

Physics A

General Certificate of Secondary Education

Unit **A182/02**: Unit 2 – Modules P4, P5, P6 (Higher Tier)

Mark Scheme for June 2012

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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 scoris to annotate scripts

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

Annotation	Meaning
	correct response
L1 , L2 , L3	draw attention to particular part of candidate's response
	information omitted

Subject-specific Marking Instructions

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

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.

<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 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, 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.

d. 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	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

- 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:

Descriptor	Award mark
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.

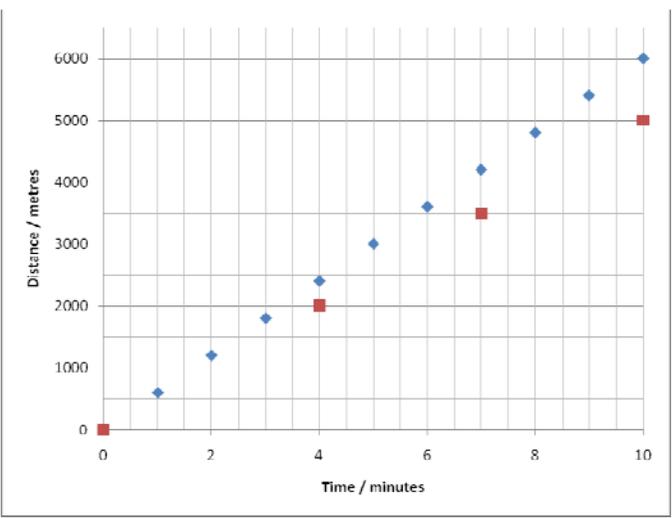
Quality of Written Communication skills assessed in 6-mark extended writing questions include:

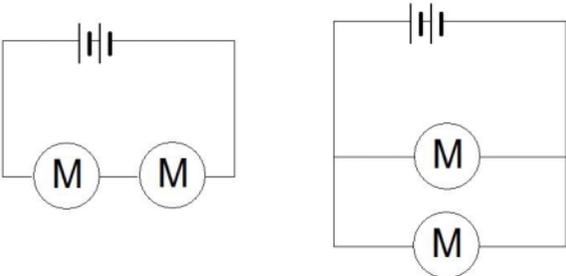
- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

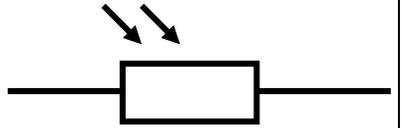
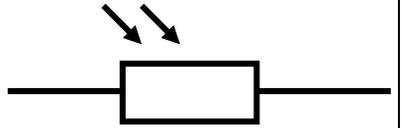
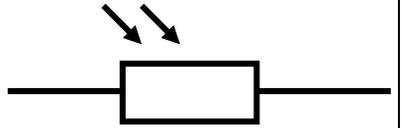
Question			Answer	Marks	Guidance
1	(a)	(i)	<div style="border: 1px solid black; padding: 2px;">Each force acts on a different object. <input checked="" type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">If the object the forces act on is stationary, the forces gradually increase in size. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">One force must be bigger than the other. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The forces act in opposite directions. <input checked="" type="checkbox"/></div>	1	Both ticks required for the mark.
		(ii)	<div style="border: 1px solid black; padding: 2px;">The friction from the beam and the weight of the beam. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The reaction of the beam and the push of the gymnast on the beam. <input checked="" type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The friction from the beam and the reaction of the beam. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The push of the gymnast on the beam and the weight of the beam. <input type="checkbox"/></div>	1	
	(b)	(i)	<div style="border: 1px solid black; padding: 2px;">The gymnast's weight increases to 750 N. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The trampoline causes the force on the gymnast to halve. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The gymnast pushes down on the trampoline with a force of 250 N. <input type="checkbox"/></div> <div style="border: 1px solid black; padding: 2px;">The trampoline transfers 250J of energy to the gymnast. <input checked="" type="checkbox"/></div>	1	
		(ii)	0.5 m	1	

Question		Answer	Marks	Guidance																								
	(iii)	<p>GPE → KE (when falling); (1) KE → elastic (as trampoline stretches); (1) Elastic → KE (as trampoline pushes gymnast back into the air); (1) KE → GPE (as the gymnast rises to the top of the bounce); (1) energy losses as heat/ sound (does not return to same height) (e.g. either to air via air resistance/or to trampoline as heat) (1)</p> <p>3 Max</p>	3	<p>additional marking points allow correct higher level responses involving energy change from the muscles of the gymnast (e.g. energy put in by gymnast during the bounce from muscles in legs to the stretching of trampoline/ energy transfers from chemical energy in food etc.) – 1 mark for each correct energy change</p>																								
	(c)	<table border="1"> <thead> <tr> <th></th> <th>increase</th> <th>stays same</th> <th>decreases</th> </tr> </thead> <tbody> <tr> <td>counter force</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>upwards force</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>driving force</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>weight</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>momentum of cyclist</td> <td></td> <td>✓</td> <td></td> </tr> </tbody> </table>		increase	stays same	decreases	counter force	✓			upwards force		✓		driving force	✓			weight		✓		momentum of cyclist		✓		3	<p>5 correct for 3 3 or 4 correct for 2 marks 2 correct for 1 mark</p>
	increase	stays same	decreases																									
counter force	✓																											
upwards force		✓																										
driving force	✓																											
weight		✓																										
momentum of cyclist		✓																										
Total			10																									

Question	Answer	Marks	Guidance
2	<p>[Level 3] Calculation of momentum and/ or force correct. Clear comparison, using the data, showing reduced force with crumple zone. Relates this to reduction in injuries and the benefit of government legislation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Correct partial attempt at a calculation e.g. momentum of one vehicle. Sensible discussion linking crumple zone to increased impact time therefore reduced force and hence reduction in injuries. Considers why the government would want to impose legislation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Probably no/ poor attempt at a calculation. May discuss increased time of collision reducing force of impact. Will link crumple zone to reduced force and/ or injury. May link reduced injury to legislation being beneficial. 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/A*</p> <p>Indicative scientific points may include:</p> <ul style="list-style-type: none"> • Force=change of momentum/time of impact • calculation of momentum change: $80 \times 20 = 1600$ (Ns / kg m/s) • (if mass of car+driver used =31 600kgm/s, or just car=30 000kgm/s) • calculation of force of impact: (crumple zone)$1600 / 0.8 = 2000$ N (without cz)$1600 / 0.2 = 8000$ N • (if mass of car+driver used =39 500N and 158 000N, or just car=37 500N and 150 000N) • Force reduced by a factor of 4. • crumple zone increases the time of the collision • force of collision for driver B is greater • smaller force is safer • the risk of injury is greater without crumple zones so governments would choose to make them a legal requirement to save lives. • Costs to NHS reduced by reducing injury to drivers. <p>ignore units</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	Total	6	

Question		Answer	Marks	Guidance
3	(a)	6000/600 (1) = 10 (m/s) (1)	2	Correct answer, no working=2marks allow 1 mark for 600 m/s (no conversion of minutes)
	(b) (i)		1	All four points required for the mark. Judge points to be on the intersection of the correct gridlines by eye. If no points visible, but a correct straight line is drawn then award 1 mark (BOD).
	(ii)	Recognise that the slope/gradient tells us the speed (1) The steeper the slope/gradient (the faster) (1)	2	A candidate scoring the second marking point will automatically score 2 marks. Allow: The van that goes further / specific distance e.g Van A 1000m more than Van B(1) In the same time / e.g. in 10 minutes (1)
Total			5	

Question		Answer	Marks	Guidance
4	(a)	Named device <u>and</u> description of what the motor does	1	eg "DVD player – to turn the disk" or " <u>electric</u> car – to spin the wheels"
	(b)	charge at right angles to a magnetic a force	2	all correct for two marks two or three correct for one mark
	(c) (i)	One mark for each correct circuit diagram. 	2	allow parallel with cells in the middle. allow a single cell in place of the battery symbol. allow M or "motor" in a round/square/rectangle for motor symbol. eg  one mark for the correct circuits but the wrong way around. ie parallel on the left. Max 1 mark for candidate that identifies series as the slower motor/ parallel as the faster if diagrams are incorrect/ missing.
	(ii)	In parallel (each motor has) higher p.d.; Idea that the faster motors have a higher p.d. across them; (1) Idea that the faster motors receive more current;(1) More current/ p.d. linked to higher power (1) Or Idea that the circuit with faster motors has lower resistance; (1) Lower resistance leads to more current; (1) More current/ p.d. linked to higher power (1)	3	3 marks Max Allow idea that each motor in the faster (parallel) circuit receives more energy (per second) for 1 mark. Award marks from either option in answer, but not a combination of both. (i.e. either use top 4 marking points or the bottom 3).
Total			8	

Question		Answer	Marks	Guidance															
5	(a)	<table border="1"> <thead> <tr> <th>Circuit symbols</th> <th>component</th> <th>function</th> </tr> </thead> <tbody> <tr> <td></td> <td>switch</td> <td>breaks or makes a circuit</td> </tr> <tr> <td></td> <td>cell</td> <td>resistance varies with temperature</td> </tr> <tr> <td></td> <td>thermistor</td> <td>transforms chemical energy into electrical energy</td> </tr> <tr> <td></td> <td>LDR</td> <td>resistance varies light intensity</td> </tr> </tbody> </table>	Circuit symbols	component	function		switch	breaks or makes a circuit		cell	resistance varies with temperature		thermistor	transforms chemical energy into electrical energy		LDR	resistance varies light intensity	2	<p>one mark for matching all circuit symbols with components</p> <p>one mark for matching all components with function</p>
Circuit symbols	component	function																	
	switch	breaks or makes a circuit																	
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	LDR	resistance varies light intensity																	
	(b)	Thermistor/ 	1																
	(c)	<p>calculation of power; (1)</p> <p>LED will be able to stay on longer (as it is lower power);(1)</p> <p>Filament lamp will waste more energy (as heat)/ LED will be more efficient (1)</p> <p>Max 2</p>	2	<p>Only one power calculation needed for 1st mark.</p> <p>LED = 0.0015 (W), filament lamp = 0.15 (W)</p> <p>Ignore units for power.</p> <p>2nd mark is for a comparative statement.</p>															
	(d)	<p>there is a correlation (between age and time lit); (1)</p> <p>there may be other causes for the correlation/example of alternative cause (eg amount of light on solar panel); (1)</p> <p>not enough data/ only 6 readings/ collect data over a longer period (1)</p> <p>Max 2</p>	2	<p>Correlation can be described from data for first marking point.</p>															
Total			7																

Question	Answer	Marks	Guidance
6	<p>[Level 3] Refers to charging, discharging and risk. Gives a detailed account of at least one of these. No significant errors in science. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Candidate produces a coherent discussion of charging/ discharging and/ or risk. Few, if any, errors of science are present. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Attempts to discuss either charging/ discharging or risk. Discussion of these may contain limited reference to correct scientific terms. 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 Indicative scientific points may include:</p> <ul style="list-style-type: none"> • when the shoes and carpet rub, charges/ electrons are transferred • the shoes and carpet are insulators • charges can not move through insulators • negative charges/electrons are transferred • touching the metal causes charges/electrons to flow to the rail • metal is a conductor • metal contains charges that are free to move • some electric shocks may cause heart attacks • consequences of these shocks are unlikely to be dangerous • Many people experience these shocks with no observed effects • Some people may be more at risk than others <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	Total	6	

Question		Answer	Marks	Guidance												
7	(a)	W: electron X: nucleus Y: proton Z: neutron	2	Answers must be in the correct order. one mark for W and X correct one mark for Y and Z correct												
	(b)	<table border="1"> <tbody> <tr> <td>alpha particle scattering</td> <td></td> <td>The nucleus is small, negative and has no mass.</td> </tr> <tr> <td>beta decay</td> <td></td> <td>The nucleus is large, negative and has no mass.</td> </tr> <tr> <td>nuclear fission</td> <td></td> <td>The nucleus is small positive and has mass.</td> </tr> <tr> <td>nuclear fusion</td> <td></td> <td>The nucleus is small, positive and has no mass.</td> </tr> </tbody> </table>	alpha particle scattering		The nucleus is small, negative and has no mass.	beta decay		The nucleus is large, negative and has no mass.	nuclear fission		The nucleus is small positive and has mass.	nuclear fusion		The nucleus is small, positive and has no mass.	1	
alpha particle scattering		The nucleus is small, negative and has no mass.														
beta decay		The nucleus is large, negative and has no mass.														
nuclear fission		The nucleus is small positive and has mass.														
nuclear fusion		The nucleus is small, positive and has no mass.														
	(c) (i)	Strong	1													
	(ii)	Protons (in the nucleus) are positively charged (so protons will repel each other pushing the nucleus apart); (so an attractive force is needed) to overcome the force of repulsion.	2													
Total			6													

Question		Answer	Marks	Guidance												
8	(a)	<p>(yes/ maybe) The means are (very) different (1) The ranges of the two sets of data do not overlap (1)</p> <p>(no/ maybe) Sensible suggestion to account for Billy's results being higher (1)</p> <p>2 Max</p>	2	<p>Allow average in place of mean.</p> <p>Allow a correct numerical comparison of the two data sets for either of the first two marking points.</p> <p>Sensible suggestions may include; Billy's detector was closer/ Billy used more salt / Billy's background count was higher etc.</p>												
	(b)	<table border="1"> <tr> <td>take measurements without the low-sodium salt</td> <td></td> <td>to remove gamma rays</td> </tr> <tr> <td>repeat the experiment with paper on top of the container</td> <td></td> <td>to allow for background radiation</td> </tr> <tr> <td>heat the low-sodium salt</td> <td></td> <td>to break down the molecules</td> </tr> <tr> <td>dissolve the low-sodium salt in acid</td> <td></td> <td>to mix the particles properly</td> </tr> </table>	take measurements without the low-sodium salt		to remove gamma rays	repeat the experiment with paper on top of the container		to allow for background radiation	heat the low-sodium salt		to break down the molecules	dissolve the low-sodium salt in acid		to mix the particles properly	1	
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heat the low-sodium salt		to break down the molecules														
dissolve the low-sodium salt in acid		to mix the particles properly														
	(c) (i)	4 minutes	1													

Question		Answer	Marks	Guidance								
	(ii)	<table border="1"> <tr> <td>The book was wrong as half-lives are always short.</td> <td><input type="checkbox"/></td> </tr> <tr> <td>The experiment was wrong as half-lives are always long.</td> <td><input type="checkbox"/></td> </tr> <tr> <td>They could both be right, as half-lives can vary widely for the same isotope.</td> <td><input type="checkbox"/></td> </tr> <tr> <td>They could both be right, as half-lives can vary widely between different isotopes.</td> <td><input checked="" type="checkbox"/></td> </tr> </table>	The book was wrong as half-lives are always short.	<input type="checkbox"/>	The experiment was wrong as half-lives are always long.	<input type="checkbox"/>	They could both be right, as half-lives can vary widely for the same isotope.	<input type="checkbox"/>	They could both be right, as half-lives can vary widely between different isotopes.	<input checked="" type="checkbox"/>	1	
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	(d)	Beta/ β / e^-	1									
		Total	6									

Question	Answer	Marks	Guidance
9	<p>[Level 3] Evidence of detailed knowledge of ionising radiation linked to health with no obvious errors in science. Good use made of data from the article in forming an opinion. Considers alternative arguments related to the benefits of nuclear power and/ or limitations in the data. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Good knowledge of ionising radiation, at least some of which is linked to health effects. An argument is formed based on some of the data in the article – may be one sided. Possible limitations to the data may be referred to. May look at alternative explanations or reasons against closure. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Refers to some relevant facts regarding ionising radiation. May make some reference to data in the article to support their argument. Any suggestion as to a course of action is likely to consider only one side of the argument. 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/A*</p> <p>Indicative scientific points may include:</p> <ul style="list-style-type: none"> • ionising radiation can break molecules in cells into bits that can go on to take part in chemical reactions • idea of relative ranges of alpha, beta and gamma • idea of the difference between contamination and irradiation • plausible explanations for the correlation • the study had a large sample size • the study was conducted by a well known university and for the government • consideration of drawbacks involved with closing nuclear power stations e.g. energy supply, unemployment etc. • other mechanisms of causing cancer (viruses etc). <p>ignore references to nuclear waste</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
	Total	6	

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