



Mark Scheme (Results)

Summer 2013

International GCSE
Physics (4PH0) Paper 1PR

Science Double Award (4SC0)
Paper 1PR

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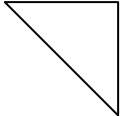
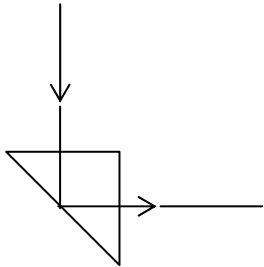
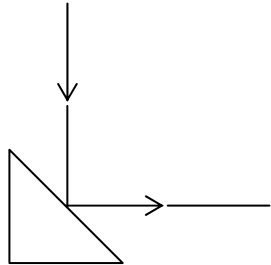
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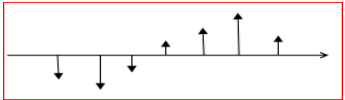
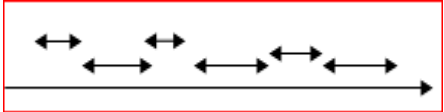
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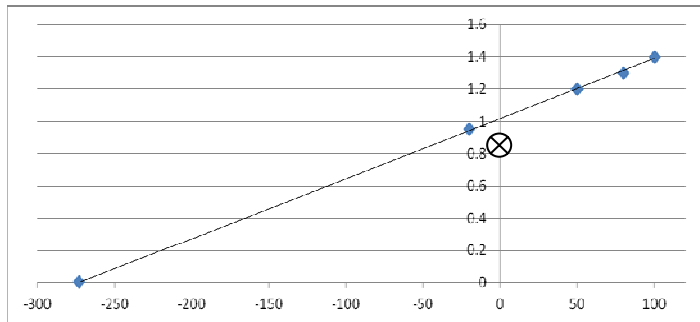
Question number		Answer	Notes	Marks
1 (a)		total internal reflection	Accept TIR	1
1 (b) (i)		prism drawn in correct orientation (by eye) 	Accept a freehand sketch of the triangular prism Size of prism unimportant, e.g. can fill the entire square, but horizontal and vertical edges must be drawn	1
1 (b) (ii)		correct reflection of rays (by eye): 	Accept freehand sketch Accept correct external reflection e.g. reflection as shown below gets 1 mark for 1(b)(ii) despite the error in the 1(b)(i) response 	1

Question number	Answer	Notes	Marks
2 (a) (i)	B- 2 cm		1
(ii)	C- 8 cm		1
(b)	<p>Idea that in a transverse wave the direction of vibration is perpendicular to the direction of the wave; (May be shown with labels on the diagram)</p> <p>Idea that longitudinal wave the direction of vibration is parallel to the direction of the wave; (May be shown with labels on the diagram)</p> <p>A named freehand sketch of either wave indicating the two directions; e.g.</p>  <p>transverse</p>  <p>Longitudinal</p>	<p>Allow (for vibration) oscillation / displacement / disturbance (for direction of wave) direction of travel / energy / transfer (for perpendicular) at right angles, is \perp to (for parallel) the same as, //</p> <p>the minimum labelling is to name of the type of wave they have drawn.</p> <p>Allow sine waves with appropriate arrows</p> <p>Allow diagrams indicating compression and rarefaction e.g. in a spring</p> <p>Allow for 1 mark (but only if other mark is scored) a comparison of the directions of vibration of both waves without relating them to the direction of the wave</p> <p>e.g. transverse vibrates up and down but longitudinal vibrates back and forward</p>	3
(c)	any two of		2

		<p>MP1 can travel through vacuum OR needs no medium;</p> <p>MP2 speed (in a vacuum) OR speed = 3×10^8 (m/s);</p> <p>MP3 obeys laws of reflection / refraction;</p> <p>MP4 obeys wave equation OR speed = frequency \times wavelength;</p> <p>MP5 carries energy/ information;</p> <p>MP6 they are transverse</p>	<p>“speed in a vacuum” where seen, scores 2 marks (MP1 and MP2)</p> <p>Accept reflect, refract, diffract</p>	
(d)	i	D - X-rays		1
	ii	A – absorbed by the bone		1
	iii	<p>X-rays OR gamma rays</p> <p>idea of causing damage to cancer cells e.g. cells killed/mutated/ionised/destroys;</p>	<p>allow symbol γ do not allow UV</p> <p>Independent mark</p>	2

Question number		Answer	Notes	Marks									
3 (a)		<table border="1" data-bbox="566 268 1142 539"><tr><td data-bbox="566 268 786 411">temperature</td><td data-bbox="786 268 965 411">boiling point of nitrogen</td><td data-bbox="965 268 1142 411">boiling point of water</td></tr><tr><td data-bbox="566 411 786 475">in °C</td><td data-bbox="786 411 965 475">-196</td><td data-bbox="965 411 1142 475"></td></tr><tr><td data-bbox="566 475 786 539">in Kelvin</td><td data-bbox="786 475 965 539"></td><td data-bbox="965 475 1142 539">373</td></tr></table> <p data-bbox="465 619 801 651">one mark for each correct;;</p>	temperature	boiling point of nitrogen	boiling point of water	in °C	-196		in Kelvin		373	ignore -273	2
temperature	boiling point of nitrogen	boiling point of water											
in °C	-196												
in Kelvin		373											

3 (b) (i)	<p>Plotting to nearest half-square (minus one for each plotting error, up to max 2 marks) ;;</p> <p>line of best fit that intersects x-axis between -250 and -300;</p> <p>(ii) point (0, 0.85) circled or otherwise indicated;</p>	<table border="1" data-bbox="1288 210 1688 584"> <thead> <tr> <th>Temperature in °C</th> <th>Volume in litres</th> </tr> </thead> <tbody> <tr> <td>-20</td> <td>0.95</td> </tr> <tr> <td>0</td> <td>0.85</td> </tr> <tr> <td>50</td> <td>1.20</td> </tr> <tr> <td>80</td> <td>1.30</td> </tr> <tr> <td>100</td> <td>1.40</td> </tr> </tbody> </table>	Temperature in °C	Volume in litres	-20	0.95	0	0.85	50	1.20	80	1.30	100	1.40	3
Temperature in °C	Volume in litres														
-20	0.95														
0	0.85														
50	1.20														
80	1.30														
100	1.40														
b(iii)	Reading from graph to nearest small square (± 5 degrees);		1												



Question number		Answer	Notes	Marks
4 (a)		any three of MP1 idea that there is current (in the wire/coil); MP2 idea that (the coil has) a magnetic field ; MP3 idea that coil's magnetic field interacts with field of permanent magnet; MP4 idea that there is a force on the coil/wire; MP5 Idea that current or force reverses every half turn;	Allow ideas of electromagnetic field, electromagnet Allow - 'magnetic fields touch / overlap' Ignore - 'cutting of magnetic fields' Allow ideas of LHM rule, Fleming's LHR, catapult field, attraction, repulsion Allow action of a commutator described	3

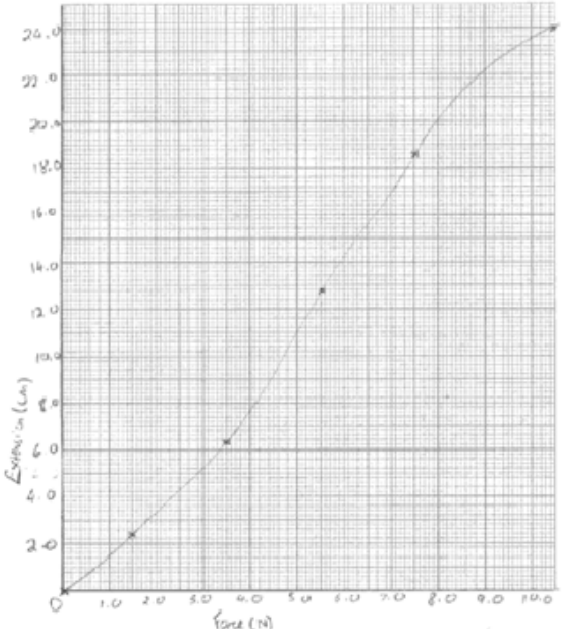
<p>(b) (i)</p>		<p>any two of</p> <p>MP1 increase magnetic field(e.g. stronger magnets or magnets closer or magnets curved round coil);</p> <p>MP2 increase current OR voltage Or more cells;</p> <p>MP3 increase number of turns (on coil);</p> <p>MP4 a sensible alternative suggestion e.g. use two or more sets of coils at angles, lubricate axle;</p>	<p>Allow “use thicker wire”</p> <p>Ignore “stronger battery”</p> <p>Allow idea of 3 phase supply, iron stator</p>	<p>2</p>
<p>(ii)</p>		<p>Suggestion that clearly results in reversal of the current OR the cell connections OR the magnet’s field;</p>		<p>1</p>
<p>(c)</p>		<p>any two of</p> <p>MP1 Idea that force is increased (by stronger field);</p> <p>MP2 Idea of radial magnetic field (rather than a uniform one);</p> <p>MP3 Coil remains in the field for a longer time;</p>	<p>Allow idea that iron is magnetised</p> <p>Allow idea that magnetic field acts “all the way around”</p> <p>Allow idea that force acts over a larger part of a cycle</p>	<p>2</p>

Question number		Answer	Notes	Marks
5	(a) B D	constant velocity of <u>5 m/s</u> Idea that velocity/speed = 0	Allow speed is <u>5 m/s</u> Allow "stops", "stationary", "at rest"	2
	(b)	Idea of greater slope (for stage E); e.g. the gradient is steeper	Allow reverse argument, provided stage A is identified e.g. "stage A has a shallower slope" Allow attempts to demonstrate through - calculation of both gradients - qualitative comparison of data	1
	(c)	distance = speed \times time OR distance = area under graph; attempt to find any area; attempt to total correct areas (or use trapezium method); evaluation; e.g. distance = area under graph 7×7 or $\frac{1}{2} \times 7 \times 3$ $(7 \times 7) + (\frac{1}{2} \times 7 \times 3) = 49 + 10.5$ 59.5 (m)	The correct relationship can be implicit in the working 59.5 (m) with no working = full marks Allow the trapezium method - e.g. $7 \times ((7+10) \div 2) = 7 \times 8.5$ = 59.5 (m)	4
	(d)	Correct equation shown ; e.g. (average speed) = distance (moved) / time (taken) Substitution of correct distance and suitable time; Correct evaluation ; e.g. $106.5/27$ 3.94 (m/s)	Allow d/t Allow (ecf) max 2 4.26 (m/s) (use of time = 25 s) 3.55 (m/s) (use of time = 30 s) Allow reverse argument max 2 e.g. $106.5 \div 4 = 26.6$ (s)	3

Question number		Answer	Notes	Marks
6 (a)	(i)	any three of Idea of collisions / impact (with walls); Continuous bombardment; force produced; Pressure = force ÷ area;	Ignore collisions between particles Allow idea of momentum changing	3
	(ii)	Idea that the student is right OR the pressure decreases; AND any two of The number(or mass) of molecules stays the same; The gas volume increases; Pressure is inversely proportional to volume; Particles collide with the wall less frequently;	Both marks depend on previous correct response (e.g. pressure decreases) Allow idea that area of can in contact with gas increases OR gas particles have more space Allow mention of $p_1V_1 = p_2V_2$ in this context Allow "longer time between collisions"	3
(b)		(Average speed) increases;		1

Question number		Answer	Notes	Marks	
7	(a)	(i)	pressure difference = height (or depth) x density x g ;	Allow $h \times \rho \times g$ (and rearrangements) Reject "gravity" for g in 7(a)(i)	1
		(ii)	substitution into correct equation; evaluation; e.g. $1028 \times 10 \times 700$ $7\,196\,000$ (Pa)	Allow standard form Allow use of $g = 9.8(1) \rightarrow 7\,059\,276$ or $7\,052\,080$	2
		(iii)	(total pressure =) $72 \times 10^5 + 1 \times 10^5$ (Pa);	Allow $7\,296\,000$ (Pa) OR answer to 7(a)(ii) + $100\,000$	1
	(b)	(i)	pressure = force/area	Allow $p = F/A$	1
		(ii)	Substitution into correct equation; Transformation; Evaluation; e.g. $41 \times 10^5 = F/3.1$ $F = 41 \times 10^5 \times 3.1$ 1.271×10^7 (N)	Substitution and transposition either order $12\,710\,000$, 127.1×10^5 , 1.3×10^7	3
	(c)		because fresh water has a lower density than sea water OR reverse argument;		1
	(d)		any five of MP1 suitable measuring instruments mentioned; e.g. measuring cylinder and (electronic) balance MP2 method of obtaining correct mass; e.g. subtract mass of container, use of tare MP3 detail to ensure accuracy of liquid volume; e.g. burette, pipette, density bottle, account taken of meniscus MP4 equation stated - density = mass \div volume; MP5 suitable units used, e.g. g for mass and cm^3 for volume MP6 Idea of appropriate repeating or averaging at any stage	Allow scales Ignore newtonmeter, weighing machine Ignore weight Allow keep temperature constant Allow $\rho = m/V$ Allow ml, l Allow "discard anomalous results"	5

Question number	Answer	Notes	Marks																		
8 (a)	<p>all 3 for both marks;;</p> <p>any two for 1 mark ;</p> <table border="1" data-bbox="385 368 1016 874"> <thead> <tr> <th data-bbox="385 368 752 437">item</th> <th data-bbox="752 368 1016 437">Tick if needed</th> </tr> </thead> <tbody> <tr> <td data-bbox="385 437 752 491">ammeter</td> <td data-bbox="752 437 1016 491"></td> </tr> <tr> <td data-bbox="385 491 752 545">steel spring</td> <td data-bbox="752 491 1016 545"></td> </tr> <tr> <td data-bbox="385 545 752 600">retort stand and clamp</td> <td data-bbox="752 545 1016 600">✓</td> </tr> <tr> <td data-bbox="385 600 752 654">rubber band</td> <td data-bbox="752 600 1016 654">given ✓</td> </tr> <tr> <td data-bbox="385 654 752 708">ruler</td> <td data-bbox="752 654 1016 708">✓</td> </tr> <tr> <td data-bbox="385 708 752 762">thermometer</td> <td data-bbox="752 708 1016 762"></td> </tr> <tr> <td data-bbox="385 762 752 817">mass hanger</td> <td data-bbox="752 762 1016 817">✓</td> </tr> <tr> <td data-bbox="385 817 752 871">mass</td> <td data-bbox="752 817 1016 871">given ✓</td> </tr> </tbody> </table>	item	Tick if needed	ammeter		steel spring		retort stand and clamp	✓	rubber band	given ✓	ruler	✓	thermometer		mass hanger	✓	mass	given ✓	each incorrect tick = -1	2
item	Tick if needed																				
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(b) i	5.5 (in the table)		1																					
ii	<p>suitable scale for axes; axes labelled with units; points plotted to nearest mm square (minus one for each plotting, up to max 2 marks);; Line (curve) of best fit acceptable;</p> 	<p>-1 for each incorrect plot Allow (ecf) a balanced straight line of best fit that takes account of any plotting errors and indicated anomalies</p> <table border="1" data-bbox="1187 507 1803 853"> <thead> <tr> <th>Mass in g</th> <th>Force in N</th> <th>Extension in cm</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0.0</td> </tr> <tr> <td>150</td> <td>1.5</td> <td>2.4</td> </tr> <tr> <td>350</td> <td>3.5</td> <td>6.3</td> </tr> <tr> <td>550</td> <td></td> <td>12.8</td> </tr> <tr> <td>750</td> <td>7.5</td> <td>18.6</td> </tr> <tr> <td>1050</td> <td>10.5</td> <td>24.0</td> </tr> </tbody> </table>	Mass in g	Force in N	Extension in cm	0	0	0.0	150	1.5	2.4	350	3.5	6.3	550		12.8	750	7.5	18.6	1050	10.5	24.0	5
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iii	<p>No / yes (no mark)</p> <p>Idea that Hooke's law should show (direct) proportionality;</p> <p>Use of data (from the table or graph) to explain that the results do not show this; e.g. 'line is a curve', '(table shows) rubber band extends unevenly'</p>	<p>Allow (ecf) - converse from <u>straight</u> drawn line, using data from their graph (not the table) e.g. 'Yes' AND 'line is a straight'</p>	2																					
		Total	10																					

Question number	Answer	Notes	Marks
9 (a) i	0.45;	no unit penalty	1
ii	Power = current \times voltage;	Allow $P = I \times V$ and rearrangements	1
iii	Substitution; Evaluation; e.g. $1.5 = I \times 0.45$ $I = 3.3$ (A) (answer to at least 2 s.f.)	Allow reverse argument yielding <u>1.35</u> (W) for 1 mark	2
(b) i	conversion of time to seconds; substitution into correct equation ($E = I \times V \times t$); evaluation; e.g. time = $7 \times 5 \times 60 \times 60$ (= 126 000) $E = 3.3 \times 9 \times 7 \times 5 \times 60 \times 60$ 3 742 000 (J)	Allow solution in stages i.e. from $P=IV$ and $P = E/t$ Allow for full marks 3 402 000 (J) (from use of 3 A given above) 3 780 000 (J) (from $1.5 \times 20 \times 7 \times 5 \times 60 \times 60$) Allow max of 1 if time not in seconds, e.g. 1040 (J) (from $3.3 \times 9 \times 7 \times 5$, time in hours) 62400 (J) (from $3.3 \times 9 \times 7 \times 5 \times 60$, time in minutes)	3
ii	A description to include electrical; to light (and heat);	Reject "electricity" for the first mark Allow chemical to electrical to light for 1 mark only	2
		Total	9

Question number	Answer	Notes	Marks
1 (a)	<p>i MP1 Any circuit including correct circuit symbols for</p> <ul style="list-style-type: none"> • battery /cell / d.c. power supply • ammeter • voltmeter ; <p>ii MP2 ammeter clearly measures current through the wire; MP3 voltmeter clearly across wire;</p> <p>Idea of measuring current through the wire;</p> <p>Idea of measuring voltage across the wire;</p> <p>Idea of a range of values (of I and V); e.g. alter variable resistor OR repeat for different voltages</p>	<p>ignore other components for MP1</p> <p>allow even if voltmeter in series with ammeter allow circuit line drawn through meter allow voltmeter across a section of the test wire</p>	<p>3</p> <p>3</p>
(b)	<p>i any one of resistance changes (with temperature) ;</p> <p>ii wire gets hot and melts/burns/catches fire/dangerous; V proportional to I only at constant temperature;</p> <p>(c) Ohms Law is only true if temperature constant;</p> <p>i any one of putting the wire in a water bath ; taking the reading quickly; switching off between readings; using only small currents; voltage = current × resistance ;</p> <p>ii horizontal line above axis;</p>	<p>Reject incorrect relationship between R and θ</p> <p>Ignore damage to wire</p> <p>Reject insulating the wire</p> <p>Allow to return to room temperature</p> <p>Allow $V = I \times R$ and rearrangements</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>

		Total	10
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Question number	Answer	Notes	Marks
11 (a) i	GPE = mass $\times g \times$ height ;	Allow GPE = $m \times g \times h$ and rearrangements	1
ii	Substitution into correct equation; Evaluation; e.g. $0.25 \times 10 \times 1.75$ 4.375 (J)	Reject "gravity" for g in 11(a)(i) 4.4, 4.38 Allow use of 9.81 (or 9.8) \rightarrow 4.29 for full marks	2
(b)	Value given in 11(a)(ii);		1
(c) i	KE = $\frac{1}{2} \times$ mass \times speed ² ;	Allow KE = $\frac{1}{2} \times m \times v^2$ and rearrangements	1
ii	Substitution into correct equation; Transformation; Evaluation; e.g. $3.1 = \frac{1}{2} \times 0.25 \times v^2$ $v^2 = 3.1 \div \frac{1}{2} \times 0.25$ $v = 4.98$ (m/s)	Substitution and transposition either order Accept 5.0, 5 and allow truncation e.g. 4.97 m/s	3
		Total	11

Question number		Answer	Notes	Marks
12 (a)		<p>A description to include any 5 of MP1 nucleus absorbs neutron OR nucleus hit by neutron; MP2 splits into (two) fragments/parts OR daughter atoms OR daughter nuclei; MP3 extra neutrons released; MP4 (kinetic) energy released; MP5 released neutrons hit further nuclei OR uranium nuclei; MP6 moderator slows down the neutrons/ makes it more likely for a neutron to be absorbed; MP7 control rods absorb extra neutrons; MP8 idea that control rods help prevent a "runaway" chain reaction;</p>	<p>Correct process using consistently incorrect particle instead of neutron (e.g. electron) = max 4 NB uranium, U-235 or nucleus must be mentioned Reject cells, molecules, more uranium Ignore heat allow atoms OR uranium atoms</p>	5
(b)		kinetic/movement energy;		1
(c)		Idea that the shielding absorbs radiation / particles / energy;	<p>Allow "stops radiation /particles from escaping" Ignore "radioactivity" escaping</p>	1
			Total	12

Question number	Answer	Notes	Marks
13 (a) i	<p>there is a voltage;</p> <p>And one of (because there is a) change of flux OR field (lines) are cut; (which is) an induced voltage / emf;</p>	<p>Allow induced current</p>	2
ii	<p>greater deflection/voltage;</p> <p>Idea that rate of change of flux (linkage) is greater; eg more magnetic field lines cutting coil (per second)</p>	<p>ignore speed of magnet</p>	2
(b) i	<p>Idea that deflection is smaller;</p>		1
ii	<p>Idea that deflection is greater;</p>		1
iii	<p>Idea that deflection is in opposite direction;</p>		1
		Total	7

Question number	Answer	Notes	Marks
14 (a) i	(Nuclei / atoms) with same number of protons OR same atomic number; different number of neutrons OR different mass number;	Ignore electrons Allow "(nuclei) of the same element" Allow different number of nucleons	2
	ii (stable isotopes) do not emit (ionising) radiation OR (stable isotopes) do not emit alpha, beta and gamma radiation ;	Ignore "radioactive", "decay" ignore idea of remaining the same element for ever	1
(b) i	210 – 84 OR 126		1
	ii ideas that proton number increases by 1; neutron number decreases by 1;	allow a calculation / nuclear equation Ignore discussion of "number of nucleons"	2
	iii beta decay	allow β or β^- or β^+	1
(c)	Any two of idea that gamma is not a particle; e.g. gamma rays have no (rest) mass gamma rays do not have a proton number gamma rays do not contain any protons or neutrons gamma rays are electromagnetic radiation OR energy; no particles are lost (from the nucleus) when a gamma ray is emitted;	Allow photons	2
		Total	9

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