

Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Physics  
(5PH2F) 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(ai)</b>    | <b>A</b> a battery (1) |                    | <b>(1)</b> |

| Question Number | Answer  | Acceptable answers  | Mark       |
|-----------------|---|---|------------|
| <b>1 (aii)</b>  | <p>an explanation linking:</p> <p>in one direction (1)</p> <p>second mark can only be scored if first mark is scored</p> <p>movement of charges/electrons (1)</p> | <p>from negative to positive or positive to negative or in {one/same} {direction/way}</p> <p>ignore it goes straight/directly to.....</p> <p>{charge(s)/electrons}</p> <p>{moving/flowing}</p> <p>condone current /idea of movement</p> <p>ignore electricity</p> <p>NOT energy/power/voltage/p.d. or atoms</p> | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers  | Mark       |
|-----------------|--|---|------------|
| <b>1 (bi)</b>   | <p>substitution:<br/>0.3 x 30 (1)</p> <p>evaluation<br/>9 (1)</p> <p>C (1)</p> | <p>in all calculations if the candidate gives two different methods and writes the wrong answer in the answer space award no marks</p> <p>if the candidate writes correct answer they will gain full marks</p> <p>allow both marks for correct answer with no working shown.</p> <p>allow POT error for 1 mark</p> <p>coulomb(s)/Coulomb(s)</p> <p>condone lower case c, amp second or As</p> <p>NOT A/s</p> <p>unit mark is independent of value</p> | <b>(3)</b> |

| Question Number | Answer                             | Acceptable answers  | Mark       |
|-----------------|------------------------------------|---|------------|
| <b>1 (bii)</b>  | (ammeter reading/it) decreases (1) | accept (ammeter reading or amps or current) less/lower/smaller/weaker or not as big<br>accept charge transferred is less/lower/decreases<br><br>ignore slow down<br>ignore references to any other quantities<br><br>accept number less than 0.3 (A)<br>BUT<br>do not accept negative values of current | <b>(1)</b> |

| Question Number | Answer          | Acceptable answers | Mark       |
|-----------------|-----------------|--------------------|------------|
| <b>1 (biii)</b> | B electrons (1) |                    | <b>(1)</b> |

| Question Number | Answer        | Acceptable answers | Mark     |
|-----------------|---------------|--------------------|----------|
| <b>2(a)</b>     | <b>D</b> ions |                    | <b>1</b> |

| Question Number  | Answer  | Acceptable answers | Mark                |  |          |   |     |            |     |     |  |          |
|------------------|---|--------------------|---------------------|--|----------|---|-----|------------|-----|-----|--|----------|
| <b>2(b)</b>      | <table border="1"> <thead> <tr> <th>name of particle</th> <th>number of particles</th> <th></th> </tr> </thead> <tbody> <tr> <td>(proton)</td> <td>2</td> <td>(1)</td> </tr> <tr> <td>neutron(s)</td> <td>(2)</td> <td>(1)</td> </tr> </tbody> </table> | name of particle   | number of particles |  | (proton) | 2 | (1) | neutron(s) | (2) | (1) |  | <b>2</b> |
| name of particle | number of particles   |                    |                     |  |          |   |     |            |     |     |  |          |
| (proton)         | 2   | (1)                |                     |  |          |   |     |            |     |     |  |          |
| neutron(s)       | (2)   | (1)                |                     |  |          |   |     |            |     |     |  |          |

| Question Number | Answer  | Acceptable answers  | Mark     |
|-----------------|---|---|----------|
| <b>2(c)</b>     | <p>a description to include:</p> <p>neutron(s) (from the fission) (1)</p> <p>(neutrons from fission go on to) collide with/be absorbed by another uranium(-235) nucleus (1)</p> | <p>2/3 neutrons</p> <p>references to the neutron on the diagram colliding with the uranium-235 nucleus do not score. The answer must imply neutrons from fission</p> <p>cause more fissions/splitting</p> <p>alternative descriptions of collisions eg hit/bump into/smash into etc condone (go on to) collide with another uranium(-235 atom)</p> <p>new neutrons {cause fission/repeat this process} scores both marks</p> <p>ignore react/chain reaction</p> | <b>2</b> |

| Question Number | Answer  | Acceptable answers  | Mark     |
|-----------------|---|---|----------|
| <b>2(d)</b>     | <p>a description to include any <b>three</b> of the following:</p> <p>(two light/small) nuclei (1)</p> <p>fuse (together) (1)</p> <p>(to produce a) heavier nucleus (1)</p> <p>releasing energy (1)</p> | <p>condone atoms for nuclei throughout this item</p> <p>named examples {eg hydrogen/deuterium/tritium} or identifiable symbols</p> <p>{join/merge/bind/bond/combine} (together)</p> <p>(to produce) helium/He (nuclei/atoms)</p> <p>condone bigger/larger</p> <p>{make/create/produce} energy condone gives off energy accept any reasonable form of energy</p> <p>eg thermal/heat or light or KE</p> | <b>3</b> |

| Question Number | Answer          | Acceptable answers | Mark     |
|-----------------|-----------------|--------------------|----------|
| <b>3(a)</b>     | <b>B</b> Weight |                    | <b>1</b> |

| Question Number | Answer  | Acceptable answers | Mark     |
|-----------------|---|--------------------|----------|
| <b>3(bi)</b>    | <b>D</b> the friction forces are the same size as the forward force on the boat |                    | <b>1</b> |

| Question Number | Answer  | Acceptable answers   | Mark     |
|-----------------|---|--|----------|
| <b>3(b)(ii)</b> | <p>divide any suitable pair of values<br/>eg <math>60 \div 10</math> or <math>120 \div 20</math> (1)</p> <p>evaluation (1)<br/>6 ( m/s)</p> | <p>no credit for speed = distance <math>\div</math> time as on formulae page</p> <p>allow both marks for correct answer with no working shown.</p> <p>answers in range 5.8 to 6.2 (m/s)</p> <p>allow POT error for 1 mark but not if clear they have multiplied 60 and 10</p> <p>no marks for a correct evaluation of a wrong pair of numbers eg <math>140/20 = 7</math> scores zero</p> | <b>2</b> |

| Question Number | Answer   | Acceptable answers  | Mark     |
|-----------------|--|---|----------|
| <b>3(ci)</b>    | <p>substitution<br/>(force =) <math>680 \times 3.8</math> (1)</p> <p>evaluation (1)<br/>2584 (N) (which is about 2600 N)</p> | <p>accept alternative explanations<br/><math>2600 \div 680</math> seen for one mark<br/>= <math>3.82(\text{m/s}^2)</math> (which is about <math>3.8 (\text{m/s}^2)</math>)<br/>for both marks<br/>OR<br/><math>2600 \div 3.8</math> seen for one mark<br/>= <math>684(.2)</math> (kg) (which is about 680 (kg))<br/>for both marks</p> <p>2580 (N)<br/>ignore 2600 (N) for the second mark</p> <p>accept 2584 (N) with no working seen for both marks</p> | <b>2</b> |

| Question Number | Answer  | Acceptable answers   | Mark     |
|-----------------|---|--|----------|
| <b>3(c)(ii)</b> | combining vectors (1)<br><br>evaluation (1)<br>3800 (N) | 2600 + 1200<br>or 2600 - 1200 or 1200 - 2600<br>not divide or multiply<br>eg 1400 (N) for 1 mark<br><br>allow both marks for correct answer<br>with no working shown.<br>accept 3784 (N) | <b>2</b> |

| Question Number | Answer  | Acceptable answers   | Mark     |
|-----------------|---|--|----------|
| <b>3(d)</b>     | an explanation linking 1 <sup>st</sup> marking point with either of the 2 <sup>nd</sup> two: <ul style="list-style-type: none"> <li>driver (exerts an unbalanced) force (on the boat) (1)</li> </ul> second mark can only be scored if first mark is scored <ul style="list-style-type: none"> <li>(in the) opposite direction (to which he moves) (1)</li> <li>(unbalanced force) accelerates the boat (away from bank) (1)</li> </ul> | <b>ignore 'causing the boat to move away from the bank' unless linked to push from driver as this is in the question</b><br>ignore references to currents in river<br><br>driver (produces) a push/thrust (on the boat)<br><br>backwards/(in a direction) away (from the bank/himself)<br>take negative velocities/speeds as away from bank<br>action/reaction (forces)<br><br>(unbalanced force) changes the speed/ momentum (of boat)<br><br>explanations in terms of momentum can score up to two marks | <b>2</b> |



| Question Number | Answer                                  | Acceptable answers | Mark       |
|-----------------|---|--------------------|------------|
| <b>4(ai)</b>    | <b>C</b> sterilising hospital equipment |                    | <b>(1)</b> |

| Question Number | Answer   | Acceptable answers  | Mark       |
|-----------------|--|---|------------|
| <b>4(aii)</b>   | <p>an explanation linking any <b>two</b> of the following:</p> <ul style="list-style-type: none"> <li>• (gamma rays are) ionising (1)</li> <li>• (gamma rays are very/highly) penetrating (1)</li> <li>• cause { DNA/cells} to mutate (1)</li> <li>• cause cancer (1)</li> </ul> | <p>accept reverse arguments eg difficult to shield against as reverse to penetrating</p> <p>ignore radioactive</p> <p>ignore high energy as in stem penetrate body/tissue/skin/cells/paper /aluminium/lead</p> <p>accept damage your insides for idea of penetration only</p> <p>mutates/damages { DNA/cells/tissue/organs}</p> <p>condone kills cells/cause mutation(s)</p> <p>ignore harm cells/kill you</p> <p>tumours</p> <p>damage cells inside your body scores two marks for damage <u>cells</u> and penetration</p> | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers  | Mark       |
|-----------------|--|---|------------|
| <b>4(aiii)</b>  | <p>idea of halving mass (1)</p> <p>0.5(0) (mg) (1)</p> | <p>1(.00) (mg)</p> <p>accept idea of 2 half-lives for this mark</p> <p>ignore <math>60 \div 2</math> AND <math>10 \div 2</math> for this mark</p> <p>allow both marks for correct answer with no working shown.</p> <p>no power of ten error on this item</p> | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers   | Mark       |
|-----------------|--|--|------------|
| <b>4(aiv)</b>   | any <b>one</b> from: <ul style="list-style-type: none"> <li>• use a lead (-lined) box <b>(1)</b></li> <li>• warning signs <b>(1)</b></li> <li>• restricted access owtte <b>(1)</b></li> <li>• locked room/cupboard <b>(1)</b></li> </ul> | ignore references to temperature/safety <b>goggles/gloves/don't touch it/keep it at a distance/protective clothing/(face) mask</b><br><br>sealed/secure container eg metal-lined box or in concrete (block) or behind lead (walls)<br><br>keep people away / keep away from people | <b>(1)</b> |

| Question Number | Answer   | Acceptable answers   | Mark       |
|-----------------|--|--|------------|
| <b>4(b)(i)</b>  | any <b>two</b> advantages from: <ul style="list-style-type: none"> <li>• no carbon dioxide (produced) (1)</li> <li>• no { sulphur dioxide/nitrogen oxides} (produced) (1)</li> <li>• conserves fossil fuels (1)</li> <li>• reduces dependence on foreign supplies of energy (1)</li> <li>• good safety record (under normal operating conditions) (1)</li> <li>• uses less fuel (1)</li> </ul> | less/no { greenhouse gases/global warming}<br>less/no { acid rain/atmospheric pollution}<br>condone no harmful gases released<br>ignore less pollution<br><br>fossil fuel (reserves) will last longer owtte<br><br>condone nuclear fuel (reserves) will last longer than (those for fossil fuels)<br>accept nuclear power is more efficient (per kg of fuel used)<br><br>ignore references to more power/reliability/energy/electricity generated or cost and vague terms such as environmentally friendly<br><br>ignore nuclear energy is (a) renewable (energy source) | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers   | Mark       |
|-----------------|--|--|------------|
| <b>4(b)(ii)</b> | <p>a description including any <b>two</b> from:</p> <p>idea of initial treatment (1)</p> <p>idea of containment (1)</p> <p>idea of long term storage or reprocessing (1)</p> | <p>(radioactive waste/fuel rods/it) under water or vitrification<br/>any description of immobilising waste by combining with inert material<br/>eg put it in a concrete block/glass</p> <p>sealing in (stainless) steel (cylinder)<br/>condone suitable (sealed) {cylinder/box/container/barrel} eg metal barrel</p> <p>(long term) storage (deep) underground<br/>put in (salt/coal) mines or any underground cavern</p> <p>(radioactive) waste is reprocessed/turned into new fuel can be combined with any of the above points to score up to two marks</p> <p>ignore keep it away from people/houses<br/>ignore dump it in the sea</p> | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers  | Mark       |
|-----------------|--|---|------------|
| <b>5(a)(i)</b>  | substitution:<br>$6.0 \div 0.4$ (1)<br><br>evaluation<br>$15 (\Omega)$ (1) | allow both marks for correct answer with no working shown<br>allow POT error for 1 mark | <b>(2)</b> |

| Question Number | Answer   | Acceptable answers  | Mark       |
|-----------------|--|---|------------|
| <b>5(a)(ii)</b> | substitution:<br>$0.4 \times 6.0$ (1)<br><br>evaluation<br>$2.4$ (W) (1) | allow both marks for correct answer with no working shown<br>allow power of ten error for max 1 eg $0.24$ (W) or $0.024$ (W) or $240$ (W)<br>accept fractions eg $12/5$ | <b>(2)</b> |

| Question Number  | Answer  | Acceptable answers   | Mark       |
|------------------|---|--|------------|
| <b>5(a)(iii)</b> | substitution:<br>$0.4 \times 6.0 \times 40$ (1)<br><br>evaluation<br>$96$ (J) (1) | $2.4 \times 40$<br>ecf from 5(a)(ii)<br>ie answer to 5a(ii) x 40 correctly evaluated gains both marks<br><br>allow both marks for correct answer with no working shown<br>allow power of ten error for max 1 mark<br>eg $9.6$ (J) or $0.96$ (J) or $960$ (J) or $9600$ (J) | <b>(2)</b> |

| Question Number | Indicative Content  | Mark  |
|-----------------|---|---|
| <b>QWC</b>      | <p><b>*5(b)</b></p> <p>a description including some of the following points</p> <ul style="list-style-type: none"> <li>• resistance of filament changes slowly at low currents</li> <li>• values of resistance taken from graph</li> <li>• resistance of filament almost constant at low currents</li> <li>• comparison of lamp resistance values at different currents<br/>e.g. resistance of lamp 100% greater at 0.2 A compared to that at 0.1 A or double that at 0.1 A</li> <li>• resistance of lamp increases with increasing current</li> <li>• higher currents produce higher temperatures/heating in lamp</li> <li>• resistance of lamp increases with increasing temperature</li> <li>• resistance of thermistor decreases with temperature</li> <li>• rate at which resistance of thermistor decreases is lower at higher temperatures</li> <li>• values of thermistor resistance taken from graph</li> <li>• comparison of thermistor resistance values at different temperatures</li> <li>• rate at which resistance of thermistor decreases is greater at lower temperatures</li> <li>• idea of resistance of thermistor halving every 10 degrees C</li> </ul> <p>NOTE: In the absence of any other rewardable content: resistance of lamp has a positive correlation AND resistance of thermistor has a negative correlation is only acceptable for level 1: 2 marks and does not contribute to marks at higher levels</p> | <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 description giving one fact OR two simple statements about the graphs<br/>e.g. The resistance of thermistor decreases with temperature<br/>OR resistance of lamp increases with current<br/>OR the resistance of the lamp increases AND the resistance of the thermistor decreases</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 description giving more than one fact, about resistance of the filament lamp or thermistor OR at least one fact about both.<br/>e.g. The resistance of the lamp increases with current, the resistance of the thermistor decreases with temperature.<br/>OR The resistance of lamp is almost steady at low current but increases at high(er) currents.<br/>OR The resistance of the thermistor decreases from 160 <math>\Omega</math> to almost zero (at 50 <math>^{\circ}\text{C}</math>).</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 description giving more than two facts about the resistance of either device<br/>OR a description involving more than one fact about the resistance of one component AND at least one fact about the resistance of the other component.<br/>e.g. The resistance of lamp is almost steady at first. This resistance is about 25 ohms. The resistance increases at high(er) currents.<br/>OR Higher currents produce higher resistance in lamp. The resistance of the lamp increases rapidly after 0.1. The thermistor's resistance gets lower as the temperature gets higher.</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> |

| Question Number | Answer                                | Acceptable answers  | Mark       |
|-----------------|---------------------------------------|---|------------|
| <b>6(a)(i)</b>  | (driver was) reacting (to danger) (1) | thinking (about stopping) / getting ready (to brake)<br><b>condone (it is the driver's) reaction time</b><br>condone thinking distance/time<br>accept speed is constant/continues at steady speed<br><br>ignore references to braking/slowing unless clearly referring to A-B | <b>(1)</b> |

| Question Number | Answer  | Acceptable answers   | Mark       |
|-----------------|---|--|------------|
| <b>6(a)(ii)</b> | substitution<br>700 x 60 (1)<br><br>evaluation (1)<br>42 000 (J) or <u>42 k</u> (J) | allow one mark for evaluation of 55 300 (J) (ie using distance of 79m)<br><br>allow both marks for correct answer with no working shown.<br>allow power of ten error for max 1 mark<br>eg 42 (J) or 420 (J) or 4200 (J) or 420 000 (J) | <b>(2)</b> |

| Question Number  | Answer   | Acceptable answers  | Mark       |
|------------------|--|---|------------|
| <b>6(a)(iii)</b> | an explanation linking any <b>three</b> of the following:<br><br>same thinking distance (1)<br><br>braking distance increases (1)<br><br>(so) greater (stopping) distance (1)<br><br>greater mass (1)<br><br>(so) greater momentum OR greater kinetic energy (1)<br><br>more work done by brakes (1)<br><br>for same (braking) force (1) | accept reverse argument<br>ignore references to gravitational and friction forces between tyres and surface<br><br>condone references to time for distances<br>eg same thinking time<br>brakes (still) applied at B<br><br>C is further (away)<br>condone longer for further<br><br>accept longer (stopping) distance<br>condone takes longer to stop<br><b>it's longer scores 1 mark as question asks about stopping distance</b><br>ignore slower {braking/stopping} distance<br><br>ignore heavier as this idea is in the stem<br><br><u>brakes</u> {work harder/transfer more energy}<br>condone <u>brakes</u> use more energy<br>braking force is (always) 700 N | <b>(3)</b> |

| Question Number | Indicative Content  | Mark  |
|-----------------|---|---|
| <b>QWC</b>      | <p><b>*6(b)</b> an explanation linking some of:</p> <ul style="list-style-type: none"> <li>• air bags are released when the car stops suddenly / is in a crash OR airbags inflate rapidly</li> <li>• people have momentum / kinetic energy</li> <li>• (when car stops/brakes suddenly or is in an accident) the driver keeps moving (forwards)</li> <li>• <b>force is needed to reduce (the driver's) momentum / KE to zero</b></li> <li>• force = rate of decrease of momentum</li> <li>• airbags reduce momentum gradually</li> <li>• air bags increase the time taken for people to stop</li> <li>• this reduces the deceleration/speed decreases at a slower rate</li> <li>• air bags increase the distance through which stopping force acts</li> <li>• force/impact on people is reduced</li> </ul> <p>NOTES:<br/> condone absorb the force / impact for reduce the force<br/> condone driver/passenger stops (more) slowly for reduces deceleration<br/> ignore references to crumple zones and seat belts</p> <p>In the absence of any other rewardable content:<br/> references to cushioning /break your fall or stop you hitting the dashboard/steering wheel/windscreen/something hard are only acceptable for level 1: 2 marks and do not contribute to marks at higher levels</p> | <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 gives one relevant fact about how injuries are reduced<br/> e.g. air bags are released when the car crashes<br/> OR airbags stop the driver slowly<br/> OR there is a smaller impact/force (on the passenger)</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 giving more than one fact about how injuries are reduced<br/> e.g. air bags are released when the car crashes. The impact/force (on the driver/passenger) is less.<br/> OR the driver keeps moving (forwards). The airbag inflates rapidly.</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 giving more than two facts about how injuries are reduced<br/> e.g. air bags inflate rapidly and increase the time it takes the driver to stop. This reduces the force (on the driver).<br/> OR air bags are released when the car crashes. The force (on the driver/passenger) is less as the bag stops them slowly.<br/> OR the time taken (for the driver) to stop is increased. This makes the deceleration smaller and so the force (on the passenger) is less.</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> |





