



# **Mark Scheme (Results)**

Summer 2018

Pearson Edexcel International GCSE  
In Physics (4PH0) 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)	cell;	condone battery	1
(b)	(indicator) lamp;	allow (light) bulb, (filament) lamp	1
(c)	(fixed) resistor;	reject resistance	1
(d)	light dependent resistor / LDR;		1

**Total for question 1 = 4 marks**

Question number	Answer	Notes	Marks
2 (a)	any two from:  MP1. different orbital radii; MP2. different orbital path lengths; MP3. different eccentricity;  MP4. different speeds; MP5. different time periods;	allow specific statements involving a comparison e.g. Mercury orbits closer to the Sun Earth travels a greater distance in its orbit Mercury's orbit is more elliptical, Sun more centralised for Earth's orbit Mercury travels faster Earth takes longer to complete an orbit	2
(b)	any two from:  MP1. variable orbital radii;  MP2. variable orbital speed;  MP3. different planes of orbit; MP4. different eccentricity;  MP5. different orbital path lengths;	allow specific statements involving a comparison e.g. distance from Earth to Sun stays constant but comet's distance changes Earth orbits at constant speed but speed of comet changes  comet's orbit is more elliptical, Sun more centralised for Earth's orbit comet travels a greater distance in its orbit	2

**Total for question 2 = 4 marks**

Question number	Answer	Notes	Marks
3 (a)	D (2500 J);  D is the only correct answer  A is incorrect because this is the wasted output energy B is incorrect because this is the (useful – wasted) output energy C is incorrect because this is the useful output energy		1
(b)	any two from: MP1. there is a current in the coil / wire;  MP2. coil / wire has resistance; MP3. electrical energy transferred to thermal energy;	allow answer in terms of electron movement e.g. electrons move through coil allow electrons collide (with ions in the coil); condone electrical energy transferred to heat energy	2
(c) (i)	power = current $\times$ voltage;	allow in standard symbols and rearrangements e.g. $P = I \times V$ reject C, A for current reject W for power	1
(ii)	substitution OR rearrangement; evaluation to at least 3 s.f.;  e.g. $2500 = I \times 230$ OR current = power / voltage ( $I =$ ) 10.9 (A)	allow dimensionally correct substitution reject 10.8 (A)  allow 10.86, 10.87, 10.869... (A)	2
(iii)	if current increases above 13A (for a sustained length of time); fuse (wire) melts / eq.; circuit is broken;	allow 'too large a current'  condone 'fuse blows' allow current is cut off / eq.	3

**Total for question 3 = 9 marks**

Question number	Answer	Notes	Marks												
4 (a)	<table><thead><tr><th>Statements</th><th>Tick</th></tr></thead><tbody><tr><td>the light from the object passes through the image in a plane mirror</td><td></td></tr><tr><td>the light waves are longitudinal</td><td></td></tr><tr><td>the angle of incidence equals the angle of reflection</td><td>✓</td></tr><tr><td>the image in a plane mirror is virtual</td><td>✓</td></tr><tr><td>the incident ray is always at right angles to the reflected ray</td><td></td></tr></tbody></table> <p>1 mark for each correct tick;; if more than two ticks, -1 for each additional tick to a minimum of zero</p>		Statements	Tick	the light from the object passes through the image in a plane mirror		the light waves are longitudinal		the angle of incidence equals the angle of reflection	✓	the image in a plane mirror is virtual	✓	the incident ray is always at right angles to the reflected ray		2
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the light waves are longitudinal															
the angle of incidence equals the angle of reflection	✓														
the image in a plane mirror is virtual	✓														
the incident ray is always at right angles to the reflected ray															
(b)	$i = 45 (^{\circ});$ $r = 26 (^{\circ});$	allow answers in range 43-47° allow answers in range 24-28°	2												

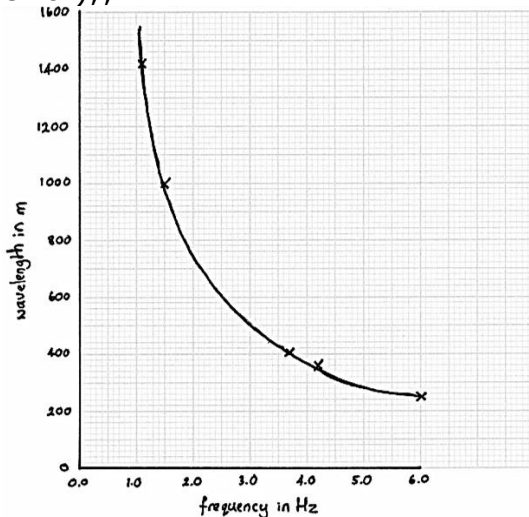
Question number	Answer	Notes	Marks
(c) (i)	$n = \sin i / \sin r$ ;	allow in words and rearrangements	1
(ii)	<p>any 6 from:</p> <p><b>apparatus (2 marks max.)</b>  MP1. suitable named light source;  MP2. ruler / pencil / paper;  MP3. protractor;</p> <p><b>measurements needed (2 marks max.)</b>  MP4. measure angle of incidence / angle of refraction;  MP5. repeat for <b>different</b> angle(s) of incidence;  MP6. repeat for <b>same</b> angle of incidence;</p> <p><b>data analysis (2 marks max.)</b>  MP7. (use equation to) calculate <math>n</math>;  MP8. plot a graph of <math>\sin i</math> against <math>\sin r</math>;  MP9. calculate <math>n</math> from gradient / calculate average value of <math>n</math>;</p>	<p>allow any marking point if clear from labelled diagram</p> <p>e.g. ray box, light box, laser  ignore 'source of light', torch  allow optical pins</p> <p>ignore unqualified 'take repeats'</p> <p>no need to quote equation as it is requested in (c)(i)</p>	6

**Total for question 4 = 11 marks**



Question number	Answer	Notes	Marks
5 (a) (i)	voltage = current $\times$ resistance;	allow in standard symbols and rearrangements e.g. $V = I \times R$ reject C, A for current	1
(ii)	substitution; rearrangement; evaluation; unit;  e.g. $4.80 = 0.42 \times R$ (R =) $4.8 / 0.42$ (R =) 11 ohms / $\Omega$	-1 if rounding error e.g. 11.42  allow 11.4, 11.43, 11.42857...	4
(b) (i)	charge = current $\times$ time;	allow in standard symbols and rearrangements e.g. $Q = I \times t$ reject C for current and charge	1
(ii)	dimensionally correct substitution; evaluation;  e.g. (Q =) $0.42 \times 45 (\times 60)$ (Q =) 1100 (C)	can be scored even if time not converted to seconds  allow 1130, 1134 (C) 18.9, 19 (C) gets 1 mark only	2
(iii)	time (to charge fully) increases; current reduces; (because) resistance of cable has increased;	allow longer {wire / lead} has greater resistance	3

**Total for question 5 = 11 marks**

Question number	Answer	Notes	Marks												
6 (a) (i)	<p>suitable linear scale chosen (&gt;50% of grid used); axes labelled with quantities and unit; plotting correct to nearest half square (minus one for each plotting error);;</p> 	<p>ignore orientation</p> <p>i.e. two plotting errors = no marks for plotting</p> <table><tr><td>Frequency in Hz</td><td>6.0</td><td>4.2</td><td>3.7</td><td>1.5</td><td>1.1</td></tr><tr><td>Wavelength in m</td><td>250</td><td>360</td><td>405</td><td>1000</td><td>1420</td></tr></table>	Frequency in Hz	6.0	4.2	3.7	1.5	1.1	Wavelength in m	250	360	405	1000	1420	4
Frequency in Hz	6.0	4.2	3.7	1.5	1.1										
Wavelength in m	250	360	405	1000	1420										
(ii)	acceptable curve of best fit drawn;	i.e. smooth curve within 1 small square of each point ignore parts of curve outside plotted points if extrapolated	1												
(iii)	2.6 (Hz)	allow 2.4-2.8 (Hz) ECF from curve drawn in (a)(ii)	1												
(iv)	as frequency increases, wavelength decreases; non-linear relationship;	allow similar pattern sentence ignore 'negative correlation' 'they are <u>inversely proportional</u> ' gets both marks	2												
(b)	any suitable suggestion; e.g. <ul style="list-style-type: none"><li>• wider range</li><li>• intermediate values</li><li>• take repeats and average</li></ul>	allow regular intervals  allow 'more results'  allow take repeats to identify anomalies	1												

Question number	Answer	Notes	Marks
(c) (i)	(wave) speed = frequency $\times$ wavelength;	allow in standard symbols and rearrangements e.g. $v = f \times \lambda$ allow c for v	1
(ii)	substitution; evaluation;  e.g. (v =) $510 \times 3.0$ (v =) 1500 (m/s)	      allow 1530 (m/s)	2

**Total for question 6 = 12 marks**

Question number	Answer	Notes	Marks
7 (a)	pressure is force per unit area;  sharp blade has smaller area; hence greater pressure (for the same force);	allow equation in words or symbols allow pressure inversely proportional to area allow RA allow RA ignore 'more force'	3
(b) (i)	fewer particles inside the canister; less (frequent) collisions with walls (of canister); (therefore) less force (on walls);	allow molecules for particles  ignore 'less pressure' as given in question	3
(ii)	substitution into $p_1V_1 = p_2V_2$ ;  rearrangement; evaluation;  e.g.  $2300 \times 18\,000 = N \times 100 \times 8200$ (N =) $\frac{2300 \times 18\,000}{100 \times 8200}$ (N =) 50	no mark for the equation as given  -1 for POT error  allow alternative methods e.g. calculate final volume of gas available from canister, divide by volume of one balloon allow $2300 \times 18\,000 = 100 \times V$ allow $N = V / 8200$  allow 50.5, 50.49 etc. condone 51	3

**Total for question 7 = 9 marks**

Question number	Answer	Notes	Marks
8 (a)	(i) (unbalanced) force = mass $\times$ acceleration;	allow in standard symbols and rearrangements e.g. $F = m \times a$	1
	(ii) substitution; evaluation;  e.g. ( $F =$ ) $7.9 \times 0.87$ ( $F =$ ) 6.9 (N)	-1 for POT error e.g. changing kg to g  allow 7, 6.87, 6.873 (N)	2
	(iii) to oppose its movement / to the left;	allow backwards	1
	(iv) any two from: <b>between</b> {wheels / trolley} and bench;  <b>between</b> string and pulley; drag/air resistance (on the front of trolley / falling mass); the axle(s) (of the trolley / pulley);	allow table/floor/ground for bench allow tyres for wheels	2
(b)	(i) GPE = mass $\times g \times$ height;	allow in standard symbols and rearrangements e.g. $GPE = m \times g \times h$ reject 'gravity' for $g$	1
	(ii) substitution; evaluation;  e.g. (GPE =) $5 \times 10 \times 0.65$ (GPE =) 33 (J)	allow $g = 9.8 / 9.81$ (N/kg) -1 for POT error e.g. changing kg to g  allow 31.85, 31.89, 31.9, 32, 32.5 (J)	2
	(iii) 33 (J) / same answer as in (b)(ii);		1

**Total for question 8 = 10 marks**

Question number	Answer	Notes	Marks														
9 (a)	dimensionally correct substitution; rearrangement; evaluation of period in seconds; period in minutes;  e.g. $7.5 = \frac{2 \times \pi \times (780 + 6\,371)}{T}$ $(T =) \frac{2 \times \pi \times (780 + 6\,371)}{7.5}$ $(T =) 5\,991 \text{ (s)}$ $(T =) 99.85 \text{ (mins)}$	no mark for equation as given  if $R_E$ or height used instead of orbital radius then 3 marks max  allow range of 99-100 (mins) 10.89... , 88.9... gets 3 marks 653.45... , 5337... gets 2 marks	4														
(b)	(number of revolutions = $24 \times 60 / 99.8$ ) = 14.42;	allow ECF from (a) allow 14, 14.4	1														
(c)	<table><thead><tr><th>Statements</th><th>Tick</th></tr></thead><tbody><tr><td>the higher the speed, the lower the height of the satellite</td><td>✓</td></tr><tr><td>a greater period means that the satellite has a greater speed</td><td></td></tr><tr><td>satellites that orbit higher make more revolutions per day</td><td></td></tr><tr><td>lower height satellites have shorter periods</td><td>✓</td></tr><tr><td>satellites with a higher speed make fewer revolutions per day</td><td></td></tr><tr><td>the higher the number of revolutions per day, the shorter the period</td><td>✓</td></tr></tbody></table> 1 mark for each correct tick;;; if more than three ticked, then -1 for each additional tick		Statements	Tick	the higher the speed, the lower the height of the satellite	✓	a greater period means that the satellite has a greater speed		satellites that orbit higher make more revolutions per day		lower height satellites have shorter periods	✓	satellites with a higher speed make fewer revolutions per day		the higher the number of revolutions per day, the shorter the period	✓	3
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**Total for question 9 = 8 marks**

Question number	Answer	Notes	Marks
10 (a) (i)	any three from: MP1. distance is continuous variable; MP2. meter reading is discrete / discontinuous variable; MP3. graph 1 correct for continuous data; MP4. graph 1 better for identifying anomalies; MP5. idea that graph 1 can be used to predict non-tested values; MP6. graph 2 correct if any data is discrete / discontinuous;	e.g. distance for a certain meter reading can be found	3
(ii)	any sensible suggestion; e.g. <ul style="list-style-type: none"> <li>• read rule at eye level</li> <li>• move rule closer to torch</li> <li>• rule parallel to torch</li> <li>• check for zero error / use a fiducial marker;</li> </ul>	ignore references to repeats and precision  avoid parallax	1
(iii)	any sensible suggestion; e.g. <ul style="list-style-type: none"> <li>• zero error</li> <li>• always a small amount of ultraviolet present</li> <li>• change is too small to measure</li> </ul>	allow because of background light ignore background radiation	1
(b)	any four control variables from: MP1. constant {thickness / amount / mass / volume} of sunscreen cream; MP2. constant distance (from torch to meter); MP3. constant ultraviolet light intensity; MP4. same (transparency / thickness of) sheet used each time; MP5. same detector used each time; MP6. constant temperature; MP7. constant background light level;	allow constant distance from sheet to torch / meter allow same torch, constant power of the torch / eq.	4

**Total for question 10 = 9 marks**

Question number	Answer	Notes	Marks
11 (a)	<p>A;</p> <p>A is the only correct answer</p> <p>B is incorrect because the amplitude of the alpha wave should be smaller than the amplitude of the delta wave</p> <p>C is incorrect because the frequency of the alpha wave should be higher than the amplitude of the delta wave</p> <p>D is incorrect because the amplitude of the alpha wave should be shorter than the amplitude of the delta wave and the frequency should be higher</p>		1
(b)	<p>B;</p> <p>B is the only correct answer</p> <p>A is incorrect because the motion arrows do not show vibrations</p> <p>C is incorrect because the motion arrows do not show vibrations</p> <p>D is incorrect because the motion arrows show vibrations, but in the wrong orientations compared to the direction of wave travel</p>		1
(c)	<p>any four from:</p> <p>MP1. rays A, B and C are refracted (at the boundary);</p> <p>MP2. A is un-deviated;</p> <p>MP3. C is more deviated than B;</p> <p>MP4. angles of incidence increase from A to B to C to D;</p> <p>MP5. ray D undergoes (total internal) reflection;</p> <p>MP6. ray D angle of incidence &gt; critical angle;</p>	<p>allow rays B and C refracted</p> <p>allow correct description of refraction e.g. 'rays B and C bend away from the normal'</p> <p>allow A does not change direction</p> <p>ignore A does not refract</p> <p>allow C bends more than B</p> <p>allow ray D undergoes TIR</p>	4

**Total for question 11 = 6 marks**



Question number	Answer	Notes	Marks
12 (a) (i)	neutron numbers correct; particle X numbers correct;  <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="border: 1px solid black; padding: 5px; text-align: center;">1</div> <div style="text-align: center;"> <math>n + {}^{14}_{7}\text{N} \longrightarrow {}^{14}_{6}\text{C} + X</math> </div> <div style="border: 1px solid black; padding: 5px; text-align: center;">1</div> </div> <div style="display: flex; align-items: center; justify-content: center; gap: 20px; margin-top: 10px;"> <div style="border: 1px solid black; padding: 5px; text-align: center;">0</div> <div></div> <div style="border: 1px solid black; padding: 5px; text-align: center;">1</div> </div>		2
(ii)	proton / p;	allow hydrogen, H, H <sup>+</sup> (ion)	1
(iii)	any two from: MP1.both have same number of protons (and electrons); MP2.C-12 has <b>fewer</b> {neutrons / nucleons} than C-14; MP3.C-12 is lighter than C-14;	both C atoms have 6 protons allow RA C-14 has 8 neutrons, C-12 has 6 neutrons allow RA	2
(iv)	mass number is constant; atomic number increases <u>by one</u> ;	however expressed, including numerically	2
(b)	working seen / appropriate line(s) on graph seen; 5 500 (years)	e.g. line drawn across from 125 Bq allow 5000-6000 (years)	2
(c) (i)	(due to) background radiation;		1
(ii)	idea that activity depends on the mass;	allow 'fair test' idea  ignore 'to have the same activity'	1

<b>Question number</b>	<b>Answer</b>	<b>Notes</b>	<b>Marks</b>
(d)	{activity / amount of C-14} too low (to measure);  quantitative supporting statement; e.g. <ul style="list-style-type: none"> <li>• age of bone is much greater than one half-life</li> <li>• activity becomes zero after 35 000 years</li> <li>• C-14 decays fully after 35 000 years</li> </ul>	allow activity is zero allow no longer emits radiation allow ‘all C-14 has gone’        allow any value given greater than 35 000 years allow any value given greater than 35 000 years	2

**Total for question 12 = 13 marks**

Question number	Answer	Notes	Marks
13 (a)	any three from: MP1. energy is transferred by particle vibration; MP2. copper is the best conductor; MP3. metals are better conductors; MP4. plastic is an insulator; MP5. statement linking number of rings to conduction;	allow electron movement in metals allow metals ranked in order of conductivity for both MP2 and MP3  allow plastic is a poor conductor e.g. <ul style="list-style-type: none"> <li>• most wax rings have melted on copper</li> <li>• more wax rings have melted on metals</li> <li>• wax has not melted on the plastic</li> </ul>	3
(b)	any two from: MP1. energy is not transferred to ice; MP2. (because) little conduction in liquids / glass; MP3. hot water stays at top (of test tube); MP4. (because) it is less dense;	ignore references to metal ring ignore heat for energy  allow no conduction in water  allow hot water rises	2
(c)	paper on the brass does not get as hot; (because the) brass tube conducts thermal energy (away from the flame);	allow metal for brass allow RA allow heat for thermal energy allow RA	2

**Total for question 13 = 7 marks**

Question number	Answer	Notes	Marks
14 (a) (i)	pressure difference = density $\times g$ $\times$ height;	allow in standard symbols and rearrangements e.g. $(\Delta)p = \rho \times g \times (\Delta)h$ reject 'gravity' for $g$	1
(ii)	idea that pressure depends on {height / depth} of liquid; the height is lower (above point Y / in tube B);	allow pressure is proportional to height	2
(iii)	speed is greater; because the (cross-sectional) area (at Y) is smaller / eq.;	allow diameter / radius for area allow 'because tube is narrower' ignore 'volume is smaller'	2
(b)	air (between the balloons) moves faster; pressure (between the balloons) decreases/eq.;	ignore references to pressure inside balloons	2

**Total for question 14 = 7 marks**

