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Mark Scheme (Results)

November 2021

Pearson Edexcel International GCSE

In Physics (4PH1) Paper 1P and

Sciences (Double Award) (4SD0) Paper 1P

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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>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td>one mark for each correct row;;;;
<table>
<tr><th rowspan="2">Type of motion</th><th colspan="4">Graph</th></tr>
<tr><th>P</th><th>Q</th><th>R</th><th>S</th></tr>
<tr><td>constant acceleration</td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>increasing acceleration</td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>moving at constant velocity</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>stationary</td><td></td><td>✓</td><td></td><td></td></tr>
</table>
reject mark for row if more than one tick seen</td><td></td><td>4</td></tr>
<tr><td>(b)</td><td>area (under the line) / eq;</td><td></td><td>1</td></tr>
</table>

Total for Question 1 = 5 marks

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Question number	Answer	Notes	Marks
2 (a)	the **rate** of flow of charge/electrons;	allow amount of charge per second, amount of charge per unit time	1
(b)	electron(s);	ignore words written in addition to electron(s)	1
(c) (i)	power = current × voltage;	allow standard symbols and rearrangements e.g. I = P / V	1
(ii)	substitution; rearrangement; evaluation; e.g. 1400 = current × 230 (current =) 1400 / 230 (current =) 6.1 (A)	 -1 for POT error allow 6, 6.09, 6.086…	3
(iii)	any two from: MP1. idea that wire has resistance; MP2. electrons collide with lattice ions; MP3. idea of transferring energy (from electrons to wire/eq); MP4. increasing vibrations of lattice ions;	 ignore friction allow sensible alternatives for lattice ions e.g. atoms in the wire etc. ignore generic references to "heat" allow sensible alternatives for lattice ions e.g. atoms in the wire etc.	2

Total for Question 2 = 8 marks

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Question number	Answer	Notes	Marks
3 (a)	magnet moves through / near coil of wire; field lines of magnet are cut by coil; idea that voltage is induced across the coil;	allow idea that magnet enters / leaves coil ignore references to the coil having its own field ignore references to current	3
(b)	any two from: MP1. shaking torch harder / faster; MP2. increasing the number of turns on the coil; MP3. using a less resistive metal for the coil of wire;	 allow moving coil/magnet faster ignore “larger coil”	2

Total for Question 3 = 5 marks

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Question number	Answer	Notes	Marks
4 (a)	becquerel(s) / Bq;	allow recognisable spellings allow if written in table	1
(b) (i)	vertical axis labelled "activity" AND horizontal axis labelled "time in years";	ignore unit on vertical axis	1
(ii)	smooth curve of best fit drawn;	curve should pass within 1 small square of each data point condone curve starting at second point	1
(iii)	evidence of working on graph or in working space; half-life = 5.6 (years);	e.g. lines shown on graph or evidence of halving 8000 etc. allow range of 5.4-5.8	2
(iv)	3 half-lives; (3 × 5.6 =) 16.8 (years);	allow 16.2-17.4 (years) allow ecf from (iii)	2
(c)	both have same number of protons; cobalt-60 has one more neutron;	allow RA ignore references to atomic/mass numbers	2
(d)	nucleus loses a neutron; nucleus gains a proton;	"neutron becomes a proton" scores both marks condone plurals e.g. neutrons, protons	2
(e)	any four from: **Hazards (max. 2 marks)** MP1. radiation from them can cause cancer / cell damage / damage to organisms / people; MP2. radiation is highly penetrating; MP3. risk of theft / eq; MP4. remain radioactive for some time; MP5. risk of contamination of land/water; **Precautions (max. 2 marks)** MP6. need for shielding; MP7. use of machines to remove from reactor; MP8. need for security (to prevent public access/protect from hijacking/eq); MP9. need to be suitably protected against damage; MP10. special facilities required, not landfill; MP11. relatively short half-life means that very long-term storage is not necessary;	 e.g. lead, concrete etc. e.g. from earthquakes, overheating etc. e.g. stored underground/underwater, measures to avoid leakage	4

Total for Question 4 = 15 marks

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Question number	Answer	Notes	Marks
5 (a)	A (accuracy of the measurement); B is incorrect because removing a zero error does not allow the measurement to be made to more decimal places C is incorrect because removing a zero error does not allow the repeatability to be assessed D is incorrect because removing a zero error does nothing to improve the control of other variables that may affect the measurement of mass		1
(b)	C (reliability of the measurement); A is incorrect because repeating a measurement does not make the measurement closer to the true value B is incorrect because repeating a measurement does not allow the measurement to be made to more decimal places D is incorrect because repeating a measurement does nothing to improve the control of other variables that may affect the measurement of mass		1
(c) (i)	19.34 reading circled;		1
(ii)	anomalous reading excluded from calculation; mean mass evaluated; final answer expressed to 2 decimal places; e.g. (mean =) [18.96 + 19.01 + 19.05 + 18.98 + 19.04] ÷ 5 (mean =) 19.008 (mean mass =) 19.01 (g)	allow ecf from (i) allow ecf if anomalous reading included allow ecf if anomalous reading included if anomalous reading included, allow final 2 marking points only 19.06 = 2 marks 19.063… = 1 mark	3
(iii)	volume;		1

Total for Question 5 = 7 marks

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Question number	Answer	Notes	Marks
6 (a)	any two from: MP1. ruler; MP2. protractor; MP3. named suitable light source; MP4. optical pin(s);	 e.g. ray box, light box, laser ignore torch	2
(b) (i)	ray drawn bending in the correct direction; ray drawn parallel to ray before it enters the block;	 judge by eye	2
(ii)	normal drawn perpendicular to block's surface where light ray enters;	judge by eye normal must be drawn in both air and block	1
(iii)	angle of incidence = 44 (degrees); angle of refraction = 26 (degrees);	allow 43-45 allow 25-27	2
(iv)	refractive index = $\frac{\sin(\text{angle of incidence})}{\sin(\text{angle of refraction})}$;	allow standard symbols and rearrangements e.g. n = sin(i) ÷ sin (r)	1
(v)	substitution; evaluation; e.g. (n =) sin44 / sin26 (n =) 1.6	allow ecf from (iii) allow range 1.5-1.7	2
(c)	idea that multiple angles (of incidence) measured; graph of sin(i) against sin(r) plotted; **gradient** of graph = refractive index;	 can be gained from diagram ignore orientation of axes can be gained from diagram reject if inconsistent with graph. However, accept if sin(r) on y-axis then gradient = 1/n	3

Total for Question 6 = 13 marks

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Question number	Answer	Notes	Marks
7	any five from: MP1. current in coil produces magnetic field; MP2. direction of this magnetic field is (continuously) changing; MP3. field of coil interacts with field of magnet; MP4. producing a force on coil/wire; MP5. direction of the force changes; MP6. cone/coil/wire vibrates; MP7. air particles (next to the cone) are made to vibrate;	allow coil is magnetised / becomes an electromagnet allow cone moves in and out / backwards and forwards	5

Total for Question 7 = 5 marks

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Question number	Answer	Notes	Marks
8 (a)	Callisto drawn with a circular orbit around Jupiter; Jupiter positioned at the centre of the orbit;	judge circular shape by eye	2
(b)	conversion of time from hours to seconds; substitution into orbital speed formula; evaluation; final answer given to 3s.f.; e.g. time = (400 × 60 × 60 =) 1 440 000 (s) (orbital speed =) 2 × π × 1 880 000 / 1 440 000 (orbital speed =) 8.203… (km/s) (orbital speed =) 8.20 (km/s)	allow use of 1 440 000 seen anywhere allow ecf from incorrect time conversion mark independently	4
(c) (i)	any one from: MP1. Callisto has a larger radius; MP2. Callisto has a lower density; MP3. Callisto has a smaller core;	allow RA allow Callisto is larger ignore references to orbital radius/distance from Sun	1
(ii)	use of weight = mass × g; setting up ratio OR evaluation of mass of object; evaluation of weight on Callisto; e.g. $W = m \times g$ $W_c / g_c = W_m / g_m$ OR m = 37 (kg) (W_c =) 44 (N)	seen anywhere in working answer of 78-79 gets 2 marks allow 44.3, 44.25	3

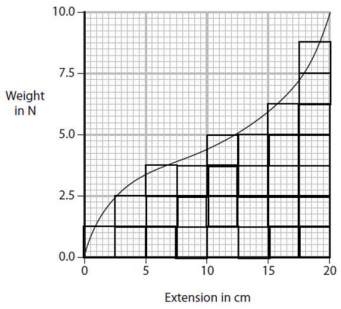
Total for Question 8 = 10 marks

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Question number			Answer	Notes	Marks
9	(a)	(i)	pressure = force / area;	allow standard symbols and rearrangements e.g. p = F / A	1
		(ii)	substitution; rearrangement; evaluation; e.g. 1.03×10^6 = force / 1.13 (force =) $1.03 \times 10^6 \times 1.13$ (force =) 1.16×10^6 (N)	 -1 for POT error allow 1.2×10^6, 1163900 etc.	3
		(iii)	any two from: MP1. idea that gas particles move randomly; MP2. idea that gas particles collide with **all** walls of container; MP3. idea that force per unit area is the same on all sides of cylinder;	 allow move in all directions	2
	(b)	(i)	idea of extrapolating line backwards; absolute zero is the temperature when the pressure is zero;	allow if seen on graph allow temperature when line cuts x-axis/temperature axis (may be indicated on graph)	2
		(ii)	−273 (°C);	allow −273.15	1
		(iii)	straight line with positive gradient drawn; line passes through the origin;	judge by eye	2

Total for Question 9 = 11 marks

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Question number	Answer	Notes	Marks
10 (a)	determine stretched/original length; with a ruler / tape measure; extension = stretched length – original length/12(cm);	set unstretched length to zero (on) ruler reading on ruler is extension	3
(b) (i)	line is not straight / line is curved; (therefore) weight/force and extension are not proportional to each other;	allow gradient is not constant	2
(ii)	evidence of using a reasonable method of estimating an area; evaluation of the area of one shape; correct evaluation of area without factoring cm to m; correct final evaluation; e.g. counting squares approach used 1 medium square = (1.25 × 2.5 =) 3.125 total area = 29 squares × 3.125 = 91 increase in energy = (91/100 =) 0.91 (J)	e.g. counting squares, splitting into rectangles, approximating to a triangle etc. medium square = 0.03125 (J) large square = 0.125 (J) allow 85-100 allow 0.85-1.00 (J)  	4

Total for Question 10 = 9 marks

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Question number	Answer	Notes	Marks
11 (a) (i)	12 (V);		1
(ii)	voltage = current × resistance;	allow standard symbols and rearrangements e.g. R = V / I	1
(iii)	substitution; rearrangement; evaluation; e.g. 12 = 0.019 × R (R =) 12 / 0.019 (R =) 630 (Ω)	allow ecf from (i) -1 for POT error 0.631… scores 2 marks if 35mA used as the current (giving 342.8…) then award 2 marks max. allow 632, 631.6, 631.57…	3
(b) (i)	idea that current is conserved at a junction in a circuit;	e.g. current before and after junction must be the same, 16 + 19 = 35 etc. ignore "current is shared"	1
(ii)	use of voltage = current × resistance; calculation of total resistance of path (750 Ω); idea that resistances of two resistors in series adds up to total resistance; evaluation of resistance of Y; e.g. 12 = 0.016 × R_T R_T = 750 (Ω) 750 = 250 + R_Y R_Y = 500 (Ω)	must be more than just quoting the formula for the mark calculation of voltage across 250 Ω resistor (4.0 V) evaluation of voltage across R (8.0 V) evaluation of resistance of R (using V=IR) if mA not converted to A and 0.75 seen then award 2 marks max.	4
(c)	current decreases; with any one from: • (total) resistance of circuit has increased; • idea that there are now less paths for the current in the circuit;	DOP	2

Total for Question 11 = 12 marks

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Question number	Answer	Notes	Marks
12 (a)	D (by radiation); A is incorrect because conduction cannot take place through the vacuum of space B is incorrect because convection cannot take place through the vacuum of space C is incorrect because evaporation cannot take place through the vacuum of space		1
(b)	air (inside external pipe) is heated; air expands; air decreases in density (and therefore rises);	 allow particles move further apart reject particles become less dense	3
(c)	idea that air entering tube is hotter than the ground; energy is transferred from air (to ground/surroundings); by conduction;	allow RA e.g. ground is cooler than air	3
(d)	black / other dark colour; (because) dark colours are better/good **absorbers** of radiation; air inside pipe becomes hotter / convection increases;	 allow infrared / IR for radiation ignore heat	3

Total for Question 12 = 10 marks

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