Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE

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

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (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>(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>(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

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

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

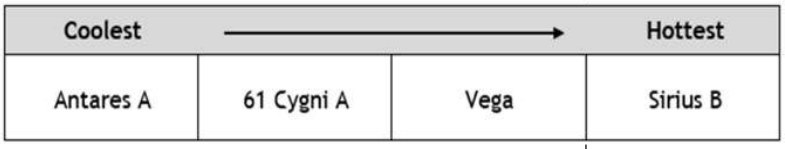
Total for Question 3 = 8 marks

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

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

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

Question number	Answer	Notes	Marks
7 (a)	any five from MP1-MP7: apparatus: MP1. method of creating thin beam of light; MP2. protractor; method: MP3. draw round the block; MP4. shine light into the block at an angle to the normal; 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 marking points from diagram e.g. laser, ray box etc. ignore torch however expressed allow simple use of n=sin(i)/sin(r)	6
(b)	optical fibres; named prismatic use e.g. cats eye reflector, binoculars, periscope etc;		2

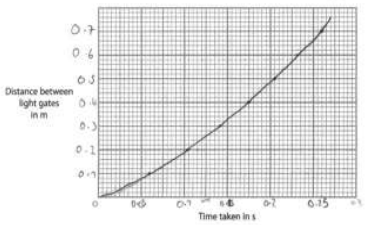
Total for Question 7 = 8 marks

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

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

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

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

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