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Mark Scheme (Results)

Summer 2013

International GCSE
Physics (4PH0) Paper 1PR

Science Double Award (4SC0)
Paper 1PR

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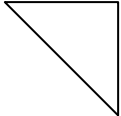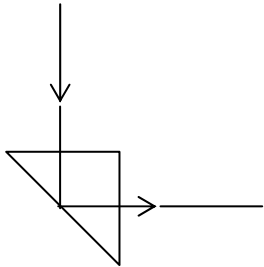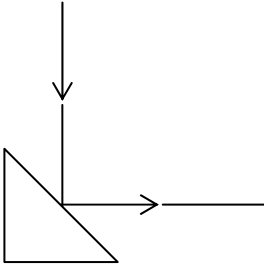**Pearson: helping people progress, everywhere**

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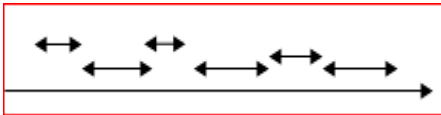
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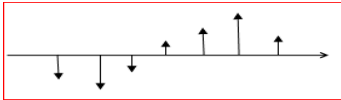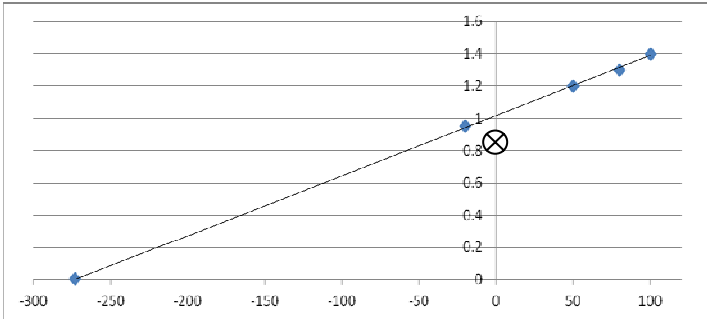| Question number			Answer	Notes	Marks
1 (a)			total internal reflection	Accept TIR	1
(b)	(i)		prism drawn in correct orientation (by eye)	Accept a freehand sketch of the triangular prism Size of prism unimportant, e.g. can fill the entire square, but horizontal and vertical edges must be drawn	1
	(ii)		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)			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) Idea that longitudinal wave the direction of vibration is parallel to the direction of the wave; (May be shown with labels on the diagram) A named freehand sketch of either wave indicating the two directions; e.g. transverse Longitudinal	Allow (for vibration) oscillation / displacement / disturbance (for direction of wave) direction of travel / energy / transfer (for perpendicular) at right angles, is ⊥ to (for parallel) the same as, // the minimum labeliing is to name of the type of wave they have drawn. Allow sine waves with appropriate arrows Allow diagrams indicating compression and rarefaction e.g. in a spring 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 e.g. transverse vibrates up and down but longitudinal vibrates back and forward	3
(c)			any two of		2

			MP1 can travel through vacuum OR needs no medium;		
			MP2 speed (in a vacuum) OR speed = 3 X10^8 (m/s);	"speed in a vacuum" where seen, scores 2 marks (MP1 and MP2)	
			MP3 obeys laws of reflection / refraction;	Accept reflect, refract, diffract	
			MP4 obeys wave equation OR speed = frequency × wavelength;		
			MP5 carries energy/ information;		
			MP6 they are transverse		
(d)	i		D - X-rays		1
	ii		A – absorbed by the bone		1
	iii		X-rays OR gamma rays	allow symbol γ do not allow UV	2
			idea of causing damage to cancer cells e.g. cells killed/mutated/ionised/destroys;	Independent mark	

Question number		Answer	Notes	Marks
3 (a)			ignore -273	2

temperature	boiling point of nitrogen	boiling point of water
in °C	-196	
in Kelvin		373

one mark for each correct;;

3	(b)	(i)		Plotting to nearest half-square (minus one for each plotting error, up to max 2 marks) ;;				3

line of best fit that intersects x-axis between -250 and -300;

Temperature in °C	Volume in litres
− 20	0.95
0	0.85
50	1.20
80	1.30
100	1.40

(ii)   point (0, 0.85) circled or otherwise indicated;

1

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

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

Question number		Answer	Notes	Marks
5 (a) B		constant velocity of <u>5 m/s</u>	Allow speed is <u>5 m/s</u>	2
D		Idea that velocity/speed = 0	Allow "stops", "stationary","at rest"	
(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 × 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 ½ × 7 × 3 (7 × 7) + (½ × 7 × 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 × ((7+10) ÷ 2) = 7 × 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 ÷ 4 = 26.6 (s)	3

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

Question number			Answer	Notes	Marks
7 (a) (i)			pressure difference = height (or depth) x density x g ;	Allow h × ρ × g (and rearrangements) Reject "gravity" for g in 7(a)(i)	1
(ii)			substitution into correct equation; evaluation; e.g. 1028 X 10 X 700 7 196 000 (Pa)	Allow standard form Allow use of g = 9.8(1) → 7 059 276 or 7 052 080	2
(iii)			(total pressure =) 72 x10^5 + 1 x 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 × 10^5 = F/3.1 F= 41 × 10^5 x 3.1 1.271 x 10^7 (N)	Substitution and transposition either order 12 710 000, 127.1 x 10^5, 1.3 x 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 ÷ 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 ρ=m/V Allow ml, l Allow "discard anomalous results"	5

Question number	Answer	Notes	Marks
8 (a)	all 3 for both marks;; any two for 1 mark ; 	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

(b)	I	5.5 (in the table)		1
	ii	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; 	-1 for each incorrect plot Allow (ecf) a balanced straight line of best fit that takes account of any plotting errors and indicated anomalies | 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
	iii	No / yes (no mark) Idea that Hooke's law should show (direct) proportionality; 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'	 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'	2
			Total	10
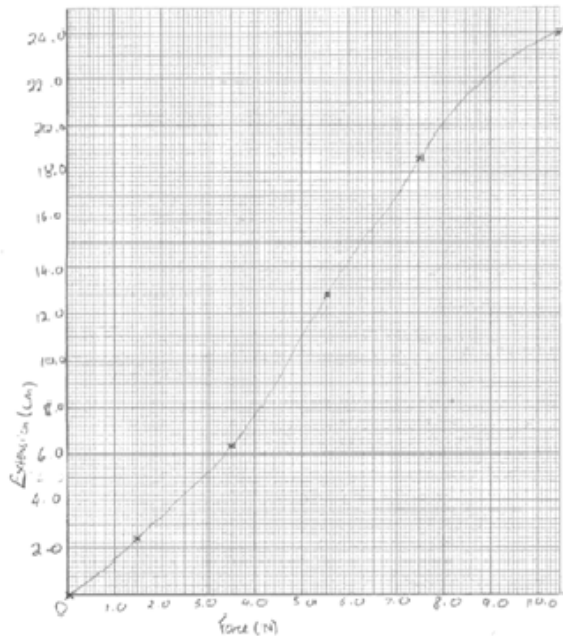
Question number			Answer	Notes	Marks
9	(a)	I	0.45;	no unit penalty	1
		ii	Power = current × voltage;	Allow P = I × V and rearrangements	1
		iii	Substitution; Evaluation; e.g. 1.5= I x 0.45 I = 3.3 (A) (answer to at least 2 s.f.)	Allow reverse argument yielding <u>1.35</u> (W) for 1mark	2
	(b)	i	conversion of time to seconds; substitution into correct equation (E = I × V × t); evaluation; e.g. time = 7 × 5 × 60 × 60 (= 126 000) E = 3.3 x 9 x 7 x 5 x 60 x 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 x 20 x 7 x 5 x 60 x 60) Allow max of 1 if time not in seconds, e.g. 1040 (J) (from 3.3 x 9 x 7 x 5, time in hours) 62400 (J) (from 3.3 x 9 x 7 x 5 x 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 0	(a)	I	MP1 Any circuit including **correct circuit symbols** for • battery /cell / d.c. power supply • ammeter • voltmeter ;	ignore other components for MP1	3
		ii	MP2 ammeter clearly measures current through the wire; MP3 voltmeter clearly across wire; Idea of measuring current through the wire; Idea of measuring voltage across the wire; Idea of a range of values (of I and V); e.g. alter variable resistor OR repeat for different voltages	allow even if voltmeter in series with ammeter allow circuit line drawn through meter allow voltmeter across a section of the test wire	3
(b)		i	any one of resistance changes (with temperature) ;	Reject incorrect relationship between R and Θ	1 1
		ii	wire gets hot **and** melts/burns/catches fire/dangerous; V proportional to I only at constant temperature;	Ignore damage to wire Reject insulating the wire	1
	(c)		Ohms Law is only true if temperature constant; any one of	Allow to return to room temperature	
		i	putting the wire in a water bath ; taking the reading quickly; switching off between readings; using only small currents; voltage = current × resistance ;	Allow V = I × R and rearrangements	
		ii	horizontal line above axis;		1

| 10 | Total | 10 |

Question number			Answer	Notes	Marks
11	(a)	i	GPE = mass × g × height ;	Allow GPE = m × g × h and rearrangements	1
		ii	Substitution into correct equation; Evaluation; e.g. 0.25 x 10 x 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) → 4.29 for full marks	2
	(b)		Value given in 11(a)(ii);		1
	(c)	i	KE = ½ × mass × speed^2 ;	Allow KE = ½ × m × v^2 and rearrangements	1
		ii	Substitution into correct equation; Transformation; Evaluation; e.g. 3.1 = ½ × 0.25 × v^2 v^2 = 3.1 ÷ ½ × 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)		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;	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	5
(b)		kinetic/movement energy;		1
(c)		Idea that the shielding **absorbs** radiation / particles / energy;	Allow "stops radiation /particles from escaping" Ignore "radioactvity" escaping	1
	1		**Total**	**12**

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