

# Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Physics  
(5PH2H) Paper 01  
Unit P2: Physics for your future

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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.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- 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.

## **Quality of Written Communication**

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
<b>1 (a)</b>	D (Proton)		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (b) (i)</b>	<p>An explanation linking</p> <ul style="list-style-type: none"> <li>• friction (between shoes and carpet) (1)</li> <li>• movement of electrons (1)</li> <li>• {electrons/-ve charges} move from the student ( to carpet) (1)</li> </ul> <p>stating that positive charges move can only score a maximum of one from the last two marking points</p>	<ul style="list-style-type: none"> <li>• rubbing (of shoes on carpet)</li> <li>• movement / transfer of charge</li> </ul> <p>friction causes the student to lose electrons to the carpet gains all 3 marks</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (b) (ii)</b>	<p>An explanation linking any two from</p> <ul style="list-style-type: none"> <li>• electrons flow (1)</li> <li>• to the student (1)</li> <li>• through the metal handle (1)</li> </ul>	<p>Current  Condone charge for electrons  Student is discharged/ charge is earthed /student is earthed</p> <p>from the {handle / ground / earth}  metal / handle is a conductor</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (c)</b>	<p>Substitution  <math>70 \times 10^{-3} \times 90</math> (1)</p> <p>Evaluation:  6.3 (C) (1)</p>	<p>allow 1 mark maximum for power of ten error in final answer (C)</p> <p>Allow 2 marks for correct answer with no working shown.</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (a)</b>	B (is triggered by neutrons)		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (b)</b>	92 (protons) (1) 143 (neutrons) (1)	Must be in this order	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (c)</b>	A description to include any two from <ul style="list-style-type: none"> <li>• Slow down neutrons (1)</li> <li>• Allow capture by nucleus (1)</li> <li>• To increase the rate of / maintain the reaction / eq (1)</li> </ul>	Allow uranium for nucleus <b>increase</b> chance of collision / fission	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (d)</b>	An explanation linking any two from  at high(er) temperature... <ul style="list-style-type: none"> <li>• the nuclei have a high (kinetic) energy (1)</li> <li>• more able to overcome (mutual) repulsion (1)</li> <li>• likelihood of fusion reaction is higher (1)</li> </ul> ORA	condone atoms for nuclei  nuclei are moving (more) quickly	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2 (e)</b>	A suggestion to include  Results not verified / validated (by scientific community) (1)	Could not reproduce results / insufficient evidence	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(a)</b>	Substitution into $PE = m \times g \times h$ :  $18 \times 9500 \times 10$ (1)  Evaluation:  $1\,710\,000$ (J) (1)	Allow 1 mark for evaluation of 2 375 000 (arising from using 25m for distance)  $1\,710$ kJ Allow full marks for correct answer with no working shown	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3 (b)</b>	$1\,710\,000$ J (1)	Allow ecf from 3 a	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(c)</b>	A description to include  An energy transfer involving (gravitational ) <b>potential energy</b> and <b>kinetic energy</b> (1)  Correct direction of that transfer, i.e. potential energy increases / kinetic energy decreases (from C to D) (1)  second mark point is dependent on first	Ignore heat / sound energy  Accept kinetic energy is transferred into potential energy for both marks	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(d)</b>	Substitution into $p = m \times v$ (1)  $150\,000 = 9\,500 \times v$  Transposition: (1) $v = 150\,000 / 9\,500$  evaluation: (1) $16$ (m/s)	Substitution and transposition can be in either order  Answers which round to 16 such as 15.8, 15.79 etc  Allow full marks for correct answer with no working shown	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(e)</b>	<p>An explanation linking any <b>two</b> from</p> <p><b>EITHER</b>  (larger distance) allows more time to stop (1)</p> <p>smaller rate of change of momentum / velocity (1)</p> <p>smaller force (on passengers) (1)</p> <p><b>OR</b>  Use of <math>\text{work done} = \text{force} \times \text{distance}</math> (1)</p> <p>smaller force (on passengers) (1)</p> <p>to do work (required to bring car to a stop) (1)</p>	<p>slow down gradually    owtte</p> <p>Note: takes "longer" without reference to time gets no credit for first MP(repeat of stem)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(ai)</b>	Relevant working on graph (1)  8 (days) (1)	for example ; line from 90 mg to curve OR from curve to 8 days  7.5 to 8.5 days  Allow both marks for correct answer with no working shown.	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(aii)</b>	330 (mg)	Any answer in the range 300 – 360 inclusive	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a iii)</b>	An explanation linking any two of <ul style="list-style-type: none"> <li>• <b>gamma</b> rays are highly penetrating (1)</li> <li>• cause DNA/cells to mutate <b>(1)</b></li> <li>• if subjected to repeated exposure (1)</li> </ul>	Beta /gamma is ionising Gamma/Beta rays penetrate tissue/skin OR Gamma have long range  damage/kill cells/ tissues cause cancer ignore ultimate effects such as organ failure/ death etc	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a iv)</b>	any <b>one</b> from: <ul style="list-style-type: none"> <li>• store in a lead (-lined) box <b>(1)</b></li> <li>• warning signs <b>(1)</b></li> <li>• restricted access owtte <b>(1)</b></li> <li>• shielding <b>(1)</b></li> <li>• do not touch <b>(1)</b></li> <li>• relevant protective clothing <b>(1)</b></li> <li>• monitor dose <b>(1)</b></li> </ul>	any reasonable precaution	<b>(1)</b>



Question Number	Answer	Acceptable answers	Mark
<b>4(b)(i)</b>	<b>B</b> a beta emitter		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(b)(ii)</b>	<p>An explanation linking the following points:</p> <ul style="list-style-type: none"> <li>• paper absorbs radiation (1)</li> <li>• detector send signals (to system controlling) rollers (1)</li> <li>• when paper too thick, rollers pushed closer together.(1)</li> </ul>	<p>ignore type of radiation used</p> <p>radiation penetrates the paper</p> <p>detector reacts to change in amount of radiation received</p> <p>reverse argument</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(a)</b>	voltmeter in parallel with lamp (1)	Any recognisable symbol or drawing	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(b)</b>	A (12 joules per coulomb)		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(c)</b>	<p>Substitution: (using <math>R=V/I</math>)  <math>4.0 / 0.37</math> (1)</p> <p>Evaluation:  <math>10.8</math> (<math>\Omega</math>) (1)            (Approx 11 )</p> <p>Accept answer of 10.8 with no working for both marks</p>	<p>Substitution: (using <math>V = IR</math>)  <math>0.37 \times 11</math> (1)</p> <p>Evaluation:  <math>4.07</math> (V) (1)            (approx 4 )</p> <p>Accept answer of 4.07 with no working for both marks</p> <p><b>Or</b></p> <p>Substitution: (using <math>I = V/R</math>)  <math>4/11</math> (1)</p> <p>Evaluation:  <math>0.364</math> (A) (1)            (approx. 0.37 )</p> <p>Accept answer of 0.364 with no working for both marks</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(d)</b>	C (decreases decreases)		<b>(1)</b>

Question Number	Indicative Content	Mark
<b>QWC</b>	<p><b>*5(e)</b></p> <p>An explanation linking some of the following points</p> <p><u>Change in resistance</u></p> <ul style="list-style-type: none"> <li>• calculation of two (different) resistances</li> <li>• resistance of lamp constant up to (about) 3 V</li> <li>• resistance of lamp increases with increasing voltage/current</li> <li>• qualitative comparison of lamp resistance values at different voltages/currents</li> <li>• relationship between voltage and current linear at low values but becomes non-linear</li> </ul> <p><u>Change in temperature</u></p> <ul style="list-style-type: none"> <li>• higher currents / voltages produce higher temperatures/heating in lamp/ increase in brightness</li> </ul> <p><u>Change in energy transfer</u></p> <ul style="list-style-type: none"> <li>• Higher currents / voltages result in greater energy transfer (per second)</li> </ul> <p><u>Events in lattice</u></p> <ul style="list-style-type: none"> <li>• energy transfer as a result of collisions in filament</li> <li>• collisions between electrons (and ions in lattice)</li> <li>• lattice vibrations linked to temperature</li> </ul>	<b>(6)</b>
<b>Level</b>	<b>0</b>	No rewardable content
<b>1</b>	<b>1 - 2</b>	<ul style="list-style-type: none"> <li>• A limited explanation identifying a change in the filament (lamp).  e.g. a comparison of at least two correct values of resistance OR resistance of lamp increases at higher voltages / currents compared with low voltages / currents</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>
<b>2</b>	<b>3 - 4</b>	<ul style="list-style-type: none"> <li>• A simple explanation that links at least two of the above points  e.g. The resistance increases at high voltages due to collisions in the filament OR higher currents produce higher temperatures/heating in lamp. This means the resistance increases</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>

<b>3</b>	<b>5 - 6</b>	<ul style="list-style-type: none"><li>• a detailed explanation that links at least two points and uses a correct theory of events in the lattice e.g. the collision theory to explain that link.</li></ul> <p>e.g. The resistance of lamp increases at higher voltage as higher currents produce higher temperatures/heating in the lamp. This is due to collisions between electrons and ions</p> <p>OR</p> <p>Higher currents produce higher temperatures/heating in lamp. The heat energy comes from increased energy transfer as a result of collisions in filament.</p> <ul style="list-style-type: none"><li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li><li>• spelling, punctuation and grammar are used with few errors</li></ul>
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Question Number	Answer	Acceptable answers	Mark
<b>6ai</b>	evidence of calculation of gradient of graph during acceleration: (1)  Evaluation: (1) 6.3 (m/s <sup>2</sup> )	Allow full marks for correct answer with no working shown  accept values from 6.0 to 6.5 inclusive	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>6a ii</b>	Line with smaller initial gradient and then horizontal at 17 m/s (1)	Ignore time at which acceleration stops. Judge horizontal value by eye but do not accept any part of line which goes outside range of 16 to 18	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>6 a iii</b>	A reason which includes reference to  air resistance / drag / friction (1)	Wind resistance overcome resistance	(1)

Question Number	Answer	Acceptable answers	Mark
<b>6 a iv</b>	Substitution : (1)  600 = w / 240  Transposition (1) w = 600 x 240  evaluation: (1) 144 000 J	conversion between mins and secs can be delayed until evaluation 600 = w / 4  W = 600 x 4  Substitution and transposition can be in either order  144 kJ Allow full marks for correct answer with no working shown  2400 obtained by failure to convert mins to secs can score a maximum of 2 marks	<b>(3)</b>

Question Number	Indicative Content	Mark
<b>QWC</b>	<p><b>*6(b)</b></p> <p>An explanation linking some of the following points</p> <p><b>What</b> has changed / improved; eg:</p> <ul style="list-style-type: none"> <li>• Bicycle has less mass</li> <li>• Tyres are thinner/ lighter</li> <li>• Frame / wheels / body position more aerodynamic / stiffer</li> <li>• Clothing or headgear is lighter / smoother / streamlined</li> </ul> <p><b>Why</b> this is an advantage: eg:</p> <ul style="list-style-type: none"> <li>• Greater acceleration (for the same force)</li> <li>• Less frictional force (eg air resistance/ rolling resistance) to overcome</li> <li>• Total work done over the race is less</li> </ul> <p><b>How</b> this has decreased record times eg:</p> <ul style="list-style-type: none"> <li>• Less total energy used to overcome friction</li> <li>• Frictional forces balance driving forces at a higher velocity</li> <li>• Greater velocity reached during acceleration at the start</li> <li>• Allowing cyclist to maintain higher (average) velocity</li> <li>• For same cyclist power, less time required to do less work</li> </ul>	<b>(6)</b>
<b>Level</b>	<b>0</b>	No rewardable content
<b>1</b>	<b>1 - 2</b>	<ul style="list-style-type: none"> <li>• a limited explanation which describes what has changed. eg: the cyclists' clothes make them more streamlined</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>
<b>2</b>	<b>3 - 4</b>	<ul style="list-style-type: none"> <li>• a simple explanation which includes why the change described is an advantage eg: the cyclists are more streamlined and so the air resistance is less</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>
<b>3</b>	<b>5 - 6</b>	<ul style="list-style-type: none"> <li>• a detailed explanation which includes how the change described has decreased time eg: the cyclists are more streamlined so the air resistance is less. They can travel at a higher velocity before they meet the same frictional forces.</li> <li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li> <li>• spelling, punctuation and grammar are used with few errors</li> </ul>



