Pearson Edexcel

Mark Scheme (Results)

January 2023

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.

Question number			Answer	Notes	Marks
1	(a)		C; A cannot be correct as the angle of reflection is not equal to the angle of reflection. B and D cannot be correct as the ray penetrates into the mirror rather than reflects.		1
	(b)		protractor;		1
	(c)	(i)	attempt at measuring the (time) difference between the two peaks; 2.5 s;	award both marks if correct answer on answer line	2
		(ii)	substitution and rearrangement into given eqn; evaluation; correct answer: 750 000 (km) e.g. distance = speed × time distance = 300 000 × 2.5 distance = 750 000 (km)	ECF from (c)(i) accept answer given in standard form	2
		(iii)	division of candidate's answer for (ii) by 2; correct answer: 375 000 (km)		1

Total for Question 1 = 7 marks

Question number	Answer	Notes	Marks
2 (a) (i)	any orbit around Earth; circular orbit centred on Earth;		2
(ii)	any elliptical orbit around Sun; with focus at Sun;	accept incomplete or full orbit; accept parabolic/hyperbolic path with Sun at focus for 2 marks	2
(b)	evidence of correct conversion from days to seconds; substitution into given formula; correct evaluation; Correct answer: 30 km/s e.g. $365 \times 24 \times 60 \times 60 = 31.5 \times 10^6$ s Orbital speed = $(2\ \pi\ r) \div T$ Orbital speed = $(2 \times \pi \times 150\ 000\ 000) / 31.5\ldots. \times 10^6$ s Orbital speed = 29.9 km/s		3
(c)	B – gravitational; A, C and D cannot be correct as only the gravitational force is responsible for keeping planets in orbit around their star.		1
(d)	starts as nebula/cloud (of gas); reference to main sequence; finishes as white dwarf; PLUS at least ONE, in the correct place, from protostar/red (super) giant/planetary nebula; e.g. nebula → protostar → main sequence → red giant → white dwarf and planetary nebula	 ignore black dwarf reject supernova for this mark	4

Total for Question 2 = 12 marks

Question number	Answer	Notes	Marks
3 (a) (i)	8.2 (m/s) ;		1
(ii)	any TWO from: MP1. reference to weight and drag; MP2. weight greater than drag; MP3. resultant force causes acceleration; MP4. drag increases with speed; PLUS weight = drag at terminal velocity/eq;	ignore reference to upthrust accept water friction or water resistance for "drag" accept 'gravitational force' for 'weight' "F=ma" is insufficient by itself	3
(b) (i)	pressure difference = height × density × g ;	accept depth for height accept accepted symbols e.g. p, h, d (for height), d or ρ (for density), accept any correct rearrangement reject 'gravity' for 'g'	1
(ii)	substitution; evaluation; correct answer: 250 000 (Pa) e.g. pressure difference = height × density × g pressure difference = 25 × 1000 × 10 pressure difference = 250 000 (Pa)	accept use of 9.8(1) for 'g' giving 245 000 (Pa) POT error gives −1 except if no evidence of use of 'g'	2
(iii)	addition of 1.0×10^5 to candidate's answer to (ii); correct answer: 3.5×10^5 (Pa)	accept answer not given in standard form	1
(iv)	substitution into given equation; rearrangement; correct evaluation; correct answer: 0.13(14) (m^3) e.g. $p_1 \times V_1 = p_2 \times V_2$ $1.0 \times 10^5 \times 0.46 = 3.5 \times 10^5 \times V_2$ $V_2 = (1.0 \times 10^5 \times 0.46) \div (3.5 \times 10^5)$ $V_2 = 0.1314$ (m^3)	subs and rearrange can be in either order; condone use of 2.5×10^5 Pa giving V = 0.18… (m^3) for 2 marks condone use of 2.45×10^5 Pa giving V = 0.188… (m3) for 2 marks	3

Total for Question 3 = 11 marks

Question number	Answer	Notes	Marks
4 (a)	correct symbols for all components; components connected in a series circuit; ammeter in series with lamp; voltmeter in parallel with lamp;	 ignore ammeter and voltmeter	4
(b) (i)	all points plotted correctly;	within half a small square	1
(ii)	curve passes within half a small square of all points;	by eye	1
(c) (i)	idea of taking more data at different voltages;		1
(ii)	any TWO from: MP1. current (in filament) heats up the filament; MP2. resistance changes with temperature; MP3. idea that change of resistance affects gradient (of graph);	 allow idea that higher voltage will increase the temperature of the filament condone 'lamp' for filament allow 'increasing resistance decreases current for the same voltage' for MP2 and MP3	2

Total for Question 4 = 9 marks

Question number	Answer	Notes	Marks
5 (a)	fission is the **splitting** of a nucleus; fusion is the **joining** of (two) nuclei;	allow "breaking down", "dividing" for splitting allow "fusing", "combining" for joining reject "atom" for "nucleus""	2
(b) (i)	mass number = 1; atomic number = 0;		2
(ii)	any THREE from: MP1. idea that reactants are not (as) hazardous for fusion; MP2. idea that products of fusion are not radioactive; MP3. (so) no {mutations/damage to cells/tissue/cancer} ; MP4. (so) no long-term storage problems; MP5. idea that no shielding is required; MP6. idea of lower or no risk of meltdown for fusion; MP7. idea that there is no runaway chain reaction for fusion;	accept RA allow reference to no gamma radiation from fusion	3
(c)	evidence of activity halved; evidence of activity halved four times only; correct evaluation; correct answer: 7.5 (kBq) e.g. 120 ÷ 2 = 60 60 ÷ 2 = 30 30 ÷ 2 = 15 15 ÷ 2 = 7.5	allow reference to 4 half lives, including showing that 48/12 = 4	3

Total for Question 5 = 10 marks

Question number	Answer	Notes	Marks
6 (a)	any THREE from: MP1. correct reference to convection; MP2. fan aids convection; MP3. reference to conduction not being the main method; MP4. (since) {plastic/air} is a poor conductor/good insulator; MP5. white (materials) are poor at emitting /eq;	allow idea of heat reflecting back / not absorbing well from this interior white surface	3
(b)	any THREE from: MP1. correct reference to conduction; MP2. since {metals/aluminium} conducts well; MP3. reference to convection not being the main method; MP4. as hot air particles can't circulate (from inside to outside); MP5. black (materials) are good at emitting/eq;	allow idea of heat being absorbed well from the interior black surface	3
(c) (i)	power = voltage × current;	accept 'P = IV' accept any correct rearrangement	1
(ii)	substitution; evaluation; watt or W as the unit; correct answer: 15 watts e.g. power = voltage × current power = 5.1 × 2.9 power = 14.8 watts	accept 14.8,14.79 W	3

Total for Question 6 = 10 marks

Question number	Answer	Notes	Marks
7 (a) (i)	C – 51°; Angle should be measured and cannot be either A, B or D.		1
(ii)	refractive index = sin (i)/sin (r);	allow n, η for refractive index	1
(iii)	substitution; rearrangement; correct evaluation; correct answer: 31 degrees e.g refractive index = sin (i)/sin (r) 1.52 = sin(51)/sin(r) sin(r) = sin(51)/1.52 sin(r) = 0.511… r = $\sin^{-1}$(0.511…) = 30.7… degrees	allow ECF from (i) answers of 26.66…, 28.76…, 32.06… all score 3 marks ECF	3
(b) (i)	use of formula sin c = 1/n; substitution; correct evaluation; correct answer: 41 (degrees) e.g. sin c = 1/n sin c = 1/1.52 c = $\sin^{-1}$(1/1.52) = 41.1 (degrees)		3
(ii)	total internal reflection (TIR) / angle of incidence is above the critical angle and so reflects;		1

Total for Question 7 = 9 marks

Question number	Answer	Notes	Marks
8 (a) (i)	balance;	condone scales reject scale	1
(ii)	take repeats **and** either find mean, identify or remove anomalies;		1
(b)	mass of air is 0.61 g; correct use of formula: density = mass/volume; correct evaluation to 2 sf; appropriate unit i.e. g/cm^3; correct answer = 0.0012 g/cm^3 e.g. mass of air = 15.61 − 15.00 = 0.61 density = mass ÷ volume density = 0.61 ÷ 490 density = 0.00124 g/cm^3 density = 0.0012 g/cm^3 to 2 sf	 −1 POT error accept use of standard form i.e. 1.2(4) × 10^{-3} g/cm^3	4
(c)	any THREE from: MP1. any reference to displacement method; MP2. measure original volume of water; MP3. (fully) submerge balloon; MP4. re-measure volume of water; MP5. subtract one volume from the other;	 allow reference to displacement to a different vessel and use of measuring cylinder or beaker for three marks	3

Total for Question 8 = 9 marks

Question number	Answer	Notes	Marks
9 (a) (i)	any ONE from: wear gloves; use tongs; do not point source at anyone; keep source at arm's length; keep source in lead-lined box; keep exposure time short; wear goggles; lead **apron**;	 accept use of remote control i.e. a robot i.e. only have the source out for as long as is necessary	1
(ii)	Geiger-Muller tube (and counter);	allow GM tube/counter/detector condone 'photographic film'	1
(b)	;;; Material Type of radiation / 10 mm of air / 2 cm of aluminium / 10 cm of lead alpha / X / X / X beta / / X / X gamma / / / X	each correct row scores 1 mark	3
(c) (i)	recall of KE = ½ m v^2; substitution; correct evaluation; correct answer: 1.5 × 10^{-12} (J) e.g. KE = ½ m v^2 KE = ½ × (6.6 × 10^{-27}) × (2.1 × 10^7)^2 KE = 1.4553 x 10^{-12} (J)	 −1 POT error	3
(ii)	candidate's answer for (i) e.g. 1.5 × 10^{-12} (J)		1
(iii)	thermal;		1

Total for Question 9 = 10 marks

Question number	Answer	Notes	Marks
10 (a) (i)	26(.4) (N) ;		1
(ii)	(resultant) force = mass × acceleration;	allow acceptable symbols e.g. F, f, m, M, a, A allow any correct rearrangement;	1
(iii)	conversion of 160 g to 0.16 kg; rearrangement or substitution; correct evaluation; correct answer: 165 (m/s^2) e.g. acceleration = resultant force ÷ mass acceleration = 26.4 ÷ 0.16 acceleration = 165 (m/s^2)	 allow ECF for incorrect resultant force Condone rounding to 160 or 170.	3
(iv)	any THREE from: MP1. weight decreases; MP2. air resistance increases; MP3. consistent inference of changing resultant force; MP4. (therefore) changing acceleration;	ignore references to running out of fuel reducing thrust/eq ignore references to energy DOP consistent with MP3	3
(b)	any FOUR from: MP1. (observed) frequency decreases; MP2. speed of **waves** constant; MP3. wavefronts behind firework spread out/eq; MP4. causing an increased wavelength (at the observer); MP5. reference to f = speed ÷ wavelength;	ignore references to region in front of rocket or an approaching rocket allow any rearrangement	4

Total for Question 10 = 12 marks

Question number	Answer	Notes	Marks
11 (a) (i)	current provides a magnetic field/eq; magnets in a magnetic field experience a force/magnets line up along a field line/eq;		2
(ii)	(circular) field line through all of the compass needles; arrow clockwise;	allow any circle concentric with the wire	2
(iii)	changes direction / eq;		1
(b)	vertical; upwards;		2
(c) (i)	up / down; idea of cutting field lines;	allow any inference of up/down	2
(ii)	cutting field lines **induces** a voltage across the wire; complete circuit so voltage gives a current;	allow emf or potential difference or p.d. for voltage allow idea of a force on electron(s) causing them to move	2

Total for Question 11 = 11 marks

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