Mark Scheme results

Summer 2026

Pearson Edexcel International Advanced Subsidiary Level In Physics
WPH12/01

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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.

Mark scheme notes

Underlying principle
The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. **It is not a set of model answers.**

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the MS has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'

1.2 Bold lower case will be used for emphasis e.g. '**and**' when two pieces of information are needed for 1 mark.

1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".

1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.

2.2 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in epen.

2.4 Occasionally, it may be decided not to insist on a unit e.g the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.

2.5 The mark scheme will indicate if no unit error is to be applied by placing brackets around the unit.

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not prevent a mark being awarded if the answer given rounds to the answer in the MS.

3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.

3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.

3.4 The use of $g = 10\ m\ s^{-2}$ or $10\ N\ kg^{-1}$ instead of $9.81\ m\ s^{-2}$ or $9.81\ N\ kg^{-1}$ will be penalised by one mark (but not more than once per clip). Accept $9.8\ m\ s^{-2}$ or $9.8\ N\ kg^{-1}$

3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

4.1 **use of** the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.2 If a 'show that' question is worth 2 marks, then both marks will be available for a reverse working. If the question is worth 3 marks then only 2 marks will be available.

4.3 The mark scheme will show a correctly worked answer for illustration only.

5. Quality of Written Expression

5.1 Questions that asses the ability to show a coherent and logically structured answer are marked with an asterisk.

5.2 Marks are awarded for indicative content and for how the answer is structured.

5.3 Linkage between ideas, and fully-sustained reasoning is expected.

Question Number	Answer	Mark
1	**The only correct answer is B (ampere second)** A is not correct because this is the unit for current C is not correct because this is the unit for charge D is not correct because this is the unit for current	1
2	**The only correct answer is B (decreases, increases)** A is not correct because charge carrier density increases C is not correct because resistance decreases and charge carrier density increases D is not correct because resistance decreases	1
3	**The only correct answer is C (higher, higher)** A is not correct because density higher at compressions B is not correct because pressure would be higher at compressions D is not correct because pressure and density are higher at compressions .	1
4	**The only correct answer is A (displacement will be a minimum due to destructive interference)** B is not correct because the displacement will be a minimum due to destructive interference C is not correct because the displacement will be a minimum due to destructive interference D is not correct because the displacement will be a minimum due to destructive interference	1
5	**The only correct answer is A (The angle i > critical angle and $n_{water} > n_{air}$.)** B is not correct because the angle of incidence is more than the critical angle C is not correct because the refractive index of glass is greater than water D is not correct because the angle of incidence is greater than the critical angle	1
6	**The only correct answer is D ($\frac{4000 \times 0.005}{2}$)** A is not correct because distance or time should be halved B is not correct because distance or time should be halved C is not correct because distance or time should be halved	1
7	**The only correct answer is A ($\frac{1}{4}$)** B is not correct because this assumes $v \propto \frac{I}{d}$ C is not correct because drift velocity decreases with larger cross-section for the same current D is not correct because $v \propto \frac{I}{A}$ and this assumes $v \propto d$	1
8	**The only correct answer is C ($\frac{1.5-0.7}{1.8 \times 10^{-2}}$)** Ais not correct because the p.d. across the diode is incorrect C is not correct because the p.d. across the diode is incorrect D is not correct because the p.d. across the diode is incorrect	1

9	**The only correct answer is C** ($\sin^{-1}((\mathbf{6.0 \times 10^{-7} \times 4.0 \times 10^{5}})$) A is not correct because diffraction angle $= \sin^{-1}\left(\frac{\lambda}{d}\right)$ B is not correct because diffraction angle $= \sin^{-1}\left(\frac{\lambda}{d}\right)$ D is not correct because diffraction angle $= \sin^{-1}\left(\frac{\lambda}{d}\right)$	**1**
10	**The only correct answer is A** ($\sin^{-1}(\frac{2}{3}\sin 35^{\circ})$) B is not correct because $\frac{\sin i}{\sin r} = \frac{c}{v}$ and angle of incidence used is 55° C is not correct because $\frac{\sin i}{\sin r} = \frac{c}{v}$ and this uses $\frac{v}{c}$ D is not correct because $\frac{\sin i}{\sin r} = \frac{c}{v}$ and this uses $\frac{v}{c}$ and angle of incidence 55°	**1**

Question Number	Acceptable Answer		Additional Guidance	Mark
11	Use of $P = I^2R$	**(1)**	Example of calculation $P = 13^2\text{A} \times 18\,\Omega = 3042\,\text{W}$	
	Power = 3.0×10^3 W	**(1)**		**2**
	Total for question 11			**2**

Question Number	Acceptable Answer		Additional Guidance	Mark
12	Use of resistors in parallel formula Use of resistors in series formula Resistance = 81 Ω	**(1)** **(1)** **(1)**	<u>Example of calculation</u> $\left(\frac{1}{27\ \Omega}\right) + \left(\frac{1}{600\ \Omega}\right) = 0.0387\ \Omega^{-1}$ Resistance for parallel section = 25.84 Ω Total resistance = 55 Ω + 25.84 Ω = 80.8 Ω	**3**
	Total for question 12			**3**

Question Number	Acceptable Answer		Additional Guidance	Mark
13(a)	Electrons/atoms have discrete/fixed/certain energy levels	**(1)**		
	Energy of the photon corresponds to (specific) energy level differences (in the neon atoms)	**(1)**		
	Photon energy = h × frequency	**(1)**	Allow photon energy ∝ frequency	**3**
13(b)(i)	Conversion of eV to J	**(1)**	Example of calculation	
	Use of $E = hf$	**(1)**	$(21.6 - 2.1)\text{eV} \times 1.6 \times 10^{-19}\,\text{C}$ $= 19.5 \times 1.6 \times 10^{-19}\,\text{C} = 3.12 \times 10^{-18}\,\text{J}$	
	Use of $v = f\lambda$ with $v = 3.00 \times 10^{8}\,\text{ms}^{-1}$	**(1)**		
	$\lambda = 6.4 \times 10^{-8}\,\text{m}$	**(1)**	$f = \frac{E}{h} = \frac{3.12 \times 10^{-18}\,\text{J}}{6.63 \times 10^{-34}\,\text{Js}} = 4.71 \times 10^{15}\,\text{Hz}$ $\lambda = \frac{c}{f} = \frac{3.00 \times 10^{8}\,\text{ms}^{-1}}{4.71 \times 10^{15}\,\text{Hz}} = 6.37 \times 10^{-8}\,\text{m}$	**4**
13(b)(ii)	Energy of a photon is transferred to a single electron **Or** photons give all of their energy (or none at all)	**(1)**		
	There is no transition equivalent to 20.0 eV **Or** there is no energy level at (−)1.6 eV **Or** photon can only excite an electron if it matches the energy difference between levels	**(1)**		**2**
	Total for question 13			**9**

Question Number	Acceptable Answer		Additional Guidance	Mark
14(a)	**EITHER** Resistance at 90% read from graph as 1.8 (kΩ) Use of ratio of resistances Use of corresponding ratio of p.d.s V = 0.87 V for LDR [allow range from 0.83 V to 0.91V] Calculated value of V compared with 1.0 V and consistent conclusion **OR** Resistance at 90% read from graph as 1.8 (kΩ) Use of $R = \frac{V}{I}$ for whole circuit current Use of $R = \frac{V}{I}$ for p.d. across LDR V = 0.87 V for LDR [allow range from 0.83 V to 0.91V] Calculated value of V compared with 1.0 V and consistent conclusion	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	Example of calculation $\frac{V}{3.3} = \frac{1.8 \times 10^3\ \Omega}{1.8 \times 10^3\ \Omega + 5 \times 10^3\ \Omega}$ V = 0.87 V 0.87 V < 1V so screen brightness will be reduced Example of calculation I = 3.3 V / (1.8 x 10^3 + 5 x 10^3) Ω = 0.00049 A V = 0.00049 A x 1.8 x 10^3 Ω = 0.87 V < 1V so screen brightness will be reduced	**5**
14(b)	More (photons transfer) energy to the electrons (in the LDR) More free electrons (leads to more current so resistance decreases)	**(1)** **(1)**		**2**
	Total for question 14			**7**

Question Number	Acceptable Answer		Additional Guidance	Mark
15(a)	Energy (supplied) to/per unit charge **Or** Work done (supplied) to/per unit charge **Or** The work done moving unit charge around the whole circuit **Or** Terminal p.d. when the current is zero	**(1)**		**1**
15(b)(i)	Use of $R_{tot} = R_{Internal} + R_{motor}$ Use of $R = \frac{V}{I}$ for whole circuit current see ε = V + Ir with correct substitutions **Or** Use of $R = \frac{V}{I}$ to calculate p.d. across motor with correct substitutions $V_{terminal} = 7.8\ \text{V}$	**(1)** **(1)** **(1)** **(1)**	Example of calculation $R_{tot} = 93 \times 10^{-3}\ \Omega + 0.05\ \Omega = 0.14\ \Omega$ $I = \frac{12\ \text{V}}{0.14\ \Omega} = 84\ \text{A}$ $V_{terminal} = 12\ \text{V} - (84\ \text{A} \times 0.05\ \Omega) = 7.8\ \text{V}$ Alternative calculation $V_{terminal} = 12\ \text{V} \times \frac{0.093\ \Omega}{0.05\ \Omega + 0.093\ \Omega} = 7.8\ \text{V}$	**4**
15(b)(ii)	Terminal p.d. (across the battery) decreases **Or** voltage drop across the battery increases **Or** p.d. across the motor decreases Current (drawn from battery) decreases The current / power is no longer high enough for the motor to work	**(1)** **(1)** **(1)**	MP3 dependent upon MP1 or MP2	**3**
	Total for question 15			**8**

Question Number	Acceptable Answer		Additional Guidance	Mark
16(a)(i)	See $v = f\lambda$ **and** $v = \sqrt{\frac{T}{\mu}}$	**(1)**		**2**
	Algebra to show $\lambda = \frac{1}{f}\sqrt{\frac{T}{\mu}}$	**(1)**		
16(a)(ii)	T **and** μ are constant	**(1)**		**2**
	$\lambda = \sqrt{\frac{T}{\mu}} \times \frac{1}{f}$ is in the form $y = mx\ (+c)$ with <u>gradient</u> = $\sqrt{\frac{T}{\mu}}$	**(1)**	Accept v for $\sqrt{\frac{T}{\mu}}$	
16(a)(iii)	Use of $F = mg$	**(1)**	<u>Example of calculation</u> $T = 0.2 \times 9.81 = 1.96$ N	**4**
	Reads a pair of corresponding values from the graph	**(1)**	gradient = $\frac{1-0}{0.025-0} = 40$ m s^{-1}	
	Use of $\lambda = \frac{1}{f}\sqrt{\frac{T}{\mu}}$ **Or** gradient $= \sqrt{\frac{1.96}{\mu}}$	**(1)**	$40 = \sqrt{\frac{1.96}{\mu}}$	
	$\mu = 1.23 \times 10^{-3}$ (kg m^{-1}) (minimum 3 sf)	**(1)**	$\mu = 1.23 \times 10^{-3}$ kg m^{-1}	

16(b)	$\lambda = \frac{2 \times \text{length}}{3} = 1.33$ m Use of $v = f\lambda$ Use of $v = \sqrt{\frac{T}{\mu}}$ $T = 4.3$ N	**(1)** **(1)** **(1)** **(1)**	Example of calculation $\lambda = \frac{2 \times 2\text{m}}{3} = 1.33$ m $45\ \text{Hz} \times 1.33\ \text{m} = \sqrt{\frac{T}{1.2 \times 10^{-3}\ \text{kg m}^{-1}}}$ $T = 4.3$ N using answer from ii gives 4.4 N	**4**
	Total for question 16			**12**

Question Number	Acceptable Answer		Additional Guidance	Mark
17(a)	Use of $R = \frac{V}{I}$	**(1)**	Example of calculation $R = \frac{V}{I} = \frac{1.5\ \text{V}}{0.12\ \text{A}} = 12.5\ \Omega$ $A = 0.025\ \text{m} \times 1.1 \times 10^{-7}\ \text{m} = 2.75 \times 10^{-9}\ \text{m}^2$ $\rho = \frac{12.5\ \Omega \times 2.75 \times 10^{-9}\ \text{m}^2}{0.15\ \text{m}} = 2.29 \times 10^{-7}\ \Omega\,\text{m}$	
	Use of cross-sectional area = width × thickness	**(1)**		
	Use of $R = \frac{\rho l}{A}$	**(1)**		
	Resistivity $= 2.3 \times 10^{-7}\ \Omega\,\text{m}$	**(1)**		**4**
17(b)	The volume stays constant (as the length increases)	**(1)**		
	(As length increases) cross-sectional area decreases	**(1)**		
	(When length doubles cross-sectional area halves) resistance is four times greater, so suggestion is incorrect	**(1)**		**3**
	Total for question 17			**7**

Question Number	Acceptable Answer		Additional Guidance	Mark
18(a)(i)	Use of $I = \frac{P}{A}$ Use of trigonometry to obtain correct component Use of efficiency = useful power output / power input Power output = 264(W) (at least 3 sf)	**(1)** **(1)** **(1)** **(1)**	Example of calculation Power incident on solar panel $= 1.1\ \text{kWm}^{-2} \times 2.2\ \text{m}^2$ $\times \cos 57° = 1318\ \text{W}$ Useful output power $= 0.2 \times 1318\ W = 263.6\ \text{W}$	**4**
18(a)(ii)	Use of $E = P\ x\ t$ Use of 2.53×10^{16} J **Or** 15,000,000 panels No. of panels $= 14.8 \times 10^6 \approx 15 \times 10^6$ so suggestion correct **Or** Energy $= 2.56 \times 10^{16}\ \text{J} \approx 2.53 \times 10^{16}\ \text{J}$ so suggestion correct	**(1)** **(1)** **(1)**	Example of calculation Time in seconds $= 5 \times 3600 \times 365 = 6\,570\,000s$ Power $= \frac{2.53 \times 10^{16}\text{J}}{6\,570\,000s} = 3.85 \times 10^9\ \text{W}$ No solar panels $= \frac{3.85 \times 10^9\ \text{W}}{260\ \text{W}} = 1.48 \times 10^7$	**3**

<table>
<tr>
<td>*18(b)</td>
<td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Indicative content
IC1 In series current is the same (in each solar cell)
IC2 In parallel the p.d is the same (as a single solar cell)
IC3 In series the total p.d. is the sum of p.d.s (of each solar cell)
Or Series combination provides a larger total p.d.
IC4 In parallel total current is the sum of solar cell currents
Or Parallel combination provides a larger total current
IC5 Parallel circuit has higher current, lower p.d. and $P = VI$ (so power output is the same)
Or series circuit has lower current, higher p.d. and $P = VI$ (so power output is the same)
IC6 Parallel combination will still work if one solar cell fails
Or Series combination is better to identify when one solar cell has failed.</td>
<td>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.
The following table shows how the marks should be awarded for indicative content.
<table>
<tr><th>Number of indicative points seen in answer</th><th>Number of marks awarded for indicative points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5-4</td><td>3</td></tr>
<tr><td>3-2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
<table>
<tr><th></th><th>Number of marks awarded for structure and lines of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr>
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</td>
<td>6</td>
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<td></td>
<td>Total for question 18</td>
<td></td>
<td></td>
<td>13</td>
</tr>
</table>

Question Number	Acceptable Answer		Additional Guidance	Mark
19(a)(i)	Converts eV to J Use of $E = \Phi + \frac{1}{2}mv^2$ Use of $E_k = \frac{1}{2}mv^2$ with $m = 9.11 \times 10^{-31}$ kg $v = 1.53 \times 10^6$ (ms^{-1}) (at least 3 sf)	**(1)** **(1)** **(1)** **(1)**	Example of calculation $E = 10.9\text{ eV} \times 1.6 \times 10^{-19}\text{ C} = 1.74 \times 10^{-18}\text{ J}$ $\frac{1}{2}mv^2 = E - \Phi = 1.74 \times 10^{-18}\text{ J} - 6.80 \times 10^{-19}\text{ J}$ $= 1.06 \times 10^{-18}\text{ J}$ $v = \sqrt{\frac{2 \times 1.06 \times 10^{-18}\text{ J}}{9.11 \times 10^{-31}\text{ kg}}} = 1.53 \times 10^6\text{ ms}^{-1}$	**4**
19(a)(ii)	Use of $\lambda = \frac{h}{mv}$ $\lambda = 4.9 \times 10^{-10}$ m (e.c.f. from ai)	**(1)** **(1)**	Example of calculation $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}\text{ Js}}{9.11 \times 10^{-31}\text{ kg} \times 1.5 \times 10^8\text{ ms}^{-1}}$ $= 4.85 \times 10^{-10}\text{ m}$	**2**
19(b)	Each electron absorbs energy from one photon Minimum energy required for an electron (to be emitted) Higher (photon) energy related to higher frequency (so frequency of radiation has to be above a particular value)	**(1)** **(1)** **(1)**	Accept each photon transfers energy to one electron Accept correct reference to work function Accept E = hf with terms defined	**3**
	Total for question 19			**9**