OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A **A181/02**

Unit A181: Modules P1, P2, P3 (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	✎		**[Level 3]** Includes most relevant points in each category in the answer. Explains Wegener's ideas, objections to his theory, and acceptance following further evidence in terms of a causal mechanism. 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]** Outlines Wegener's ideas with some evidence, and make reasonable suggestions why his contemporaries did not accept it. The idea of a mechanism for continental drift likely to be absent. 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]** Outlines Wegener's ideas with little supporting evidence. Objections by contemporaries likely to be personal rather than scientific. 1960s evidence likely to be missing. 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:** Wegener's evidence: • continents 'fit together' • similar rock layers in different continents • similar fossils in different continents His contemporaries' objections: • Wegener was an outsider/not a geologist • no continental movement detectable • existing theories (land bridges) explained fossils • no mechanism proposed for movement For subsequent acceptance: • idea that a plausible mechanism is reasonable grounds for accepting the theory • sea-floor spreading provided a mechanism • movements in mantle as underlying cause **accept** description of magnetic stripes on seabed as evidence for seafloor spreading **ignore** references to mountain chains, unless specifically to chains on the West coast of North and South America **reject** objections to Wegener based on personality
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
2	(a)		starshade will block light … ✓ light from a planet is much … ✓ light from a distant planet … ✓	[3]	2 marks for correct pattern 1 mark for just one mistake 0 marks for more than one mistake (mistake = tick in incorrect box, missing tick or extra tick)
	(b)		there will be no light … ✓ the Earth's atmosphere **…** ✓	[2]	2 marks for correct pattern 1 mark for just one mistake 0 marks for more than one mistake (mistake = tick in incorrect box, missing tick or extra tick)
			Total	[5]	

Question			Expected answers	Marks	Additional guidance
3	(a)		wavelength = 10 m / 2.5 = 4 m	[1]	correct answer with no working gets 2 marks division of 10 m by an incorrectly counted number of wavelengths gets 1 mark if done consistently
	(b)		frequency = speed/wavelength = 4 m/s ÷ 5m = 0.8 Hz	[2]	correct answer with no working gets 2 marks
	(c)	(i)	time taken for P-wave to arrive = 360 000 m / 8000 m/s = 45 s time taken for S-wave to arrive = 360 000 m / 3000 m/s = 120 s, therefore the delay = 120 s – 45 s = 75 s	[2]	if distances and speeds are correctly converted to compatible units but one arithmetic slip is made, award 1 mark max
		(ii)	P-wave has lower amplitude than S-wave so will cause less damage therefore the early arrival of the P-wave gives a warning that allows people time to take precautions before the more damaging S-wave arrives	[2]	for 'take precautions', accept any reasonable action that could be completed in 75 seconds, eg escape from building / get under table/doorway / switch off gas appliance / etc.
			Total	[7]	

4			**B** **D** **E**	[3]	any order
			Total	[3]	

Question			Expected answers		Marks	Additional guidance
5	(a)		Microwaves can be used to heat food by causing particles to vibrate.	✓	[3]	
			Microwaves are ionising radiation.			
			The screen on a microwave oven lets light through but blocks microwaves.	✓		
			Mobile phones produce microwaves.	✓		
			Microwaves are blocked by the ozone layer.			
			The higher the intensity of microwaves in a microwave oven, the less the food is heated.			
	(b)		(some/certain) microwaves are strongly absorbed by water molecules but light waves are not		[1]	
			Total		[4]	

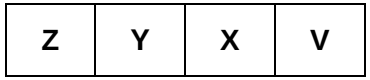
6	(a)		the data support/increase confidence in the statement because (although the value is changing) there is no trend of increase or decrease however, data for more than 100 000 years before present would be needed in order to make a statement about 'hundreds of thousands of years' / insufficient data points to determine whether statement is true	[2]	
	(b)		360ppm/present concentration is far above the <u>range</u> of the data in the table in addition, the change in concentration in the last 20 000 years is much larger than the changes seen in the previous 20 000-year intervals	[2]	
			Total	[4]	

<table>
<tr><th colspan="3">Question</th><th>Expected answers</th><th>Marks</th><th>Additional guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>
<table>
<tr><th>statement</th><th>true</th><th>false</th></tr>
<tr><td>dish increases intensity</td><td>✓</td><td></td></tr>
<tr><td>strongly absorbed by air</td><td></td><td>✓</td></tr>
<tr><td>dish removes noise</td><td></td><td>✓</td></tr>
<tr><td>metal good reflector</td><td>✓</td><td></td></tr>
</table>
</td><td>[2]</td><td>All 4 correct = (2)
2 or 3 correct = (1)</td></tr>
<tr><td></td><td>(b)</td><td></td><td>prediction is wrong because radio has more energy than infrared

any 2 from:
infrared does not fit the trend of the data so may be due to measurement error
number of photons in beam may not have been controlled
area of beams may not have been controlled
area of detector may not have been controlled
air absorbs different amounts at different frequencies</td><td>[3]</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[5]</td><td></td></tr>
</table>

Question			Expected answers	Marks	Additional guidance
8	✎		**[Level 3]** Includes most relevant points in the answer. Explains greenhouse effect in terms of radiation imbalance, and holes in ozone layer in terms of reversible reaction rates not balancing. 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]** Will recognise that carbon dioxide is a greenhouse gas producing global warming and that ozone blocks ultraviolet, and will give a clear mechanism for one of the two processes. 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]** Will recognise that carbon dioxide is a greenhouse gas producing global warming and that ozone blocks ultraviolet, but will give no details of a scientific mechanism for either. 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:** *Greenhouse effect* • incoming solar radiation is absorbed by the Earth • Earth re-emits infrared radiation • reflected radiation is lower frequency/longer wavelength than the radiation (from the Sun) absorbed by the Earth • carbon dioxide absorbs infrared radiation • greenhouse effect describes this effect • water and methane are also greenhouse gases • increased greenhouse effect is producing global warming *Holes in ozone layer* • ozone layer absorbs ultraviolet radiation • chemical changes in ozone result • these changes are reversible so $[O_3]$ is usually constant • extra loss of ozone results in 'holes' **accept** 'lower frequency radiation emitted by Earth' for infrared CFCs as agents of ozone loss **ignore** CFCs as greenhouse gases effects of global warming or depleted ozone layer
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
9	(a)		32	[1]	
	(b)		35%	[1]	
			Total	[2]	

10	(a)			[1]	all correct for the mark

Question			Expected answers	Marks	Additional guidance
	(b)		*coal:* because it is the most efficient and has one of lowest costs / is cheaper than wind power and these benefits outweigh the disadvantage/environmental cost of producing carbon dioxide **OR** *nuclear:* because it has the lowest cost / is cheaper than coal and wind power and this benefit outweighs the disadvantage/environmental cost of producing radioactive waste and outweighs the low efficiency **OR** *wind:* because it is more efficient than nuclear highest costs / expensive to produce but does not significantly harm the environment / is least damaging to the environment and these benefits outweigh the high cost of generation	**[3]**	candidates may choose any type of power station; no marks are awarded for the choice itself, only for the justification of the choice **ignore** references to any factors not described in the table (eg carbon capture in coal power stations, production of radioactive materials for medical use in nuclear power stations, wind turbines being a 'blot on the landscape', etc.)
			Total	**[4]**	

Question			Expected answers	Marks	Additional guidance
11			the power of the kettle must be much greater than the light bulb because energy transferred depends on power and time / E = Pt	[2]	**accept** reference to larger current through kettle (as power = current x voltage)
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
12	✎		**[Level 3]** Most relevant points are present. A balanced argument is provided recognising the different points of view of local people, environmentalists and energy providers. The difference between real risk and perceived risk is discussed. 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]** A balanced discussion is attempted, but significant aspects of the 'pros' or 'cons' in the views of different groups, and the difference between real and perceived risk, may be omitted. May confuse chemical and radioactive poisoning. 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]** Recognises that waste is hazardous, but does not explain why. A balanced answer is not attempted. 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:** • uranium/nuclear fuel is a non-renewable energy source • waste is radioactive • radiation can cause cell damage/cancer • remains radioactive for a very long time • large amounts of energy from little fuel • little CO_2 produced • small environmental impact (compared to coal/oil etc) • Government responsible for regulation • perceived risk may seem high to people near waste sites • real risk may seem low to people far away • radiation is 'invisible' **accept** hazards of terrorist attack waste can contaminate water supplies/soil/etc. must be kept securely for a long time in eg deep secure sites **ignore** arguments based on safety of power stations (Chernobyl, Japan etc) **reject** explosion or other confusion with nuclear bomb
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
13	(a)		points at (6.2, 3.0), (8.0, 3.3) & (9.4, 3.4)	[1]	all within one minor scale division along each axis for the mark
	(b)		best fit curve current increases non-uniformly as voltage increases increase in current becomes less and less as voltage increases	[3]	by eye; should be smooth with no inflections 'current increases' is not enough second and third marking points could be earned in a single statement.
	(c)		current = 2.6 (A) power = 2.6 A × 5.0 V = 13 W	[2]	consistent with candidate's own graph ecf own current reading
			Total	[6]	