

# Mark Scheme (Results)

## Summer 2024

Pearson Edexcel International GCSE
In Physics (4PH1) 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) | (i) | infrared; | allow IR | 1 |
| | | (ii) | ultraviolet; | allow UV | 1 |
| | (b) | (i) | heating food / eq;<br>communication;<br>radar; | | 1 |
| | | (ii) | sterilising (equipment or food);<br><br>treating cancer;<br>medical imaging;<br>medical tracing techniques; | ignore cleaning (equipment)<br>ignore chemotherapy | 1 |

Total for Question 1 = 4 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 2 (a) | any of:<br>● idea that circuit breaker can easily be reset;<br>● idea that circuit breaker turns off circuit more quickly; | allow 'does not need to be replaced' cf fuse | 1 |
| (b) (i) | power = current × voltage; | allow standard symbols and rearrangements<br>e.g. P = I × V<br>ignore C,c for current | 1 |
| (ii) | substitution;<br>evaluation in W;<br>evaluation in kW;<br><br>e.g.<br>power = 11 × 230<br>(power =) 2500 (W)<br><br>(power =) 2.5 (kW) | <br><br><br><br><br>allow 2530 W if candidate's intention is clear i.e. removal of 'k' or 2530 with W seen.<br>allow 2.53 (kW) | 3 |
| (c) | any of:<br>● idea that there are likely to be other appliances on same circuit;<br>● fuse in heater may be rated at less than 16A;<br>● idea that heater may have a (thermal) safety cut-out;<br>● idea that thermostat turns off heater; | ignore reference to an electric fault in the heater | 1 |

Total for Question 2 = 6 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 3 (a) (i) | × 1600 seen in working OR ÷ 3600 seen in working;<br>speed = 179 (m/s); | allow ÷ $60^2$<br>allow any answer that would round to 179<br>condone 180 | 2 |
| | | NB 1600 × 403 = 644800 | |
| (ii) | idea of measuring time taken (to travel between markers); | | 3 |
| | use of appropriate instrument to measure time; | allow stopwatch, timer, (stop)clock, light gates | |
| | use of speed = distance / time; | condone any subject of equation. | |
| | | | |
| (b) | | ignore vertical arrows | 3 |
| | length of arrow equal to given arrow;<br>arrow drawn horizontally to the left; | judge by eye | |
| | arrow labelled “air resistance”; | allow drag, friction<br>ignore wind resistance | |
| | | | |

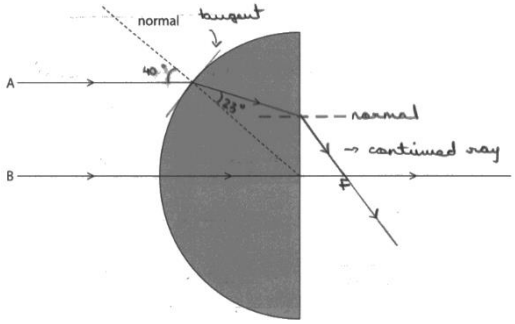
Total for Question 3 = 8 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) | one mark for each correct tick;;;;<br><br>**Stage of evolution** / **Features in the life cycle of the Sun**<br>black hole<br>main sequence ✓<br>nebula ✓<br>neutron star<br>red giant ✓<br>red supergiant<br>supernova<br>white dwarf ✓ | if 5 or more ticks given then -1 for each additional tick | 4 |
| (b) | idea of the temperatures being different;<br><br>Sun is hotter than Betelgeuse; | <br><br>also scores first mark<br>allow RA | 2 |
| (c) (i) | idea that there are no particles in space (between Sun and Earth); | allow space is a vacuum | 1 |
| (ii) | shiny / white / silver;<br>poor absorber of (IR) radiation; | <br>accept good reflector of radiation<br>accept 'does not absorb'<br>ignore references to emission<br>ignore references to conduction<br>allow 'heat' or 'energy' for 'radiation' | 2 |

Total for Question 4 = 9 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 5 (a) | MP1. use balance to measure mass;<br><br>MP2. use of measuring cylinder to measure volume;<br><br>PLUS<br><br>Any three from:<br><br>MP3. ensure balance reads zero before placing rock;<br>MP4. ensure balance is on a level surface;<br>MP5. ensure rock is dry when measuring its mass<br><br>MP6. recording volume before rock added to water<br>MP7. finding difference in volume of water after rock added<br>MP8. ensure rock is fully submerged;<br>MP9. ensure no water is spilt / all water collected by measuring cylinder;<br>MP10. read measuring cylinder at eye level / on a level surface;<br>MP11. read to bottom of water meniscus; | marks can be awarded from candidate's diagram<br>allow (weighing) scales<br><br>reject scale<br><br><br><br><br><br><br><br>allow measure mass before volume<br>fill displacement can to 'top' or 'spout'/eq<br>catch displaced volume when rock added<br><br><br><br>ignore unqualified reference to 'avoid parallax' | 5 |
| (b) (i) | density = mass / volume; | allow standard symbols and rearrangements<br>e.g. $\rho$ = m / V<br>allow d for density | 1 |
| (ii) | idea that different materials have different densities;<br><br>correct evaluation of density for at least one rock;<br><br>correct evaluation of density for all rocks;<br><br>conclusion from density values that rock A is made from a different material (so student is correct); | <br><br>A = 2.38 or 2.4 ($g/cm^3$)<br>B = 2.1(3) ($g/cm^3$)<br>C = 2.1(3) ($g/cm^3$)<br><br><br>ecf incorrect densities if candidate's conclusion is consistent | 4 |

Total for Question 5 = 10 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (a) (i) | angle of incidence = 40 (°);<br>angle of refraction = 23 (°); | allow 38-42<br>allow 21-25 | 2 |
| (ii) | n = sin(i)/sin(r); | allow rearrangements<br>reject n = i/r | 1 |
| (iii) | substitution of candidate's values into formula;<br>evidence of sines of angles;<br><br>evaluation;<br><br>e.g.<br><br>n = sin(40)/sin(23)<br>n = 1.6(5) | allow ecf from (i)<br>i.e 0.642... for sin(40), 0.390... for sin(23)<br>reject 1.73913 or any value clearly angle of incidence divided by angle of refraction<br><br>NB - using extreme values from (i), n rounds the range 1.46 to 1.87 | 3 |
| (b) (i) | single ray emerges and extended to horizontal ray;<br>ray bends away from normal by eye;<br><br> | | 2 |

| | | | |
|---|---|---|---|
| (ii) | idea that F moves away from the prism;<br><br>idea that red ray bends less than green at either interface;<br><br>idea that red ray bends less than green at both interfaces; | i.e. the crossing point is further away or moves out<br><br><br><br>allow angle of refraction is smaller at second interface<br><br>allow angle of refraction is larger at first interface<br><br>allow angle of refraction is closer to angle of incidence/eq<br><br>condone 'less refraction' | 3 |

Total for Question 6 = 11 marks

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 7 | (a) | | circuit symbols for variable resistor, ammeter and voltmeter drawn correctly;<br>variable resistor drawn in series with battery and component X; | allow variable power supply<br>allow potentiometer circuit if clear | 4 |
| | | | ammeter drawn in series with component X; | | |
| | | | voltmeter drawn in parallel with component X; | | |
| | (b) | (i) | straight line of best fit drawn with points distributed equally either side; | ignore extrapolation below V = 1.5V | 1 |
| | | (ii) | use of voltage = current × resistance; | seen in words or symbols or implied by working | 5 |
| | | | correct reading of current from graph; | allow ecf from (i) | |
| | | | substitution OR rearrangement; | ignore non-conversion of mA to A at this point | |
| | | | evaluation; | | |
| | | | matching unit; | expect Ω but allow kΩ if matched to appropriate value<br>-1 POT error | |
| | | | e.g.<br>$V = I \times R$ | | |
| | | | current = 2.35 ($\times 10^{-3}$) (A) | allow 2.3-2.4 (mA) | |
| | | | $4.2 = 2.35 (\times 10^{-3}) \times R$ OR $R = V / I$ | | |
| | | | (resistance =) 1800 | allow 1750 – 1826 | |
| | | | ohms / Ω | | |
| | | (iii) | **D (4.2 joules per coulomb);** | | 1 |
| | | | A is incorrect because this is the unit for current | | |
| | | | B is incorrect because this is the reciprocal of the unit for power | | |
| | | | C is incorrect because this is the unit for power | | |
| | | (iv) | graph for lamp should be a curve; | allow line is straight | 2 |
| | | | (because) a lamp does not obey Ohm's Law/ lamp does not have I directly proportional to V. | allow reference to (direct) proportionality | |
| | | | component X is a resistor; | allow component X is an ohmic conductor | |
| | | | | accept component X could be a lamp but it's not warm enough yet for the graph to curve for 2 marks | |

Total for Question 7 = 13 marks

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 8 | (a) | (i) | **B (78);** | | 1 |
| | | | A is incorrect because this is the number of protons | | |
| | | | C is incorrect because this is the number of nucleons | | |
| | | | D is incorrect because this is the number of nucleons + protons | | |
| | | (ii) | time taken; | allow "how long it takes"<br>reject "half the time" | 2 |
| | | | and either of | | |
| | | | for (radio)activity to halve; | allow count rate for activity | |
| | | | for half of the (radioactive) {nuclei / atoms / isotope / mass} to decay; | ignore substance | |
| | | (iii) | one mark for each correct cross drawn | curve from (iv) can be used to infer correct data points | 3 |
| | | | (8, 8000); | | |
| | | | (16, 4000); | | |
| | | | (24, 2000); | | |
| | | (iv) | smooth curve of best fit drawn; | can be used to infer points in (iii) | 2 |
| | | | correct reading of time to decrease to 5000; | ecf candidate's curve within 1 square<br>NB - perfect curve would give answer between 13-14 days | |
| | (b) | (i) | Geiger(-muller) tube/ GM tube / photographic film / scintillator; | allow detector or counter for tube<br>ignore radiation detector | 1 |
| | | (ii) | idea that gamma is more penetrating than beta; | RA<br>allow gamma less ionising (power) than beta | 1 |

| | | | |
|---|---|---|---|
| (c) | any three from:<br>MP1. gamma is less ionising than beta;<br><br>MP2. beta is more likely to cause cell damage than gamma;<br><br>MP3. technetium decays more quickly;<br><br>MP4. technetium is in the body for less time/short time; | RA<br><br><br>allow named damage e.g. cancer, cell mutation etc.<br><br>ignore half-life of technetium is less | 3 |

Total for Question 8 = 13 marks

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 9 | (a) | (i) | elastic (potential) / EPE; | | 1 |
| | | (ii) | mechanically/mechanical (working); | | 1 |
| | | (iii) | the person/the hand/the fingers; | allow chemical (energy of the student) | 1 |
| | (b) | (i) | curve/variable gradient/not linear; | accept 'unloading and loading are different'<br>ignore reference to proportionality | 1 |
| | | (ii) | line returns to {origin/start/(0,0)/no extension};<br>when the force is removed/ unloaded; | ignore reference to shape<br>allow returns to original length<br>condone 'when unloading' | 2 |
| | (c) | (i) | substitution into given equation "$v^2 = u^2 + 2as$";<br>re-arrangement;<br>evaluation;<br>answer to 2 sig figs;<br><br>e.g.<br>$0^2 = (13)^2 + (2 \times -10 \times s)$<br>height = 169 / 20<br>(height =) 8.45 (m)<br>(height =) 8.5 (m) | ignore sign<br>accept mgh = ½ m $v^2$<br><br>independent mark | 4 |
| | | (ii) | any five from:<br>MP1. band has weight;<br>MP2. no drag at highest point;<br>MP3. resultant force is downwards;<br>MP4. band accelerates;<br>MP5. (once band is moving) there is drag<br>MP6. drag increases (while accelerating);<br>MP7. resultant force decreases;<br>MP8. (so) acceleration decreases; | <br>allow 'has gravitational force'<br>ignore 'has gravity'<br>allow 'air resistance' for 'drag'<br><br>allow 'speed increases'<br><br>MP6 automatically scores MP5 | 5 |

Total for Question 9 = 15 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 10 (a) | (coil **rotates)** through magnetic field / cutting field lines;<br><br>voltage is <u>induced</u>; | allow idea of coil experiencing a changing flux<br><br>ignore current is induced<br>accept p.d. or potential difference for 'voltage' | 2 |
| (b) (i) | idea that d.c. is current in one direction only;<br>diode allows current flow in one direction only/eq; | | 2 |
| (ii) | higher speed generates higher voltage;<br><br>higher voltage causes higher current; | ignore references to energy<br><br>allow higher tier answers in terms of increased flux linkage i.e cutting field lines faster<br><br>accept p.d. or potential difference for 'voltage' | 2 |
| (c) | substitution into given equation 'E = IVt';<br>rearrangement;<br>evaluation;<br><br>e.g.<br>14 000 = I × 7.2 × 8400<br>(current =) 14000 / (7.2 × 8400)<br>(current =) 0.23 (A) | <br><br>-1 POT error<br>treat misconversion of time as a POT error<br><br><br><br>allow 0.23…(A)<br>allow 0.2 (A) | 3 |

Total for Question 10 = 9 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 11 (a) | idea that (large number of) molecules moving randomly;<br><br>idea of equal rate of collisions in each direction; | allow atoms or particles for 'molecules'<br><br>can be acquired from diagram by showing arrows of different lengths (by eye) or different directions (by eye)<br><br>condone idea of equal number in each direction | 2 |
| (b) | evaluation of new volume;<br>substitution into $p_1V_1 = p_2V_2$;<br>rearrangement;<br>evaluation of new pressure;<br><br>e.g.<br>$V_2$ = (130 × 5.0/8.4 =) 77 ($cm^3$)<br>100 × 130 = $p_2$ × 77<br>($p_2$ =) 100 × 130/77<br>($p_2$ =) 170 (kPa) | <br>ecf different yet incorrect volume<br><br>-1 POT error<br><br><br>allow 77.38…<br><br><br>allow any value that rounds to 170 (kPa) | 4 |

Total for Question 11 = 6 marks

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 12 (a) | substitution into given equation,<br>efficiency = <u>useful output energy</u> (x 100%)<br>total output energy;<br><br>rearrangement;<br><br>evaluation of total output energy;<br><br><br>evaluation of wasted energy;<br><br><br><br><br><br><br>e.g.<br><br><br>0.16 = 1800/total output<br>total output = 1800 / 0.16<br>total output = 11 250 (J)<br>(wasted energy = 11250 - 1800 =) 9500 (J) | <br><br><br><br><br>11250 (J) seen<br>-1 POT here<br><br>i.e. subtracting 1800 (J) from candidate's total output energy or calculating 84% of total output energy<br><br>ecf wrong total output energy<br><br><br><br><br><br>allow 9450 (J) | 4 |
| (b) | any two from:<br><br>MP1. wrap beaker in insulation;<br><br><br><br>MP2. cover top of beaker;<br><br>MP3. fully immerse boiling tube in water;<br><br>MP4. shiny outer layer to the beaker;<br><br>MP5. use a thinner (walled) boiling tube<br><br>MP6. use a better conducting boiling tube | <br><br>allow use a plastic beaker or beaker with better insulating properties<br>allow 'use a lid'<br><br>allow use a smaller boiling tube<br><br><br><br>i.e. use a metal boiling tube | 2 |

Total for Question 12 = 6 marks

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