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Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE

In Physics (4PH1) Paper 1PR and (Science Double Award) (4SD0) Paper 1PR

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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<table>
<tr><th colspan="2">Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>B (124);

A is incorrect because this is the number of protons
C is incorrect because this is the number of protons and neutrons
D is incorrect because this is twice the number of protons added to the neutrons</td><td></td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>C (a high frequency electromagnetic wave);

A is incorrect because this is the description of alpha radiation
B is incorrect because this is the description of beta radiation
D is incorrect because this is the description of neutron radiation</td><td></td><td>1</td></tr>
<tr><td></td><td>(c)</td><td>all 4 rows correct = 3 marks;;;
2-3 rows correct = 2 marks;;
any 1 row correct = 1 mark;

<table>
<tr><th>Variable</th><th>Independent variable</th><th>Dependent variable</th><th>Control variable</th></tr>
<tr><td>count measured using the detector</td><td></td><td>✓</td><td></td></tr>
<tr><td>distance between source and detector</td><td></td><td></td><td>✓</td></tr>
<tr><td>number of lead sheets</td><td>✓</td><td></td><td></td></tr>
<tr><td>time period for measuring the count</td><td></td><td></td><td>✓</td></tr>
</table>

more than one tick in a row negates the mark for that row</td><td></td><td>3</td></tr>
</table>

Total for Question 1 = 5 marks

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Question number	Answer	Notes	Marks
2 (a)	D (ultraviolet); A is incorrect because frequencies lower than visible light are non-ionising B is incorrect because frequencies lower than visible light are non-ionising C is incorrect because frequencies lower than visible light are non-ionising		1
(b)	one use for x-rays; e.g. taking photos or detecting of (broken) bones, internal structures (of objects), one use for gamma rays; e.g. radiotherapy, sterilising medical equipment, reference to tracing, airport scanning of luggage, irradiating food (for preservation)	 allow treating cancer / sterilising medical equipment allow treating cancer	2
(c) (i)	speed = frequency × wavelength;	allow standard symbols and rearrangements e.g. $\lambda = v / f$ condone s for speed	1
(ii)	substitution; rearrangement; evaluation; e.g. $3.0 \times 10^{8} = 2.8 \times 10^{19} \times$ wavelength wavelength = speed / frequency (wavelength =) 1.1×10^{-11} (m)	 -1 for POT error allow $1.07\ldots \times 10^{-11}$ (m)	3
(d)	B; A is incorrect because it shows an exponential relationship C is incorrect because it shows a proportional relationship D is incorrect because it shows no relationship		1

Total for Question 2 = 8 marks

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Question number		Answer	Notes	Marks
3 (a)		idea that like poles repel;		1
(b)		it is made of plastic / idea that plastic is non-magnetic;		1
(c)		correct shape e.g. lines deviating away from both magnets; correct direction e.g. any arrows must face towards poles;	reject if any field lines touch or cross except at pole	2
(d)	(i)	reading will increase; (because) magnetic field / (repulsive) force will be stronger;	allow statement to the effect that magnet B will be pushed down more (by magnet A)	2
	(ii)	reading will decrease; (because) magnets will now attract;	allow reading will become negative / zero ; allow statement to the effect that magnet B will be pulled upwards	2

Total for Question 3 = 8 marks

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Question number	Answer	Notes	Marks
4 (a)	both have magnitude; (only) vectors have a direction;		2
(b)	charge; power; temperature;	if 4 circled, 2 marks max. if 5-6 circled, 1 mark max. no marks if all circled	3
(c)	(resultant force =) 6 (N); (direction =) left;	ignore sign allow indication of same direction as 8 (N) force condone West	2

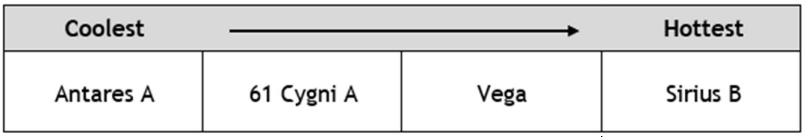
Total for Question 4 = 7 marks

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Question number	Answer	Notes	Marks
5 (a)	idea that 15% of **total** energy; is transferred **usefully**;	allow reverse argument e.g. 85% of total energy is wasted	2
(b)	correct efficiency read from graph; substitution into efficiency formula; rearrangement; evaluation; e.g. 90% or 0.9 seen in working 0.9 = 6.0 / total energy input total energy input = useful energy / efficiency (total energy input =) 6.7 (kJ)	 allow ecf from incorrect efficiency allow working in J or kJ allow any correctly rounded value for 4 marks allow 6.6 or 6.6 recurring (kJ) for 3 marks	4
(c) (i)	uranium or plutonium;	allow specifically named fuel e.g. uranium-235, plutonium-239 condone incorrect isotope number	1
(ii)	neutron; unstable; daughter; neutrons; kinetic;		5

Total for Question 5 = 12 marks

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Question number	Answer	Notes	Marks
6 (a) (i)	;;; all four stars in the correct positions = 3 marks any two stars in the correct positions = 2 marks any 1 star in the correct position = 1 mark  		3
(ii)	Antares (A);		1
(b)	any three from: MP1. nebula is (cold) cloud of dust/gas; MP2. gravity causes cloud to collapse/eq; MP3. temperature of cloud increases/eq; MP4. creating a protostar; MP5. idea that (main sequence star created when) fusion starts;		3
(c)	any four from: MP1. idea that hydrogen fusion stops (in core); MP2. core collapses; MP3. core temperature of star increases; MP4. (star expands to) become a red (super) giant; MP5. surface temperature of star decreases (during red giant phase) MP6. helium fusion begins; MP7. white dwarf formed when helium fusion stops (in core); MP8. idea of rest of star released (as a planetary nebula);	condone idea of hydrogen runs out allow star collapses	4

Total for Question 6 = 11 marks

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Question number	Answer	Notes	Marks
7 (a)	any five from MP1-MP7:	allow marking points from diagram	6
	apparatus:		
	MP1. method of creating thin beam of light;	e.g. laser, ray box etc. ignore torch	
	MP2. protractor;		
	method:		
	MP3. draw round the block;		
	MP4. shine light into the block at an angle to the normal;	however expressed	
	MP5. mark incident and refracted rays;		
	MP6. measure angles from the normal;		
	MP7. repeat for different angles of incidence;		
	PLUS		
	MP8. graph of sin(i) and sin(r) with n found from gradient	allow simple use of n=sin(i)/sin(r)	
(b)	optical fibres; named prismatic use e.g. cats eye reflector, binoculars, periscope etc;		2

Total for Question 7 = 8 marks

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Question number	Answer	Notes	Marks
8 (a) (i)	reflection;		1
(ii)	substitution into speed = distance / time;	ignore units condone incorrect conversion of time from 43 ms i.e. 43, 43/60, 43 × 1000, 43 × 60	4
	rearrangement; evaluation of correct total distance; halved to find distance to fish;	accept wherever applied i.e. to the time or to the distance travelled.	
	e.g. 1500 = distance / 0.043 distance = speed × time (distance =) 64.5 (distance = 64.5 ÷ 2) = 32 (m)	64.5, 65 = 3 marks (no halving) 32250 etc = 3 marks (POT) 64500 etc = 2 marks (POT and no halving)	
(b) (i)	3.0 ± 0.5 (cm);	accept '3'	1
(ii)	any three from: MP1. all frequencies show reduction in amplitude or intensity with distance; MP2. this reduction is non-linear; MP3. penetration decreases with increasing frequency; MP4. use of data from graph to justify MP3;	ignore 'inverse proportion' condone '(negative) exponential' however expressed e.g. 2MHz penetrates more than 4 MHz which penetrates more than 10MHz e.g. relative values at a given distance or distances at which the frequencies are at a given value	3

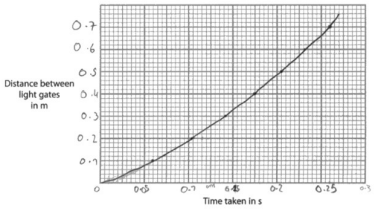
Total for Question 8 = 9 marks

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Question number	Answer	Notes	Marks
9 (a)	LED drawn on branch of circuit containing only R_1; LED drawn in the correct orientation;		2
(b) (i)	correct ammeter symbol drawn on main branch of circuit and in series with cell;		1
(ii)	voltage across R_2 is the same / 4.5 V; (because) they are in parallel;	allow higher level answers in terms of energy transferred per unit charge	2
(c) (i)	energy (transferred) = charge × voltage;	allow standard symbols and rearrangements e.g. Q = E / V reject C for charge	1
(ii)	substitution; rearrangement; evaluation; e.g. 4.1 = charge × 4.5 (charge =) 4.1 / 4.5 (charge =) 0.91 (C)	 allow 0.911…(C)	3
(iii)	idea that a voltmeter is needed; voltmeter should be connected across / in parallel (with R_2); suitable means of varying circuit current described;	 e.g. changing number of cells, using a variable power supply, adding variable resistor to the circuit	3

Total for Question 9 = 12 marks

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Question number	Answer	Notes	Marks
10 (a) (i)	substitution into $a = \Delta v / t$; evaluation to 3 or more s.f.; e.g. acceleration = (4.20 – 1.45) / 0.286 (acceleration =) 9.62 (m/s^2)		2
(ii)	idea that air resistance / friction also acts on ball; which opposes the ball's weight;	allow drag allow idea that frictional force is upwards whilst weight is downwards allow idea that resultant force is less that weight ignore idea of reaction time / other human errors	2
(iii)	substitution into $v^2 = u^2 + 2 \times a \times s$; rearrangement; evaluation; e.g. $4.20^2 = 1.45^2 + (2 \times 9.6 \times s)$ $s = (v^2 - u^2) / 2a$ (s =) 0.809 (m)	allow use of a=9.6, 9.8, 9.81 or 10 reject 'change in speed × time' giving 0.78(65) as incorrect physics allow answers using correct average velocity. allow range 0.78-0.81 (m)	3
(b) (i)	suitable scale on both axes; all points plotted correctly to nearest half square;  		2
(ii)	smooth curve drawn with an even distribution of data points either side;	ECF candidate plotting	1
(iii)	gradient of graph is equal to the speed / velocity of the ball; gradient is increasing (as time increases); speed / velocity is increasing (as time increases);	 allow "curve gets steeper" allow idea of greater distance in a unit of time DOP award 1 mark for idea that graph is a curve if no other marks awarded	3

Total for Question 10 = 13 marks

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Question number	Answer	Notes	Marks
11 (a)	substitution into $p_1 \times V_1 = p_2 \times V_2$ OR rearrangement; evaluation of volume; correctly expressed in standard form; e.g. $100 \times 0.0043 = 270 \times V_2$ OR $V_2 = p_1 \times V_1 / p_2$ (V_2 =) 0.0016 (m^3) (V_2 =) 1.6×10^{-3} (m^3)	 allow 0.00159… (m^3) allow $1.59… \times 10^{-3}$ (m^3)	3
(b) (i)	idea that particles move more slowly at lower temp; particles collide with walls less often; particles collide with walls less force;	allow RA if clear allow lower kinetic energy (KE) reject no KE allow particles colliding less hard note: with walls/eq must be mentioned once	3
(ii)	dimensionally correct substitution into $p_1 / T_1 = p_2 / T_2$; conversion of either temperature into kelvin; rearrangement; correct subsequent evaluation of p_2 with consistent conclusion; e.g. $270 / 293 = p_2 / 275$ 293 or 275 used anywhere in calculation $p_2 = 270 \times 275 / 293$ (p_2 =) 253 (kPa) so light will not show	ignore units can be implied 27 (kPa) so light will show scores 3 marks 243 (kPa) so light will show scores 2 marks	4

Total for Question 11 = 10 marks

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Question number	Answer	Notes	Marks
12 (a)	idea that the **temperature** outside the box is greater than the **temperature** inside the box;	however described e.g. "it is hotter outside the box than inside the box"	1
(b)	any two from: MP1. air / cardboard is a poor conductor / (good) insulator; MP2. air is a gas (which are poor conductors); MP3. particles in air are far apart / collide with each other rarely; MP4. idea that thicker objects (of the same material) conduct slower;	ignore idea of trapped air condone idea of 'non-conductor'	2
(c)	idea that air (particles) cannot move around; lid stops or reduces convection currents forming;	e.g. air cannot flow or air trapped accept idea that box is a solid and convection is impossible in solids for 1 mark	2
(d)	white / silver ; (because) these are poor emitters of infrared / radiation;	accept 'radiators' for emitters ignore references to absorption or reflection	2

Total for Question 12 = 7 marks

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