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# Mark Scheme (Results)

## November 2021

### Pearson Edexcel International GCSE

### In Physics (4PH1) Paper 2P

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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>
<table>
<tr><th>Observation</th><th>Supports the Big Bang theory</th></tr>
<tr><td>Black holes are formed from extremely massive stars</td><td></td></tr>
<tr><td>Cosmic microwave background radiation is seen in all directions</td><td>✓</td></tr>
<tr><td>Cosmic rays from space are detected at the Earth's surface</td><td></td></tr>
<tr><td>Each galaxy contains billions of stars</td><td></td></tr>
<tr><td>Most galaxies show a red-shift in the light detected from them</td><td>✓</td></tr>
</table>
1 mark for each correct tick;<br>-1 for each additional tick if more than two ticks seen<br>5 ticks scores zero
</td><td></td><td>2</td></tr>
<tr><td>(b)</td><td>B (decreases, increases);<br><br>A is incorrect because a red giant is more powerful than a main sequence star<br>C is incorrect because a red giant is cooler and more powerful than a main sequence star<br>D is incorrect because a red giant is cooler than a main sequence star</td><td></td><td>1</td></tr>
<tr><td>(c)</td><td>the brightness/luminosity (of an object);<br>idea of a standard distance;</td><td>allow 10 parsecs/32(.6) light years<br>condone incorrect distance</td><td>2</td></tr>
</table>

Total for Question 1 = 5 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (a) | any two from:<br>MP1. water is renewable/eq;<br>MP2. no fuel / transportation cost;<br>MP3. no air pollution / greenhouse gases;<br>MP4. always available (vs wind/solar); | <br>allow "water is free"/eq<br><br>allow named pollutant e.g. $CO_2$ etc.<br>allow "reliable"<br>allow "respond quickly to demand" | 2 |
| (b) (i) | gravitational (potential energy); | | 1 |
| (ii) | C (electrically);<br><br>A is incorrect because there is no temperature difference<br>B is incorrect because there are no light or sound waves emitted<br>D is incorrect because the transfer does not involve forces | | 1 |
| (c) (i) | rate of {energy transfer / doing work}; | allow alternatives to rate e.g. per second, per unit time etc. | 1 |
| (ii) | evaluation of number of seconds in a day;<br>substitution into P = W ÷ t;<br>evaluation;<br><br>e.g.<br>1 day = (24 × 60 × 60 =) 86 400 seconds<br>(P =) $9.7 \times 10^{14} \div 86\,400$<br>(P =) $1.1 \times 10^{10}$ (W) | seen anywhere in working<br><br>-1 for POT error<br><br><br><br>allow $1.1226\ldots \times 10^{10}$ (W)<br>allow $6.7 \times 10^{11}$ J/min or $4.04 \times 10^{13}$ J/hr if given unit changed.<br>2 marks max. if time unit conversion attempted but incorrect unit e.g. $6.7 \times 10^{11}$ (J/min) or $4.04 \times 10^{13}$ (J/hr) | 3<br><br><br><br><br><br><br><br>1 |
| (iii) | D (22 500 000 000 J/s);<br>A is incorrect because joules is not the unit for power and mega has not been dealt with correctly<br>B is incorrect because mega has not been dealt with correctly<br>C is incorrect because joules is not the unit for power | | |
| (iv) | any one from:<br>• idea that electricity demand varies;<br>• idea that water level in reservoir varies;<br>• idea that water may not be available as readily at certain times of the year; | ignore idea of efficiency | 1 |

Total for Question 2 = 10 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (a) | (some) bonds (between particles) are broken or weakened;<br><br>particles begin to move around or slide over each other; | award either or both marks if clear from diagram<br>accept idea of reduction in intermolecular forces<br><br>reject MP2 if there is a reference to the speed of particles or KE changing during melting | 2 |
| (b) (i) | any two from:<br>MP1. energy is transferred to air/particles (by heating);<br>MP2. idea that particles move faster;<br>MP3. temperature (in K) is (directly) proportional to KE of particles; | <br>accept molecules for particles<br><br>accept particles gain KE | 2 |
| (ii) | particles hit (flask) walls **more frequently**;<br>particles hit (flask) walls with more force / harder; | | 2 |
| (iii) | 136 (kPa); | allow answers in the range 135-137 (kPa) | 1 |
| (iv) | substitution;<br>rearrangement;<br><br>evaluation;<br><br>e.g.<br>136 / 400 = $p_2$ / 230<br>($p_2$ =) (136 x 230) / 400<br>($p_2$ =) 78 (kPa) | allow ecf from (b)(iii)<br>e.g. 86 (kPa) for (iii) gives 79 (kPa) for (iv)<br>substitution and rearrangement in either order<br><br><br><br>allow 78.2…<br><br>accept extrapolation back to T = 230 for 2 marks<br>accept value between 79 and 77 by this method<br><br>accept calculation using graph (i.e. extrapolation numerically/algebraically) back to 230 for 2 marks<br>accept value between 79 and 77 by this method | 3 |

Total for question 3 = 10 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) (i) | mass number = 3;<br>atomic number = 1; | | 2 |
| (ii) | idea that a (further) neutron is required (for further fission reactions);<br>(but) no neutrons produced (in the fission process); | | 2 |
| (b) | fission is the **splitting** of a <u>nucleus</u>;<br><br>fusion is the **joining** of two <u>nuclei</u>; | allow "breaking down", "dividing" for splitting<br>allow "fusing", "combining" for joining | 2 |

Total for Question 4 = 6 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) (i) | position of the mass hanger; | allow distance of mass hanger/eq<br>reject unqualified "distance" | 1 |
| (ii) | any two from:<br>MP1. weight or mass of metre rule<br>MP2. weight or mass of mass hanger;<br>MP3. positions of newton meter(s); | ignore "same equipment" | 2 |
| (iii) | any one from:<br>• take repeats and find mean;<br>• extend the range of the results;<br>• measure more intermediate positions;<br>• repeat to {identify/remove} anomalies;<br>• plot a graph to spot anomalies; | | 1 |
| (b) (i) | all data plotted to within half a small square; | | 1 |
| (ii) | straight line passing through all points; | allow straight line with points evenly distributed either side if plotting error in (i) | 1 |
| (iii) | any four from:<br>MP1. as position of mass hanger increases, reading on newton meter A decreases;<br>MP2. as position of mass hanger increases, reading on newton meter B increases;<br>MP3. relationship(s) are linear;<br>MP4. idea that newton meter readings are the same when the position is 50cm;<br>MP5. idea that the sum of the newton meter readings is constant; | accept "as A decreases, B increases" for MP1 & MP2<br>ignore references to proportionality | 4 |
| (c) | any three from:<br>MP1. idea that clockwise moment equals anti-clockwise moment;<br>MP2. distance of mass hanger from newton meter B decreases;<br>MP3. (therefore) anti-clockwise moment of mass hanger weight (about B) decreases;<br>MP4. clockwise moment (of newton meter A reading) decreases (thereby decreasing reading); | allow idea that moments must balance<br>allow distance from newton meter A increases | 3 |

Total for Question 5 = 13 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (a) (i) | (soft) iron; | | 1 |
| (ii) | pass a current in the coil / eq; | condone reference to 'electricity' | 1 |
| (b) (i) | $N_p/N_s = V_p/V_s$; | allow any correct rearrangement<br>allow "i(nput) and o(utput)" or "1 and 2" for "p(rimary) and s(econdary)"<br>allow correct word equation<br><br>ignore 'P' for 'N'<br>condone 'T', 't' or 'n' for 'N'<br>condone 'coils' for 'turns' | 1 |
| (ii) | substitution;<br>rearrangement;<br>evaluation to 2s.f. or more;<br><br>e.g.<br>$1500/280 = 115/V_s$<br>$(V_s =) 115 \times 280 / 1500$<br>$(V_s =)$ 21 (V) | <br><br><br><br><br><br>allow 21.4666…(V) | 3 |
| (iii) | use of transformer power formula;<br>substitution OR rearrangement;<br><br>evaluation;<br><br>e.g.<br>input power = output power OR $V_pI_p = V_sI_s$<br>$115 \times 1.2 = 20 \times I_s$ OR $I_s = V_pI_p/V_s$<br>$(I_s =)$ 6.9 (A) | <br><br>allow use of 20, 21, 21.5 etc. for output voltage<br>allow use of turns ratio i.e. step-down voltage means step-up current<br><br><br><br><br>allow 7 (A)<br>allow range of 6.4-6.9 | 3 |
| (iv) | any two from:<br>MP1. increase input voltage/current;<br>MP2. decrease number of turns on secondary coil;<br><br>MP3. increase number of turns on primary coil; | <br><br>condone "decrease number of secondary coils"<br>condone "increase number of primary coils" | 2 |

Total for Question 6 = 11 marks

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| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 7 (a) | | ignore statements relating to paint as a whole being attracted to the object | 3 |
| | paint particles are positively charged; | allow idea of particles being given same charge<br>condone particles being negatively charged | |
| | paint particles repel/like charges repel; | Allow idea that paint particles are attracted to the electrons in the (metal) object | |
| | producing a thin / even coat of paint; | allow idea that paint finish is improved<br>allow idea that paint reaches parts that would otherwise be difficult | |
| (b) | any three from:<br><br>MP1. object becomes charged when paint particles land on it;<br>MP2. (without earthing) further paint particles would be repelled by the object as they have the same charge;<br>MP3. earthing discharges object;<br><br>MP4. electrons transferred between Earth and object;<br>MP5. (earthing means) paint continues to reach object/ giving thicker coat/give even coverage; | allow 'neutralises object' or 'object becomes neutral' | 3 |

Total for question 7 = 6 marks

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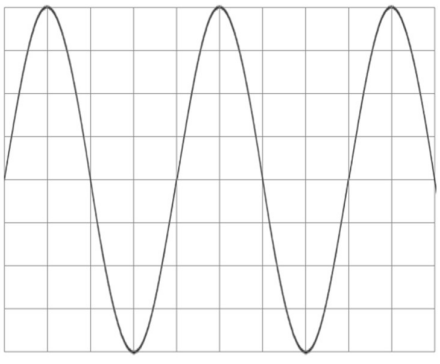
| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 8 (a) (i) | microphone; | | 1 |
| (ii) | measure number of squares for a number of complete cycles / waves and find average number of squares for one cycle;<br><br>multiply number of squares for one cycle by the time base / eq; | condone 'find number of squares for one cycle'<br>accept 'period' for 'cycle'<br><br>condone use of 'wavelength' for 'period' or 'cycle'<br><br>ignore reference to T = 1/f | 2 |
| (b) (i) | evaluation of time period of wave;<br><br>substitution into f = 1 ÷ T;<br>evaluation of frequency;<br>conclusion consistent with frequency value;<br><br>e.g.<br>time period = $4 \times 10^{-5}$ s<br>f = 1 ÷ $4 \times 10^{-5}$<br>f = 25 000 (Hz)<br>(therefore) sound cannot be heard (since frequency is greater than 20 000 Hz) | reject if candidate uses y-axis<br><br>allow ecf if frequency is incorrect<br><br>conclusion must be consistent with candidate's frequency value to be awarded the mark | 4 |
| (ii) | wave has amplitude of 4 squares;<br>wave has time period of 4 squares;<br><br>e.g.<br> | | 2 |

Total for Question 8 = 9 marks

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