

**Physics A**

General Certificate of Secondary Education

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

**Mark Scheme for June 2013**

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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.

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## 1. Annotations

Used in the detailed Mark Scheme:

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

Available in scoris to annotate scripts:

	correct response
	incorrect response
<b>BOD</b>	benefit of doubt
<b>NBOD</b>	no benefit of doubt
<b>ECF</b>	error carried forward
<b>0</b> , <b>L1</b> , <b>L2</b> , <b>L3</b>	indicate level awarded for a question marked by level of response
<b>A</b>	information omitted
<b>CON</b>	contradiction
<b>R</b>	reject

	indicate uncertainty or ambiguity
	draw attention to particular part of candidate's response

2. **ADDITIONAL OBJECTS:** You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

3. **Subject-specific Marking Instructions**

- a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).
- b. 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 the third and fourth boxes are required for the mark:*

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

*This would be worth  
1 mark.*

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

*This would be worth  
0 marks.*

<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.*

- c. 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.

d. Marking method for tick-box questions:

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 and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. 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 cities in England:*

Edinburgh	<input type="checkbox"/>
Manchester	<input type="checkbox"/>
Paris	<input type="checkbox"/>
Southampton	<input type="checkbox"/>

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		✓		✓	✓		✓	
<b>Score:</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>NR</b>

- e. For answers marked by levels of response:
- i. **Read through the whole answer from start to finish**
  - ii. **Decide the level** that **best fits** the answer – match the quality of the answer to the closest level descriptor
  - iii. **To determine the mark within the level**, consider the following:

<b>Descriptor</b>	<b>Award mark</b>
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

- iv. Use the **L1**, **L2**, **L3** annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions include:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

Question	Answer	Marks	Guidance
1	<p><b>Level 3 (5–6 marks)</b> Considers all three fuels using all data from table and other information. Considers all three key factors. Draws a clear conclusion based on and consistent with the data considered. Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b> Considers all three fuels using some data from table. Considers two key factors. Draws a conclusion based on the data considered. Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Considers two fuels using some data from table, considers one key factor. OR Considers one fuel and two factors. Draws a relevant conclusion which may not be based on the data. Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to C</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>key factor – Sustainability</b></p> <ul style="list-style-type: none"> <li>• biogas is renewable *</li> <li>• diesel and petrol are non-renewable *</li> </ul> <p><b>key factor – economics</b></p> <ul style="list-style-type: none"> <li>• unit cost of fuel is the same for all</li> <li>• may be expensive to convert vehicles *</li> <li>• may be difficult to find supplies of biogas*</li> <li>• same amount of fuel diesel will go further</li> <li>• replacement costs to replace vehicles*</li> <li>• order of energy efficiency linked to amount used.</li> </ul> <p><b>key factor – environmental impact</b></p> <ul style="list-style-type: none"> <li>• order of CO<sub>2</sub> equivalent emissions</li> <li>• more CO<sub>2</sub> from diesel or / and petrol than biogas</li> <li>• CO<sub>2</sub> emissions contribute to global warming *</li> <li>• not clear what is meant by 'CO<sub>2</sub> equivalent emissions'.</li> </ul> <p>* These are examples of other information beyond that provided in the table</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>

Question		Answer	Marks	Guidance								
	(b)	<table border="1"> <tr> <td>she wants to use the cheapest fuel</td> <td></td> </tr> <tr> <td>It provides better security of supply</td> <td>✓</td> </tr> <tr> <td>She want carbon emissions as low as possible.</td> <td></td> </tr> <tr> <td>she thinks nuclear fuel is probably better</td> <td></td> </tr> </table>	she wants to use the cheapest fuel		It provides better security of supply	✓	She want carbon emissions as low as possible.		she thinks nuclear fuel is probably better		1	
she wants to use the cheapest fuel												
It provides better security of supply	✓											
She want carbon emissions as low as possible.												
she thinks nuclear fuel is probably better												
		<b>Total</b>	<b>7</b>									



Question			Answer	Marks	Guidance
2	(a)	(i)	arrow with three heads (1) scale correct (1) <b>max 2 marks for out put labels</b> (100J) sound, (100J) light (300J) heat/waste	4	e.g. input 5 units, outputs 3 units, 1 units, 1 units  2 marks = 3 outputs correct 1 mark = 1 output correct
	(b)		540kJ or 0.15 kWh [1]  an equivalent pair of values chosen [1]	2	<b>note:</b> 540 KJ and 0.15kWh will score 2 marks  equivalent values: 9 kJ = 0.0025 kWh 27 kJ = 0.0075 kWh 36 kJ = 0.010 kWh 540 kJ = 0 15 kWh 1620 kJ = 0.45 kWh
	(c)	(i)	energy                      turbine  magnet  coil  voltage	3	all correct = 3 marks 3/4 correct = 2 marks 2 correct = 1 mark
		(ii)	hydroelectric / wind	1	<b>accept</b> tidal / wave / geothermal
			<b>Total</b>	<b>10</b>	

Question		Answer	Marks	Guidance																				
3	(a)	<table border="1"> <thead> <tr> <th></th> <th>liquid</th> <th>solid</th> <th>cannot tell</th> </tr> </thead> <tbody> <tr> <td>crust</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>mantle</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>outer core</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>inner core</td> <td></td> <td></td> <td>✓</td> </tr> </tbody> </table>		liquid	solid	cannot tell	crust		✓		mantle		✓		outer core	✓			inner core			✓	3	all 4 correct = 3 marks 3 correct = 2 marks 1 or 2 correct = 1 mark
	liquid	solid	cannot tell																					
crust		✓																						
mantle		✓																						
outer core	✓																							
inner core			✓																					
	(b)	(i)	<p><u>longitudinal</u> associated with up and down motion/P-wave OR <u>transverse</u> associated with side to side motion motion/S-wave</p> <p>in a P/longitudinal wave the particles/medium/ground move in same direction as the wave OR in an S/transverse wave the particles/medium/ground move at right angles to the direction of the waves</p>	1  1	<b>ignore</b> the wave moving up and down  <b>ignore</b> the wave moving side to side																			
		(ii)	buildings are less stable against side-to side motion / s-waves transfer more energy/power / s-waves have a larger amplitude	1	<b>ignore</b> s-waves are stronger																			
	(c)	<p>uses idea of distance = wave speed x time</p> <p>calculates time for <b>either</b> p-wave = 5 s <b>or</b> s-wave = 7.5 s</p> <p>2.5 (seconds)</p>	3	correct numerical answer gains all marks																				
<b>Total</b>			<b>9</b>																					

Question			Answer	Marks	Guidance	
4			the weight of sediments pushes the continents down		2	
			sediments fall to the sea floor at a steady rate	✓		
			the movement of the sea floor stirs up the sediments			
			The longer the time the more sediments fall	✓		
			It provides part of a mechanism for seafloor spreading			
			<b>Total</b>	<b>2</b>		

Question		Answer					Marks	Guidance																			
5	(a)	Curnow – distance to (all stars in) nebula/andromeda will be similar/less than distance to stars in the milky way / 160 light years;  Moore – distance to (some stars in) nebula/andromeda is (much) greater than distance to stars in the milky way / 160 light years;					2																				
	(b)	(i)	<table border="1"> <thead> <tr> <th></th> <th>Proved false</th> <th>Decreased confidence</th> <th>No effect on confidence</th> <th>Increased confidence</th> <th>Proved right</th> </tr> </thead> <tbody> <tr> <td>Curnow</td> <td></td> <td>✓</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Moore</td> <td></td> <td></td> <td></td> <td>✓</td> <td></td> </tr> </tbody> </table>						Proved false	Decreased confidence	No effect on confidence	Increased confidence	Proved right	Curnow		✓				Moore				✓		2	1 mark for each row
	Proved false	Decreased confidence	No effect on confidence	Increased confidence	Proved right																						
Curnow		✓																									
Moore				✓																							
		(ii)	<b>any 2</b>  the data may be incorrect/unreliable;  a small modification might make the old theory fit the data;  need more data / not much data to go on / collect more data/ use different methods to collect data  older explanations have been tested many times, so there is more data to support them  don't like to change from established ideas / have done a lot of work on old theory					2	Owtte for each point.																		
		<b>Total</b>					<b>6</b>																				

Question	Answer	Marks	Guidance
6	<p><b>Level 3 (5–6 marks)</b> A description and explanation of two methods of measuring the distance to a star. Limitations and causes of uncertainty in the chosen methods are clearly linked to the explanation. Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b> A simple description of two methods of measuring the distance to a star and explanation of one method. Limitations and causes of uncertainty are mentioned. Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Names two suitable methods OR names and simply describes a single method. Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to A / A*</b></p> <p><b>Parallax:</b> <b>Description e.g.</b> Measure angle to star (against the fixed stars) at different times of the year/ opposite sides of the Earth’s orbit. OR (apparent) movement (against background stars). Labelled diagrams acceptable. <b>Explanation e.g.</b> The smaller the angle /apparent movement measured the further away the star. <b>Limitations e.g.</b> Small angles/movement difficult to measure, atmospheric distortion including twinkling / scintillation, light pollution.</p> <p><b>Apparent brightness:</b> <b>Description e.g.</b> The further away the star the less bright it appears. <b>Explanation e.g.</b> Compare the brightness of a star with the brightness of a star with a known distance or know intrinsic brightness (luminosity) of star or light spreads out <b>Limitations e.g.</b> Different stars have different brightness. Measured stars distance uncertain. Other affects on brightness of star.</p> <p><b>Hubble’s Law (Red Shift)</b> <b>Description e.g.</b> the greater the red shift the further away the star. <b>Explanation e.g.</b> red shift dependent on stars speed, further away stars move away faster. <b>Limitations e.g.</b> Effect only significant for very distant stars, hence very faint.</p> <p><b>accept</b> other valid methods for measuring distances to stars. eg, Cepheid variables</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance										
7	(a)	<table border="1"> <tr> <td>They are blocked by sun-screens.</td> <td></td> </tr> <tr> <td>They are electromagnetic radiation.</td> <td>✓</td> </tr> <tr> <td>They can remove electrons from atoms.</td> <td>✓</td> </tr> <tr> <td>They have lower frequencies than microwaves.</td> <td></td> </tr> <tr> <td>They are used to carry information in optic fibres.</td> <td></td> </tr> </table>	They are blocked by sun-screens.		They are electromagnetic radiation.	✓	They can remove electrons from atoms.	✓	They have lower frequencies than microwaves.		They are used to carry information in optic fibres.		2	
They are blocked by sun-screens.														
They are electromagnetic radiation.	✓													
They can remove electrons from atoms.	✓													
They have lower frequencies than microwaves.														
They are used to carry information in optic fibres.														
	(b)	(i) <p>ultraviolet stopped / blocked / absorbed by skin / cannot penetrate body [1]</p> <p><b>any 2 from</b> X-rays are stopped / blocked / absorbed by (dense) parts of the body</p> <p>X-rays are not stopped / blocked / absorbed by <b>or</b> can penetrate through other (less dense) parts of the body</p> <p>idea of (shadow) picture behind body / on film / screen</p>	3	<p><b>ignore</b> comments about damage caused</p> <p><b>accept</b> bones for dense parts of the body. <b>accept</b> skin and soft tissues as less dense parts of the body</p> <p>'picture' unqualified is insufficient</p>										
		(ii) <p><b>any 3 from</b> bias in sample / samples not matched / no control group eg all had cancer / might be other cause of cancer (if Joel is wrong); small sample size / need more data;</p> <p>(the data shows a) <u>correlation</u>;</p> <p>idea that there is a mechanism for the X-rays causing cancer</p>	3	<p><b>allow</b> examples e.g. more men than women, don't know when they had X-rays</p> <p><b>accept</b> example e.g. x-rays are ionising causing cancer</p>										
<b>Total</b>			<b>8</b>											

Question	Answer	Marks	Guidance
8	<p><b>Level 3 (5–6 marks)</b> Distinguishes clearly between analogue and digital signals. Describes some steps in transmission of recorded signal. Explains advantages of digital signal. Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b> Distinguishes between analogue and digital signals. Some reference to transmission of recorded signal. Explain an advantage of digital signal. Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Describes an analogue signal OR a digital signal. Describes an advantage of a digital signal. Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to B</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>Distinguishes differences</b></p> <ul style="list-style-type: none"> <li>• analogue signal varies continuously</li> <li>• digital signal has only two values</li> </ul> <p><b>Description of transmission</b></p> <ul style="list-style-type: none"> <li>• analogue signal converted to digital signal</li> <li>• signal encoded on carrier wave</li> <li>• radio wave turned on and off</li> <li>• signal/carrier wave transmitted as electromagnetic wave/radio wave</li> <li>• receiver decodes digital signal back to analogue signal</li> <li>• loudspeaker produces analogue sound waves for Rai to hear</li> <li>• noise picked up in transmission</li> </ul> <p><b>Advantages of digital</b></p> <ul style="list-style-type: none"> <li>• two values of digital signal easily recognised amongst noise / digital signal easily regenerated / analogue signal difficult to distinguish from noise.</li> <li>• digital signal easily stored on computer</li> <li>• digital signal easily processed by computer.</li> <li>• digital signals have a higher quality because the information received is the same as the original</li> <li>• allow more information can be transmitted</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
9	(a)	<p><b>any 3 from</b>            The sun <u>emits</u> / <u>radiates</u> light;            The moon <u>reflects</u> light;            light is <u>transmitted</u> through space / the atmosphere;            light is <u>absorbed</u> by the eye</p>	3	
	(b)	<p>(i) either calculates the cross sectional area of <b>either</b> the earth <b>or</b> the moon OR calculates the square of the ratio of <b>both</b> Earth and Moon</p> <p>13.8</p>	2	<p><b>allow</b> 3.7 or 4 (use of diameters instead of areas)</p> <p>Moon cross sectional area = 9,621,127.5 km<sup>2</sup>            Earth Cross sectional area = 132,732,289.6 km<sup>2</sup>            Moon diameter<sup>2</sup> = 12,250,000 km<sup>2</sup>            Earth diameter<sup>2</sup> = 169,000,000 km<sup>2</sup>  <b>accept</b> 130<sup>2</sup>/35<sup>2</sup> or 26<sup>2</sup>/7<sup>2</sup></p> <p>correct numerical answer gains both marks  <b>accept</b> 13.5 to 14</p> <p><b>ignore</b> units</p>
		<p>(ii) the Earth has an atmosphere <b>and</b> this increases the temperature/keeps it warm/            OR            the greenhouse effect raises temperature</p>	1	<p><b>ignore</b> references to ozone layer</p> <p><b>accept</b> consistent albedo argument - the earth reflects less energy back into space and the moon reflects more energy</p>
<b>Total</b>			<b>6</b>	



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