the <u>identification</u> of insufficient and <u>irrelevant evidence</u></li> <li>identification of <u>incorrect</u> or irrelevant <u>trends</u>, <u>patterns</u> or <u>relationships</u></li> <li>incorrect or insufficient identification of <u>limitations</u> of evidence</li> </ul> </li> <li><u>invalid interpretation</u> of <u>research</u> evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by <u>inappropriate</u> or irrelevant <u>argument/s</u>.</li> </ul>	1–2
<ul style="list-style-type: none"> <li>does not satisfy any of the descriptors above.</li> </ul>	0

### Criterion: Conclusion and evaluation

#### Assessment objectives

4. interpret research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model
6. evaluate research processes, claims and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model

The student work has the following characteristics:	Marks
<ul style="list-style-type: none"> <li>insightful interpretation of research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by justified conclusion/s linked to the research question</li> <li>critical evaluation of the research processes, claims and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>insightful discussion of the quality of evidence</li> <li>extrapolation of credible findings of the research to the claim</li> <li>suggested improvements and extensions to the investigation that are considered and relevant to the claim.</li> </ul> </li> </ul>	5–6
<ul style="list-style-type: none"> <li>adequate interpretation of research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by reasonable conclusion/s relevant to the research question</li> <li>basic evaluation of the research processes, claims and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>reasonable description of the quality of evidence</li> <li>application of relevant findings of the research to the claim</li> <li>suggested improvements and extensions to the investigation that are relevant to the claim.</li> </ul> </li> </ul>	3–4
<ul style="list-style-type: none"> <li>invalid interpretation of research evidence about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by inappropriate or irrelevant conclusion/s</li> <li>superficial evaluation of the research processes, claims and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>cursory or simplistic statements about the quality of evidence</li> <li>application of insufficient or inappropriate findings of the research to the claim</li> <li>ineffective or irrelevant suggestions.</li> </ul> </li> </ul>	1–2
<ul style="list-style-type: none"> <li>does not satisfy any of the descriptors above.</li> </ul>	0

#### Criterion: Communication

##### Assessment objectives

7. communicate understandings and research findings, arguments and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model.

The student work has the following characteristics:	Marks
<ul style="list-style-type: none"> <li>effective communication of understandings and research findings, arguments and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>fluent and concise use of scientific language and representations</li> <li>appropriate use of genre conventions</li> <li>acknowledgment of sources of information through appropriate use of referencing conventions.</li> </ul> </li> </ul>	2
<ul style="list-style-type: none"> <li>adequate communication of understandings and research findings, arguments and conclusions about special relativity, ionising radiation and nuclear reactions, or the Standard Model demonstrated by               <ul style="list-style-type: none"> <li>competent use of scientific language and representations</li> <li>use of basic genre conventions</li> <li>use of basic referencing conventions.</li> </ul> </li> </ul>	1
<ul style="list-style-type: none"> <li>does not satisfy any of the descriptors above.</li> </ul>	0