GOLD COAST CHRISTIAN COLLEGE | Christ Centred Service Oriented Innovative Learning

Name	
Subject	AS Physics
Technique	Research Investigation
Unit	Unit 2: Einstein's famous equation
Topic	Topic 1: Special Relativity Topic 2: Ionising radiation and nuclear reactions Topic 3: The Standard Model
Result	/20

Conditions			
Duration	10 Hours class time		
Mode	Written response – scientific essay	**Length**	1000 – 1500 words
Individual/ Group	Individual	**Other**	–
Resources Available	School library (online: internet and school intranet, 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 AS Unit 2 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 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

- ☐ 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 copy.

Criterion	Marks Allocated	Result
Forming and Finding Assessment objectives 1, 2, 6	5	
Analysing Assessment objectives 3	5	
Interpreting Assessment objectives 1, 4	5	
Evaluating Assessment objective 5	5	
Total	20	

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 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.

Scaffolding

The response must be presented using an appropriate scientific genre (i.e. empirical 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 a claim could be developed into a research question

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

Step	Description	Example
1	**Break down the claim.** Identify the key terms of the claim.	**Claim:** Bruce Banner absorbs ambient gamma radiation, converting its energy into mass during the transformation into the Hulk. **Key terms:** gamma radiation, convert energy to mass
2	**Question the key elements of the claim.** Generate questions that help clarify the key terms as they relate to the unit of study.	• How much ambient gamma radiation exists on Earth? • How much mass increase occurs during the transformation? • How much energy is equivalent to the mass increase?
3	**Pose possible research questions.** Extend the questions from Step 2 to ask how the key terms could be linked.	• Is there a biological structure that can convert energy into mass? • How much energy is required to convert Bruce Banner's mass into the Hulk?
4	**Critique the Questions.** Examine the possible research questions for their suitability to the task: • Do they only consider one independent variable? • Do they include an element that can be measured using data? • Is the scope suitable to allow for a detailed 1500-2000 word answer?	• Is there a biological structure that can convert energy into mass? – Not relevant to the unit topics. • How much energy is required to convert Bruce Banner's mass into the Hulk? – Not specific to the type of radiation in the claim. – Not specific to a version of the Hulk, e.g. the Incredible Hulk or Grey Hulk.
5	**Finalise the research question.** Use the results of the critique to select and finalise the research question	• 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?

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

Instrument-specific marking guide (IA3 Unit 2)

Forming and Finding	Marks
The student response has the following characteristics:	
• a considered rationale identifying clear development of the research question from the claim • a specific and relevant research question • selection of sufficient and relevant sources • appropriate use of genre conventions • acknowledgment of sources of information through appropriate use of referencing conventions	4–5
• a reasonable rationale that links the research question and the claim • a relevant research question • selection of relevant sources • use of basic genre conventions • use of basic referencing conventions	2–3
• a vague or irrelevant rationale for the investigation • an inappropriate research question • selection of insufficient or irrelevant sources • inadequate use of genre conventions • inadequate acknowledgment of sources.	1
The student response does not match any of the descriptors above.	0

Analysing	Marks
The student response has the following characteristics:	
• the identification of sufficient and relevant evidence • thorough identification of relevant trends/patterns/relationships in evidence • thorough and appropriate identification of limitations of evidence	4–5
• the identification of relevant evidence • identification of obvious trends/patterns/relationships in evidence • basic identification of limitations of evidence	2–3
• the identification of insufficient and irrelevant evidence • identification of incorrect or irrelevant trends/patterns/relationships in evidence • incorrect or insufficient identification of limitations of evidence.	1
The student response does not match any of the descriptors above.	0

Interpreting	Marks
The student response has the following characteristics:	
• justified scientific argument/s • justified conclusion linked to the research question • fluent and concise use of scientific language/representations	4–5
• reasonable scientific argument/s • reasonable conclusion relevant to the research question • competent use of scientific language/representations	2–3
• inappropriate or irrelevant argument/s • inappropriate or irrelevant conclusion • incorrect use of language/representations.	1
The student response does not match any of the descriptors above.	0

Evaluating	Marks
The student response has the following characteristics:	
• justified 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	4–5
• reasonable description of the quality of evidence • application of relevant findings of the research to the claim • suggested improvements and/or extensions to the investigation that are relevant to the claim	2–3
• 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
The student response does not match any of the descriptors above.	0