Mark Scheme (Results)

October 2025

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.

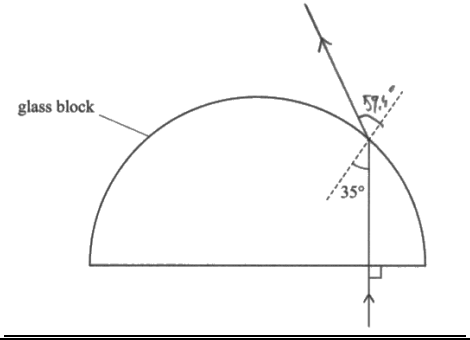
Question Number	Answer	Mark
1	**The only correct answer is B** (filament bulb) A is not correct because a diode would only show a current in one direction C is not correct because a resistor would give a straight line through the origin D is not correct because a thermistor would produce an curve	1
2	**The only correct answer is A** (2 m) B is not correct because this would be 1.5 wavelengths C is not correct because this would be 2 wavelengths D is not correct because this would be 3 wavelengths	1
3	**The only correct answer is D** $\left(\frac{1}{4 \times 0.005}\right)$ A is not correct because this gives the time period of the wave B is not correct because this gives half the time period of the wave C is not correct because the denominator is half the time period	1
4	**The only correct answer is B** $\left(\frac{6.63 \times 10^{-34}}{9.11 \times 10^{-31} \times 2 \times 10^{7}}\right)$ A is not correct because $\lambda = \frac{h}{mv}$ and this is using mass of proton C is not correct because $\lambda = \frac{h}{mv}$ and this is $\lambda = \frac{mv}{h}$ D is not correct because $\lambda = \frac{h}{mv}$ and this is t is upside down and uses mass of proton not electron	1
5	**The only correct answer is A** $\left(\frac{25 \times 2\pi}{360}\right)$ B is not correct because phase difference in rad = phase difference in deg $\times \frac{2\pi}{360}$ C is not correct because phase difference in rad = phase difference in deg $\times \frac{2\pi}{360}$ D is not correct because phase difference in rad = phase difference in deg $\times \frac{2\pi}{360}$	1
6	**The only correct answer is D** $\left(\frac{340 \times 4 \times 10^{-3}}{2}\right)$ A is not correct because this doubles time or doubles distance B is not correct because this is an incorrect rearrangement C is not correct because this does not halve distance or time	1
7	**The only correct answer is B** $\left(\sqrt{2} \times f\right)$ A is not correct because this would be the value of tension was halved C is not correct because this would be the value if the tension were reduced by a factor 4 D is not correct because this would be the value if the tension were increased by a factor 4	1

8	**The only correct answer is A** (1.5 V 0.2 Ω) B is not correct because 5 Ω would be the resistance in series C is not correct because 7.5 V would be the potential difference in series D is not correct because 7.5 V would be the potential difference in series	**1**
9	**The only correct answer is A** $\left(\frac{f}{8}\right)$ B is not correct because this is the energy for transition n = 4 to 3 or n = 2 to 1 C is not correct because this is the energy for transition n = 3 to n = 2 D is not correct because this is the energy for transition n = 4 to 1	**1**
10	**The only correct answer is D** ($V = 12 \times \frac{2}{6}$) A is not correct because $V = \left(\frac{E}{R+r}\right) \times r$ B is not correct because $V = \left(\frac{E}{R+r}\right) \times r$ C is not correct because $V = \left(\frac{E}{R+r}\right) \times r$	**1**

Question Number	Acceptable Answer		Additional Guidance	Mark
11	Use of $I = nqvA$	**(1)**	Example of calculation $v = \frac{2.5\ A}{8.5 \times 10^{28}\ \text{m}^{-3} \times 1.6 \times 10^{-19}\ \text{C} \times 2.8 \times 10^{-6}\ \text{m}^2}$ $= 6.57 \times 10^{-5}\ \text{m s}^{-1}$	**2**
	$v = 6.6 \times 10^{-5}\ \text{m s}^{-1}$	**(1)**		
	Total for question 11			**2**

Question Number	Acceptable Answer		Additional Guidance	Mark
12(a)	**EITHER**	**(1)**	Example of calculation	
	Use of $P = \frac{V^2}{R}$	**(1)**	$= \frac{(230\ \text{V})^2}{18\ \Omega} = 2939\ \text{W}$	
	Use of $P = \frac{W}{t}$	**(1)**	$W = 2939\ \text{W} \times 38\ \text{s} = 1.12 \times 10^5\ \text{J}$	
	$W = 1.1 \times 10^5\ \text{J}$			
	OR			
	Use of $R = \frac{V}{I}$	**(1)**		
	Use of $W = VIt$	**(1)**		
	$W = 1.1 \times 10^5\ \text{J}$	**(1)**		**3**
12(b)	(free) electrons collide with metal ions in the lattice	**(1)**		
	(As the temperature increases), the lattice vibrations increase	**(1)**	Accept ions / atoms for lattice	
	Increased rate of collisions between electrons and atoms / ions /lattice	**(1)**	Accept frequency for rate	**3**
	Total for question 12			**6**

Question Number	Acceptable Answer		Additional Guidance	Mark
13	Calculates cross-sectional area of wire	**(1)**		
	Reading two pairs of corresponding values from the graph	**(1)**		
	Uses gradient $= \frac{\rho}{A}$ **Or** Use of $R = \frac{\rho l}{A}$	**(1)**		
	ρ in the range 4.75×10^{-7} Ω m to 4.95×10^{-7} Ω m	**(1)**		
	Calculated value of ρ compared with value in table and consistent conclusion	**(1)**	<u>Example of calculation</u> $A = \frac{\pi \times (2.4 \times 10^{-4}\ \text{m})^2}{4} = 4.52 \times 10^{-8}\ \text{m}^2$ Gradient = 10.7 Ω m $10.7\ \Omega\ \text{m} = \frac{\rho}{4.52 \times 10^{-8}\ \text{m}^2}$ $\rho = 4.83 \times 10^{-7}$ Ω m 4.83×10^{-7} Ω m is closest to 4.90×10^{-7} Ω m so wire is constantan	**5**
	Total for question 13			**5**

Question Number	Acceptable Answer		Additional Guidance	Mark
14(a)	The incident ray is perpendicular to the surface of the glass block **Or** Ray is incident along the normal to the surface **Or** Angle of incidence = 0(°)	**(1)**	Allow wavefronts parallel to surface of glass block	**1**
14(b)(i)	Use of $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\theta = 59°$	**(1)** **(1)**	Example of calculation $1.5 \sin 35° = \sin\theta_2$ $\theta_2 = 59.35°$	**2**
14(b)(ii)	Ray refracts on correct side of normal and angle consistent with (b)(i)	**(1)**	Example of diagram 	**1**
14(c)	Use of $\sin C = \frac{1}{n}$ Use of trigonometry to calculate distance from centre to ray Adds radius of block to distance from centre x = 75 mm	**(1)** **(1)** **(1)** **(1)**	Example of calculation $\sin C = \frac{1}{1.5} = 0.67$ $0.67 = \frac{\text{distance from centre to ray}}{45 \text{ mm}}$ $0.67 \times 45\ mm = 30.3$ mm (if left as a fraction calculation gives 30.0 mm) $x = 45 + 30.3 = 75.3$ mm	**4**
	Total for question 14			**8**

Question Number	Acceptable Answer		Additional Guidance	Mark
15(a)	**MAX 4**			
	<u>Photons</u> incident on (metal) surface / plate	**(1)**		
	Energy of one photon is transferred to one electron	**(1)**	Accept one photon interacts with one electron	
	Photon energy is proportional to frequency	**(1)**	Accept reference to $E = hf$	
	Some energy used to release the electron from the surface (of the metal) **Or** Some energy used to overcome the work function (of the metal)	**(1)**	Allow reference to threshold frequency being exceeded	
	Remaining energy transferred to kinetic energy of the electron (that are released)	**(1)**		**4**

15(b)(i)	Use of $v = f\lambda$ Use of $E = hf$ $E = 5.2 \times 10^{-19}$ (J) (at least 2sf)	**(1)** **(1)** **(1)**	Example of calculation $f = \frac{3.00 \times 10^{8}\ \text{m s}^{-1}}{380 \times 10^{-9}\ \text{m}} = 7.89 \times 10^{14}\ \text{Hz}$ $E = 6.63 \times 10^{-34}\ \text{J s} \times 7.89 \times 10^{14}\ \text{Hz} = 5.23 \times 10^{-19}\ \text{J}$	**3**
15(b)(ii)	Conversion between J and eV Use of $hf = \Phi + \frac{1}{2}mv^2{}_{\text{max}}$ Energy of electron = 1.1 (eV) (ecf from 15(b)(i)) (show that value gives 0.9 eV)	**(1)** **(1)** **(1)**	Example of calculation $5.23 \times 10^{-19}\ \text{J} \div 1.6 \times 10^{-19}\ \text{C} = 3.27\ \text{eV}$ $3.27\ \text{eV} - 2.2\ \text{eV} = 1.07\ \text{eV}$	**3**
15(b)(iii)	Use of $I = \frac{P}{A}$ Calculates $N = \frac{Pt}{E}$ with t = 1 s $N = 3.1 \times 10^{20}$ (ecf from 15(b)(i)) (show that value gives 3.2×10^{20})	**(1)** **(1)** **(1)**	Example of calculation $P = 8000\ \text{W m}^{-2} \times 0.02\ \text{m}^2 = 160\ \text{W}$ $N = \frac{160\ \text{J} \times 1\ \text{s}}{5.23 \times 10^{-19}\ \text{J}} = 3.06 \times 10^{20}$	**3**
15(c)	Number of photons incident per second increases Number of electrons released per second increases Therefore current increases (MP3 dependent on MP1 or MP2)	**(1)** **(1)** **(1)**	If no other mark is awarded, award max 1 mark for statement of more photons gives more electrons so current increases.	**3**
	Total for question 15			**16**

Question Number	Acceptable Answer		Additional Guidance	Mark
16(a)(i)	Constant phase difference / relationship	**(1)**		**1**
16(a)(ii)	(At a bright dot) the path difference is equal to a whole number of wavelengths	**(1)**	Accept path difference = $n\lambda$	
	(So) these waves are in phase	**(1)**	Accept (so) the phase difference for these waves is zero	
	So constructive superposition / interference takes place	**(1)**		**3**
16(b)(i)	Use of $n\lambda = d\sin\theta$	**(1)**	<u>Example of calculation</u>	
	$\theta = 30°$	**(1)**	$\sin\theta = \frac{532 \times 10^{-9}\ \text{m}}{1.07 \times 10^{-6}\ \text{m}}$ $\theta = 29.8°$	**2**

16(b)(ii)	**EITHER** Use of $n\lambda = d\sin\theta$ with n = 3 **(1)** $\sin\theta = 1.49$ **(1)** maximum value of $\sin\theta = 1$ (so third order maximum not possible) **(1)** **OR** Maximum diffraction angle is 90° **(1)** At 90° the path difference (for adjacent slits) is the same as the slit separation *d* **(1)** $d < 3\lambda$ (so third order maximum not possible) **(1)** **OR** Use of $n\lambda = d\sin\theta$ with $\sin\theta = 1$ **(1)** n = 2.01 **(1)** maximum number of orders = 2 (so third order maximum not possible) **(1)**	Allow sin^{-1} (1.49) does not exist Allow 1.49 > 1	**3**
16(c)	A white dot in the centre **(1)** Spectra either side **(1)** Violet / blue closest to the centre **(1)**	Allow red is furthest from centre	**3**
	Total for question 16		**12**

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>*17(a)</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 (As the temperature increases) electrons (in thermistor) gain energy
IC2 So more conduction electrons (are released)
IC3 So the resistance of the thermistor decreases
IC4 The thermistor and resistor are in series so the p.d. is shared
Or Thermistor and resistor form a potential divider and share p.d.
IC5 Resistance of thermistor becomes a smaller proportion of total resistance in the circuit
Or p.d across fixed resistor increases because current increases
IC6 So the p.d. across the thermistor decreases</td>
<td>Allow e.m.f / 6V for p.d.
Allow IC4 if potential divider equation seen

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>
</table>
</td>
<td>6</td>
</tr>
</table>

17(b)	Use of $R = R_1 + R_2$ **(1)** Use of $R = \frac{V}{I}$ to calculate (circuit) current **(1)** Use of $R = \frac{V}{I}$ to calculate p.d. across thermistor **(1)** p.d. = 0.94 (V) **(1)** 0.94 (V) is more than 0.90 (V) so heater will not have switched off before water temperature is 65°C **Or** Comparison of their calculated value of p.d. with 0.90 (V) and consistent conclusion **(1)**		MP2 and MP3 can be awarded for use of potential divider equation as in alternative calculation. <u>Example of calculation</u> $R = 56\ \Omega + 300\ \Omega\ = 356\ \Omega$ $I = \frac{V}{R} = \frac{6\ \text{V}}{356\ \Omega} = 1.69\ \times\ 10^{-2}\ \text{A}$ $V_{thermistor}\ =\ 1.69\ \times\ 10^{-2}\ \text{A}\ \times\ 56\ \Omega\ =\ 0.94\ \text{V}$ 0.94 V is greater than 0.90 V so heater will not switch off when water temperature is 65°C <u>Alternative calculation</u> $\frac{V}{6} = \frac{56\ \Omega}{300\ \Omega + 56\ \Omega}$ V = 0.94 V 0.94 V is greater than 0.90 V so heater will not switch off when water temperature is 65°C	
	Total for question 17			**11**

Question Number	Acceptable Answer		Additional Guidance	Mark
18(a)(i)	Unpolarised has oscillations / vibrations in all / many planes	**(1)**		**3**
	Plane polarised has oscillations / vibrations in one plane	**(1)**		
	Which includes the direction of (wave) travel (MP3 dependent on MP1 and MP2 being awarded)	**(1)**		
	Or			
	Unpolarised has oscillations / vibrations in all / many directions	**(1)**		
	Plane polarised has oscillations / vibrations in one direction	**(1)**		
	Which is perpendicular to the direction of (wave) travel (MP3 dependent on MP1 and MP2 being awarded)	**(1)**		
18(a)(ii)	The polarising filter only transmits light in one plane / direction	**(1)**		**2**
	(as the filter is rotated) a different single plane / direction of oscillation passes through, so the intensity stays the same	**(1)**		

18(b)	<u>Initial orientation:</u> Filter 1 is aligned with filter 2 so light is transmitted through filter 2 **(1)** **Or** filter 2 transmits the light transmitted by filter 1 Filter 3 is perpendicular to filter 2 **(1)** so no light passes through filter 3 **(1)** <u>After rotation:</u> some light transmitted through filter 2 is also transmitted through filter 3 **(1)** So intensity of light transmitted through filter 3 increase **(1)**		**5**
	Total for question 18		**10**