

GCSE

Physics A

Unit **A181/02**: Unit 1 – Modules P1, P2, P3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.











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Annotations

Used in the detailed Mark Scheme:

Annotation	Meaning
/	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

Available in RM Assessor to annotate scripts

	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	no benefit of doubt
	reject

	correct response
	draw attention to particular part of candidate's response
	information omitted

Subject-specific Marking Instructions

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

E.g.

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

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 1 mark.

Put ticks (✓) in the two correct boxes.

<input type="checkbox"/>
<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 0 marks.

Put ticks (✓) in the two correct boxes.

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>

This would be worth 1 mark.

- 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, e.g. 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.
- 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, e.g. 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.

E.g. 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	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

MARK SCHEME: overlap with A181/01 shown by shading in column 3

Question		Answer	Mark	Guidance
1	a	D	1	
	b	C	1	
	c	<p>FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 2000 (m/s) award 2 marks if answer = 2 (m/s) award 1 mark 1 km = 1000 m (1); speed (= frequency × wavelength) = 2 (Hz) × 1000 (m) = 2000 (m/s) (1)</p>	2	Needs use of equation & evaluation of own values of f and λ for this mark, e.g. $\lambda = 100$ m and speed = 200 m/s would get m.p.2 (e.c.f) only as m.p.1 has a conversion error.
		Total	4	
2	a	<p>One of $t_p = 169 \text{ km} / 8.1 \text{ km/s} = 20.9 \text{ s}$ $t_s = 169 \text{ km} / 5.1 \text{ km/s} = 33.1 \text{ s}$ (1); $33.1 - 20.9 \approx 12 \text{ (s)}$ (1)</p>	2	m.p.1 is for calculating either time; m.p.2. is for the repeat calculation and subtraction to show it is about 12 s (to 4 s.f., times are 20.864 s & 33.137 s; allow rounding to 33 s & 21s) not just '12': it needs to be clear that $12 \text{ s} \approx 33.1 \text{ s} - 20.9 \text{ s}$, which can be inferred from e.g. 12.273 s answer
	b	Turkey is on a tectonic plate boundary/margin/fault line (and Britain is not) (1)	1	Comparison can be implied by statement of either e.g. UK not on plate boundary. Has to state/imply 'edge' etc. of plate not just 'Turkey is on a tectonic plates'. ALLOW 'UK is in the middle of a (tectonic) plate'.
	c	<p>Any three points from: v increases with depth/ density (1); f is constant (1); $v \uparrow$ means $\lambda \uparrow$ (in proportion) (1); scaling up e.g. v goes up $1\frac{3}{4}$ times so λ increases to $1\frac{3}{4} \times 2000 \text{ m} = 3500 \text{ m}$ (1)</p>	3	ignore consistent omission to convert km to m $[f = (8000 \text{ m/s}) / 2000 \text{ m} = 4 \text{ Hz}]$ Calculation of $\lambda = 3500 \text{ m}$ using ratios/direct proportion means candidate also gets m.p.3
		Total	6	

Question		Answer	Mark	Guidance
3	a	<p>Any two valid points. v is (positively) correlated with d ✓</p> <p>The graph shows (direct) proportion ✓</p> <p>many data not near line/data are scattered ✓</p>	2	<p>e.g. "as d from Earth increases, velocity increases"</p> <p>ACCEPT description of direct proportion, e.g. constant gradient/ratio v is (directly) proportional to d gets both m.p.1 and m.p.2</p> <p>ACCEPT outliers in data for m.p.3, but 'weak correlation' is insufficient there.</p>
	b	<p>Any two from: relatively few data ✓</p> <p>great uncertainty/spread in data ✓</p> <p>so more needed to back up this very new finding / to verify repeatability/reliability/ reproducibility ✓</p> <p>more data will give a better best-fit line ✓</p>	2	<p>e.g. need to check/replicate Hubble's observation</p> <p>e.g. make it more accurate, check for anomalies</p>
		Total	4	

Question	Answer	Mark	Guidance																												
4	<p>(Level 3) Explains one observation about stars and at least one observation about galaxies. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>(Level 2) Describes observations about stars or galaxies. One observation is explained. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>(Level 1) Response limited to descriptions of observations or unlinked explanations. Largely repeats information from the question. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>This question is targeted at grades up to A* Credit knowledge from P7, if relevant, even though it is not required in this question</p> <p>Indicative scientific points:</p> <table border="1" data-bbox="1281 435 2069 1270"> <thead> <tr> <th></th> <th>Observations</th> <th>Linked explanations</th> </tr> </thead> <tbody> <tr> <td>Stars</td> <td>Stars give off energy</td> <td>Produced by nuclear fusion</td> </tr> <tr> <td></td> <td>Light emitted has 'fingerprints'</td> <td>Stars contain certain elements</td> </tr> <tr> <td></td> <td>heavy elements present in stars</td> <td>Heavier elements formed in stars</td> </tr> <tr> <td></td> <td>Different types of stars/clouds of gas & dust</td> <td>Stars change over time</td> </tr> <tr> <td></td> <td>Stars have planets</td> <td>Condensed from gas/dust clouds (nebulae)</td> </tr> <tr> <td rowspan="2">Galaxies</td> <td>Contain many stars</td> <td>Galaxies are huge/distant</td> </tr> <tr> <td>Show redshift</td> <td>Moving away from us/each other Universe expanding</td> </tr> <tr> <td rowspan="3"></td> <td rowspan="3">Furthest galaxies have bigger redshift</td> <td>Universe started at a single point</td> </tr> <tr> <td>Produced in 'Big Bang'</td> </tr> <tr> <td>14 billion years ago</td> </tr> </tbody> </table> <p>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</p>		Observations	Linked explanations	Stars	Stars give off energy	Produced by nuclear fusion		Light emitted has 'fingerprints'	Stars contain certain elements		heavy elements present in stars	Heavier elements formed in stars		Different types of stars/clouds of gas & dust	Stars change over time		Stars have planets	Condensed from gas/dust clouds (nebulae)	Galaxies	Contain many stars	Galaxies are huge/distant	Show redshift	Moving away from us/each other Universe expanding		Furthest galaxies have bigger redshift	Universe started at a single point	Produced in 'Big Bang'	14 billion years ago
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Total		6																													

Question		Answer	Mark	Guidance	
5	a	Radiation ... some materials	<input type="checkbox"/>	2	All correct = 2 marks 3 correct [i.e. only one error] = 1 mark
		Any radiation... damage living cells.	<input checked="" type="checkbox"/>		
		Radiation ... in communication.	<input type="checkbox"/>		
		No radiation ... Earth's atmosphere.	<input checked="" type="checkbox"/>		
	b	$f = 550\,000 \times (1 \times 10^9 \text{ Hz}) = 5.5 \times 10^{14} \text{ Hz} \checkmark$ $\lambda = v / f = (3.0 \times 10^8 \text{ m/s}) / (5.5 \times 10^{14} \text{ Hz})$ $= 5.45.. \times 10^{-7} \text{ m} / 545 \times 10^{-9} \text{ m} \checkmark$ $= (5.45.. \times 10^{-7} \text{ m}) / (1 \times 10^{-9}) \text{ nm} = 500 \text{ (nm) to 1 s.f.} \checkmark$	3	m.p.1 is for conversion GHz \rightarrow Hz. Allow this for expression such as $550\,000 \times 10^9 \text{ (Hz)}$ m.p.2 is for calculation $f \rightarrow \lambda$ with e.c.f. from m.p.1 m.p.3 is for conversion m \rightarrow nm AND rounding to 1.s.f Beware awarding m.p.1. and m.p.3 for two unit conversions cancelling, e.g. $3.0 \times 10^8 \text{ m/s} / 550\,000\text{Hz} = 545.454 = 500 \text{ nm}$ gets only m.p.2 and should be annotated with two carets ^ Bald '500' and no working gains all 3 marks – must assume that the calculation has been done correctly Bald '545' and no working gains 2 marks – no rounding	
Total			5		

Question	Answer	Mark	Guidance
6	<p>(Level 3) Uses photon ideas to explain all three target areas. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>(Level 2) Attempts all three target areas, and uses photon ideas to explain at least one OR uses photon ideas to explain two target areas. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>(Level 1) Attempts at least two of the three target areas, but describes the effect without reference to photons providing energy. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>This question is targeted at grades up to A</p> <p>Indicative scientific points related to initiating chemical reactions:</p> <ul style="list-style-type: none"> • chemical reactions can be caused by removal of electron(s) from atoms/molecules / which is ionisation • some photons have enough energy to cause ionisation <p>Indicative scientific points related to skin cancer risk may include:</p> <ul style="list-style-type: none"> • UV is absorbed by the skin • UV photons have enough energy to create changes to DNA/cell chemicals (which will result in cancer) whereas visible light photons don't <p>Indicative scientific points related to the ejection of electrons from calcium:</p> <ul style="list-style-type: none"> • energy is needed to move an electron from the metal • violet light photons have enough energy to remove electrons whereas red light photons don't <p>Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.</p>
	Total	6	

Question		Answer	Mark	Guidance
7	a	fracking will increase fossil fuel burning/creates CO ₂ ✓ which is a greenhouse gas / causes global warming ✓ OR methane is a greenhouse gas ✓ and will leak into the atmosphere ✓	2	Ignore references to ozone layer
	b	suggestion ✓ ; and linked explanation ✓	2	Examples need to be specific, not general e.g. 'bad for environment'. Examples could be: heavy traffic/noise from machinery etc in National Parks ✓ which disturbs wildlife ✓ high pressure water / fossil fuels may escape into ground ✓ which contaminates drinking water/soil ✓ will need construction work above ground/ ✓ which will take away/disturb National Park land/ look ugly ✓ could cause Earth tremors ✓ which can damage houses etc. ✓ could cause subsidence/sink holes ✓ which can damage houses etc. ✓
		Total	4	
8	a	HD films have much clearer images than SD films.	1	4th box
	b	i FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 5 760 000 000 / 5.76×10⁹ award 2 marks If answer = 5760 award 1 mark No. of bytes = 720 × 1 000 000 = 720 000 000 ✓ No. of bits= 8×720 000 000= 5 760 000 000 / 5.76×10 ⁹ ✓	2	m.p.1 for converting MB → B m.p.2 for evaluating number of bits = number of B × 8 with e.c.f. from own number of bytes (e.g.720 B gives 5760 bits)
	b	ii Number of bits in 1 s = 21 000 000 ✓ time = 5 760 000 000 /21 000 000 = 274 s ✓	2	m.p.1 for converting rate in Mbits/s → rate in bits/s m.p.2 = their answer to (b)(i) / rate If the bit rate is incorrectly given as 21 bits/s, then this mark can be awarded if correctly evaluated. If s no working shown and answer = 274(.28), award 2 marks.
		Total	5	

Question	Answer	Mark	Guidance
9	<p>(Level 3) Discusses advantages and disadvantages to householders and to the country as a whole using examples from all three areas. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>(Level 2) Discusses advantages and disadvantages, using examples from more than one area. May restrict answer to householders or to the country as a whole but not consider both. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>(Level 1) Discusses advantages or disadvantages using examples from one area OR gives an advantage and a disadvantage, using examples from one area. May restrict answer to householders or to the country as a whole but not consider both. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	[6]	<p>This question is targeted at grades up to C</p> <p>Indicative scientific points may include:</p> <p>Supply issues</p> <ul style="list-style-type: none"> • reliability • capacity • locating sufficient sites for installation • displaced land use • reduces the need to import energy from other countries <p>Environmental impact</p> <ul style="list-style-type: none"> • reduces use of fossil fuels • less CO₂ • reduces global warming • habitat loss • identified pollution, e.g. health issues related to air quality, ugly solar farms, noisy wind farms • no radioactive waste produced <p>Economic impact</p> <ul style="list-style-type: none"> • cheaper • installation costs • job loss/creation • payback time • need to be aware of lobbying by e.g. local groups, big oil companies • renewables won't run out / sustainable <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	Total	6	

Question		Answer	Mark	Guidance	
10	a	appliance	current	fuse	3 Current column gets 2 marks: 3 correct = (2) 2 correct = (1) Accept currents rounded to more or fewer sig. figs Fuse column gets 1 mark, even if currents column empty. 3 fuse ratings consistent with own current values = (1)
		dish washer	10 (A)	(13 A)	
		hair dryer	7.826... (A)	13 (A)	
		laptop computer	0.304... (A)	3 (A)	
		vacuum cleaner	3.478... (A)	5 (A)	
	b	Risk: fire / risk of electric shock ✓ Cause: (if there's a fault) copper won't melt / current too high / casing may become 'live' ✓	2	Idea that kettle will still operate if not fused	
		Total	5		
11		Definition of irradiation = damage by radiation from the surroundings ✓ Definition of contamination = (radioactive) chemical ingestion/on the skin ✓ Risk: damage to /mutation of cells/DNA ✓ Difference between risk from irradiation & contamination: irradiation exposure only while in mine, but contamination exposure continues/acts for longer as material is on/in body ✓	4	Allow confusion with chemical contamination for this mp only. Not just 'cancer' or 'ionising'	
		Total	4		
12	a	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 1.15 (kWh) award 3 marks If answer = 1150 (kWh) award 2 marks power (= 10 A × 230 V) = 2300 (W) ✓ power = <u>2.3</u> (kW) OR time = <u>0.5</u> (hours) ✓ energy transferred (= 2.3 kW × 0.5 h) = 1.15 (kWh) ✓	3	Only 1 conversion needed for m.p.2 No e.c.f. from m.p.2	
	b	FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 540 (J) award 2 marks If answer = 1.8 award 1 mark power = 0.6 A × 3.0 V = 1.8 W ✓ (t = 5 × 60 s = 300 s) so E (= 1.8 W × 300 s) = 540 J ✓	2	e.g. no working but 1.8 on the answer line would get m.p.1	
		Total	5		

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