Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE

In Physics (4PH1) Paper 1P and Science

(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.

Question number	Answer	Notes	Marks
1 (a)	B; A is incorrect because the top two field lines are in the wrong direction C is incorrect because all the field lines are in the wrong direction D is incorrect because the second field line from the top is in the wrong direction		1
(b) (i)	B; A is incorrect because there is a magnetic force on each of the magnets C is incorrect because the two nearest poles are opposite not alike D is incorrect because the forces on the magnets pass through their centres of gravity		1
(ii)	C; A is incorrect because the field lines are not straight nor parallel to each other B is incorrect because the field lines are not straight nor parallel to each other D is incorrect because the field lines are not parallel to each other		1
(c)	steel / nickel / cobalt / neodymium;	condone iron	1
(d)	EITHER: (plotting) compass used; multiple compasses or repeated use of single compass; joining up of dots/idea of compasses forming continuous line; OR iron filings used; sprinkled / eq; card tapped (to reveal pattern);	all marks can be awarded from a diagram ignore 'poured' or other heavy-handed method	3

Total for Question 1 = 7 marks

Question number	Answer	Notes	Marks
2 (a)	idea of subtracting the background count rate;		1
(b) (i)	time taken;	allow "how long it takes" reject "half the time"	2
	and either of for (radio)activity to halve; for half of the (radioactive) nuclei / atoms / isotope to decay;	allow count rate for activity ignore mass, substance	
(ii)	indication on graph of a half in count rate;	e.g. line drawn across from 25 until it reaches the curve, then down to the time axis	2
	2.6 (minutes);	allow 2.5-2.7 (minutes) 2.3 (minutes) = 1 mark	

Total for Question 2 = 5 marks

Question number	Answer	Notes	Marks
3 (a) (i)	travel at the same speed (in a vacuum) / can travel in a vacuum;	allow both transverse waves, both transfer energy, both microwaves	1
(ii)	wavelength;	allow idea of different range / penetration ignore amplitude	1
(b) (i)	speed = frequency × wavelength;	allow standard symbols and rearrangements e.g. $\lambda = v / f$ allow c for speed ignore s for speed	1
(ii)	substitution OR rearrangement; evaluation; e.g. $3.0 \times 10^8 = 5.2 \times 10^9 \times \lambda$ OR $\lambda = v / f$ (wavelength =) 0.058 (m)	 -1 for POT error allow 0.06, 0.0576…(m)	2
(c) (i)	D; A is incorrect because electromagnetic waves are not longitudinal B is incorrect because electromagnetic waves are not mechanical waves C is incorrect because sound waves are not electromagnetic waves		1
(ii)	 vibrations / oscillations; correct relationship between direction of travel/energy transfer and direction of vibration for both transverse and longitudinal waves;	both marks can be scored from a suitable diagram allow movement of particles / eq for vibrations for this mark	2

Total for Question 3 = 8 marks

Question number	Answer	Notes	Marks
4 (a)	protractor;		1
(b) (i)	any indication that the angle is between the normal and the incident ray;		1
(ii)	79 (degrees);	allow 78-80 (degrees) ecf from indicated angle of incidence in (i) e.g. 10-12 (degrees) if angle marked between ray and boundary	1
(iii)	any straight ray to the right of the normal that comes from the point of incidence; correct angle of reflection;	judge by eye judge by eye	2

Total for Question 4 = 5 marks

Question number	Answer	Notes	Marks
5 (a) (i)	(average) speed = distance (travelled) ÷ time (taken);	allow standard symbols and rearrangements e.g. v = s / t allow s, d for distance condone s for speed	1
(ii)	substitution OR rearrangement; evaluation; e.g. 21 = distance / 0.14 OR s = v × t (distance =) 2.9 (m)	 allow 3, 2.94 (m)	2
(b) (i)	force = mass × acceleration;	allow standard symbols and rearrangements e.g. a = F / m	1
(ii)	substitution OR rearrangement; evaluation; e.g. 7600 = 1200 × a OR a = F / m (a =) (−)6.3 (m/s^2)	 allow 6.33… (m/s^2)	2
(iii)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $0^2 = 21^2 + [2 \times (-)6.3 \times \text{distance}]$ distance = 441 / 12.6 distance = 35 (m)	ecf answer from (ii) allow 34.8…(m)	3

Total for Question 5 = 9 marks

Question number	Answer	Notes	Marks
6 (a) (i)	any attempt to find gradient of graph;	allow use of acceleration formula	3
	use of two points on the line to calculate gradient;	allow reading of pair of velocities with matching time interval	
	evaluation;	reject positive answer	
	e.g. acceleration = gradient acceleration = (−)4.2 / 0.45		
	(acceleration =) −9.3 (m/s^2)	allow −9.3 to −9.4	
(ii)		accept alternative method using $v^2 = u^2 + 2as$ with acceleration calculated in (i)	3
	any clear indication that distance travelled = area;	allow attempt to calculate area of triangle	
	correct use of data from graph; evaluation;		
	e.g. distance = area distance = 0.5 × 0.45 × 4.2		
	(distance =) 0.95 (m)	allow 0.94, 0.945 (m)	
(b) (i)	weight / gravitational force;	ignore unqualified 'gravity', gravitational field strength	2
	drag / air resistance;	ignore upthrust, lift	
(ii)	one upward arrow and one downward arrow drawn; arrows originate at object;	judge by eye	3
	downward arrow drawn longer than upward arrow;	judge by eye	
(iii)	any four from:		4
	MP1. object is accelerating (from A to B);	allow speeding up	
	MP2. downward force greater than upward force (at A);	allow any recognisable upward force and downward force	
	MP3. gradient / acceleration decreasing (from A to B);		
	MP4. drag increases as speed increases;		
	MP5. resultant force decreases;		
	MP6. idea that (just after) B, downward force = upward force;	allow any recognisable upward force and downward force	
	MP7. idea that in region BC, acceleration is zero/close to zero;		
	MP8. terminal velocity achieved in region BC;	allow constant velocity	

Total for Question 6 = 15 marks

Question number	Answer	Notes	Marks
7 (a) (i)	idea that voltage across thermistor + voltage across fixed resistor = voltage across cell; 0.59 (V);	 allow 0.632 (V)	2
(ii)	voltage = current × resistance;	allow standard symbols and rearrangements e.g. V, I and R ignore c,C for current	1
(iii)	substitution; rearrangement; evaluation; e.g. 0.59 = 0.0062 × R R = 0.59 / 0.0062 (R =) 95 (Ω)	ecf answer from (i) -1 for POT error answers of R = 90.7… or R = 101.9…(Ω) gain full marks answer of 242 (Ω) gains 2 marks allow 95.2, 95.16… condone 95.1	3
(b) (i)	idea that resistance of thermistor decreases with an increase in temperature; idea of non-linear relationship;	 allow idea that rate of change is decreasing resistance inversely proportional to temperature scores both marks	2
(ii)	voltmeter reading decreases; (because) resistance **of thermistor** increases; idea that current in circuit/thermistor decreases;	allow voltage across resistor decreases	3

Total for Question 7 = 11 marks

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>8 (a) (i)</td><td>idea that kinetic store increases;</td><td>e.g. chemical transferred to kinetic</td><td>1</td></tr>
<tr><td>(ii)</td><td>idea that gravitational store increases;</td><td></td><td>1</td></tr>
<tr><td>(b)</td><td>two correct statements ticked;;
<table><tr><th>Statement</th><th>Correct (✓)</th></tr><tr><td>gravitational store increases</td><td>✓</td></tr><tr><td>gravitational store stays the same</td><td></td></tr><tr><td>gravitational store decreases</td><td></td></tr><tr><td>kinetic store increases</td><td></td></tr><tr><td>kinetic store stays the same</td><td></td></tr><tr><td>kinetic store decreases</td><td>✓</td></tr></table></td><td>3 ticks scores 1 max
4 or more ticks scores 0</td><td>2</td></tr>
<tr><td>(c) (i)</td><td>gravitational (force);</td><td>allow weight, gravity</td><td>1</td></tr>
<tr><td>(ii)</td><td>substitution into given formula;
evaluation;

e.g.
orbital speed = (2 × π × 7100) / 5800
(orbital speed =) 7.7 (km/s)</td><td>

allow 7.69… (km/s)</td><td>2</td></tr>
<tr><td>(d)</td><td>any four from:

MP1. bars increase in temperature when facing towards Sun / decrease in temperature when facing away from Sun;
MP2. (when pointed at the Sun,) black bar increases temperature faster than white bar;
MP3. (because) black is a better absorber of radiation than white;
MP4. (so) black bar reaches a higher temperature than white bar;
MP5. (when pointed away from the Sun,) black bar decreases temperature faster than white bar;
MP6. (because) black is a better emitter of radiation than white;
MP7. convection/conduction plays no part in heat transfer (outside the spacecraft);
MP8. (because) there are no particles outside the spacecraft;</td><td>accept any clear reverse argument

allow energy, heat, IR for radiation

allow energy, heat, IR for radiation</td><td>4</td></tr>
</table>

Total for Question 8 = 11 marks

Question number	Answer	Notes	Marks
9 (a)	any five from: MP1. measure original length of spring; MP2. measure new length / extension for a **range** of masses; MP3. extension = new length – original length; MP4. use of ruler; MP5. **method** of avoiding parallax, e.g. look at eye level or use a pointer; MP6. use of a set square / clamping ruler vertically; MP7. idea of measuring between the same two points (on the spring); MP8. idea of repeating and averaging; MP9. idea of measuring extension with decreasing mass as well;	allow any marking points if seen on diagram allow tape measure allow repeating to identify anomalies	5
(b) (i)	suitable linear scale chosen (>50% of grid used); axes labelled with quantities and units; all plotting correct to nearest half square;	ignore orientation Force in N / Extension in cm 0.0 / 0.0 1.0 / 2.5 2.0 / 5.0 3.0 / 9.8 4.0 / 10.0 5.0 / 12.5 6.0 / 15.5 7.0 / 19.5	3
(ii)	data point at (3.0,9.8) identified;	allow (7.0,19.5) as chosen point	1
(iii)	straight line of best fit passing through origin and non-anomalous points;	ecf from plotting in (i) ignore line beyond 6.0N	1
(iv)	any three from: MP1. quotation of Hooke's Law; MP2. line is straight; MP3. line passes through origin; MP4. no evidence of having passed elastic limit;	 i.e. force and extension should be proportional allow idea that line is not straight if consistent with (iii) allow idea that elastic limit has been reached if consistent with (iii)	3

Total for Question 9 = 13 marks

Question number	Answer	Notes	Marks
10 (a) (i)	36 (degrees);		1
(ii)	refractive index = sin(i) / sin(r);	allow standard symbols and rearrangements e.g. n = sin(i) / sin(r)	1
(iii)	substitution; evaluation; answer quoted to 2 s.f.; e.g. refractive index = sin(61) / sin(36) (refractive index =) 1.48799… (refractive index =) 1.5	allow ecf from (i) mark independently	3
(b)	red refracts less than violet; correct link made between colour and refractive index; correct link made between wavelength and refractive index;	allow RA allow red bends less than violet e.g. red has a lower refractive index than violet e.g. refractive index decreases with increasing wavelength	3

Total for Question 10 = 8 marks

Question number	Answer	Notes	Marks
11 (a) (i)	rearrangement OR substitution into given formula; evaluation; e.g. $V_2 = p_1 \times V_1 / p_2$ OR $120 \times 92 = 64 \times V_2$ (volume =) 170 (m^3)	 allow 172, 173, 172.5	2
(ii)	constant temperature / amount of air / mass of air;	however expressed e.g. number of particles constant	1
(b) (i)	any three from: MP1. (reduction in temperature) reduces speed/KE of particles; MP2. idea of fewer collisions with walls per unit time; MP3. idea of each collision with wall being less 'hard'; MP4. force (per unit area) on the container decreases;	 allow particles collide with walls less often	3
(ii)	substitution into given formula; rearrangement; evaluation; e.g. $120 / 290 = 64 / T_2$ $T_2 = (64 \times 290) / 120$ (temperature =) 150 (K)	 allow 155, 154.6… (K)	3

Total for Question 11 = 9 marks

Question number	Answer	Notes	Marks
12 (a)	calculation of energy transferred by battery; efficiency formula stated; correct substitution; evaluation; e.g. energy supplied = VIt = 12 × 0.25 × 12 = 36 (J) efficiency = $\frac{\text{useful energy output}}{\text{total energy output}}$ efficiency = 25 / 36 (×100%) efficiency = 69 (%)	36 (J) seen seen or implied anywhere in working allow ecf from battery energy if clear 25/36 (×100) seen allow 70, 69.4…(%)	4
(b) (i)	current / coil has a magnetic field; interaction between fields; resulting in a force; forces on opposite sides of the coil are in opposite directions;	 ignore references to attraction / repulsion	4
(ii)	C - YZ; A is incorrect because WX moves downwards B is incorrect because part of XY moves downwards D is incorrect because part of ZW moves downwards		1

Total for Question 12 = 9 marks

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