OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A **A182/02**

Unit A182: Modules P4, P5, P6 (Higher Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant – applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
words	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
work done = 0 marks
work done lifting = 1 mark
change in potential energy = 0 marks
gravitational potential energy = 1 mark

5. Annotations:
The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt **not** given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	✓
☐	☐	✓
✓	✓	✓
✓	✓	✓
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Marks	Additional guidance
1	(a)	(i)	speed = 250/20 = 12.5 m/s, so below the speed limit	[1]	
		(ii)	the calculated speed is an average (so the lorry could have exceeded the limit at certain points in the journey) but the graph shows that the speed was constant during the time period	[2]	
	(b)		mean on day one = 24.9 m/s, day two = 24.5 m/s minimum on day one less than maximum day two/ranges overlap difference in means (0.4) compared with each of the days variation (0.3)	[3]	**ignore** final conclusion, award marks for processing
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
2	✎		**[Level 3]** Answer includes all relevant points, with all four steps of the explanation, including correct directions and technical terms. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer includes most relevant points, perhaps omitting / confusing some quantitative or directional details. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer includes some relevant points, perhaps with some irrelevant details. No major errors of physics. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** To start the astronaut moving: • rocket pushes on gas to give it backwards momentum • gas and rocket are an interaction pair • gas applies equal forwards force on rocket • giving it and astronaut forwards momentum Astronaut moves at a steady speed when rocket switches off. **reject** astronaut stops moving when rockets turned off (major error of physics) **ignore** references to kinetic energy, work and power
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
3			momentum change = 1200×20 = 24 000 kg m s^{-1} force = 24 000 / 1.2 = 20 000 N	[2]	**allow** ecf on incorrect momentum change
			Total	[2]	

4	(a)		forwards 1 kN	[2]	
	(b)		**momentum** **kinetic energy**	[2]	
			Total	[4]	

5	(a)		a seatbelt increases the time it takes … ☐ ☐ ✓ ☐	[1]	
	(b)		**D**	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
6	(a)		0.70 A gives 4.0 Ω, 1.8 A gives 6.7 Ω,	[1]	
	(b)		the results show that resistance increases with increasing current / there is a correlation between resistance and current but this (correlation) does not prove Jeff's explanation (without a causal link)	[2]	'**accept** resistance depends on current for (1)'
	(c)		Carlos	[1]	
	(d)		he needs to think of a causal link / mechanism which links cause and effect and have the experiment repeated by other scientists	[2]	
			Total	[6]	

7	(a)		0.15 (1) A or amps (1)	[2]	award (1) for evidence of using $I = P/V$ if no units shown
	(b)		9 V	[1]	
			Total	[3]	

8			**B** **C** **D**	[3]	in any order
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
9	(a)		**induction**	[1]	
	(b)		**A**	[1]	
			Total	[2]	

10	✎		**[Level 3]** Includes all of the relevant points. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Includes most of the relevant points. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Includes some of the relevant points. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** • wires / components contain mobile charges / electrons • pressing the switch completes the circuit • which allows charges/electrons to move around the circuit / allows the battery to push charges/electrons around the circuit • in a continuous loop • energy is transferred from the power supply/electrons/charges to the lamp • as electrons collide with ions in the lamp filament • the filament gets hot • lamp gets hot enough to emit light **accept** battery does work on electrons / charge **ignore** references to the resistor
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
11	✎		**[Level 3]** Evaluates production and use of the radioactive materials, and correctly identifies sources for all three types of waste. Suggests how to dispose of them safely. Will give a valid reason why waste needs to be stored carefully. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Evaluates production and/or use of the radioactive materials, and correctly identifies sources for at least two types of waste, perhaps omitting some important details. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Refers to at least one type of waste and valid disposal method for it. May not give a reason for the need for careful disposal. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • high level <u>only</u> produced in reactor • high level waste is very radioactive • so is stored in ponds of water • until it becomes intermediate waste / less radioactive • hospital produces mostly intermediate • intermediate waste is encased in concrete / glass • and stored in metal drums • under guard / in secure conditions • low level produced at both hospital and reactor • low level waste is put in landfill • with waterproof linings • to keep radioactivity out of ground water • all radioactive waste is harmful / cancerous • becoming less harmful as time goes on **accept** descriptions of type / source of waste instead of names eg nuclear power station giving high level waste **accept** references to underground burial for intermediate waste
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
12			3078/5624 = 0.55 1757/3078 = 0.57 mostly Tc-99 m because half-life much shorter than 66 h / close to 6 h	[3]	**accept** attempt to calculate half-life by considering activities 6 h apart **accept** cannot say whether Mo is present, as sample only tested for 24 hours for (1)'
			Total	[3]	

13			health/cancer risk for all participants due to irradiation by the rod this risk is greatest for the radiographer who will repeat the procedure many times patient will benefit if their existing cancer is cured, but the risk of patient and radiographer developing a new cancer may outweigh the benefits of the procedure	[3]	
			Total	[3]	

14	(a)		33	[1]	
	(b)		The fraction of dose … ☐ ☐ ☑ ☐ The dose from food and drink … ☑	[2]	
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
15	(a)		**D C B E**	[2]	ecf: **C** before **B** before **E** for (1)
	(b)		chain reaction	[1]	
	(c)		5.0×10^{-10} kg	[1]	**allow** $0.5\text{x}10^{-9}$ kg'
	(d)		… still be very low … ☐ ☑ ☐ ☐	[1]	
			Total	[5]	