Pearson

Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced Subsidiary level In Physics
WPH12/01A

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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	Mark
1	**The only correct answer is C (*v* represents the drift velocity of the charge carriers in the sample)** A is not the correct answer as *n* is the number of charge carriers per m^3 B is not the correct answer as *q* is the charge per charge carrier D is not the correct answer as *A* is the cross-sectional area	1
2	**The only correct answer is A (distance between adjacent lines on the diffraction grating)** B is not the correct answer as the distance between the diffraction grating and the screen is not represented by any letter in this equation. C is not the correct answer as this is 1/d D is not the correct answer as this is n in the equation.	1
3	**The only correct answer is C (Resistance increases proportionally with temperature and resistance is not 0 at 0 °C.)** A is not correct because resistance is decreasing with temperature, but it should increase proportionally B is not correct because resistance remains constant with temperature, but it should increase proportionally D is not correct because the graph show resistance as 0 at 0°C but this is incorrect	1
4	**The only correct answer is B (Position X is a rarefaction as it is midway between two compressions)** A is not correct because a rarefaction has zero displacement C is not correct because a rarefaction has zero displacement D is not correct because Z is a compression	1
5	**The only correct answer is D ($\frac{250}{1050 \times 1.54}$)** A is not correct as this is (Power × Area) / Intensity B is not correct as this is Intensity / (Power × Area) C is not correct as this is the reciprocal of the efficiency equation	1
6	**The only correct answer is A ($\frac{Vx}{I}$)** B is not correct because $\rho = VA / Il$, where A = x^2 and l = x C is not correct because $\rho = VA / Il$, where A = x^2 and l = x D is not correct because $\rho = VA / Il$, where A = x^2 and l = x	1
7	**The only correct answer is C (π)** A is not correct because the path difference is 3cm which is 1.5λ so waves are in antiphase with phase difference π B is not correct because the path difference is 3cm which is 1.5λ so waves are in antiphase with phase difference π D is not correct because the path difference is 3cm which is 1.5λ so waves are in antiphase with phase difference π	1

8	**The only correct answer is D (increased number of conduction electrons)** A is not correct because this factor on its own would not affect resistance B is not correct because this is not as significant a factor as D C is not correct because this is not as significant a factor as D	**1**
9	**The only correct answer is C (270°, 90°)** A is not correct because 180° - 90° is 90° B is not correct because 270° - 180° is 90° D is not correct because 270° - 360° is -90°	**1**
10	**The only correct answer is B (** $h = \frac{1}{c \times \text{gradient}}$**)** A is not correct because gradient = $\frac{1}{hc}$ C is not correct because gradient = $\frac{1}{hc}$ D is not correct because gradient = $\frac{1}{hc}$	**1**

Question Number	Acceptable Answer	Additional Guidance	Mark
11	Use of $c = f\lambda$ **(1)** Use of $E = hf$ **(1)** Conversion between J and eV **(1)** Transition (-) 1.51 (eV) to (-) 3.39 (eV) **(1)**	Example of calculation $\Delta E = \frac{6.63 \times 10^{-34}\,\text{Js} \times 3.00 \times 10^{8}\,\text{ms}^{-1}}{660 \times 10^{-9}\,\text{m} \times 1.60 \times 10^{-19}\,\text{C}} = 1.88\ \text{(eV)}$ -3.39 – (-1.51) = -1.88 (eV)	**4**
	Total for question 11		**4**

Question Number	Acceptable Answer		Additional Guidance	Mark
12(a)	Enable pulse to return before next is emitted **Or** to distinguish which reflected pulse corresponds to which emitted pulse	**(1)**		**1**
12(b)	Use of $v = \frac{s}{t}$ Correct factor of 2 (either s or their t multiplied by 2) $t = 5.9 \times 10^{-4}$ s	**(1)** **(1)** **(1)**	<u>Example of calculation</u> $t = \frac{0.1\ \text{m} \times 2}{340\ \text{ms}^{-1}} = 5.88 \times 10^{-4}$ s	**3**
12(c)(i)	Ultrasound is reflected away from car/sensor **Or** Ultrasound does not reflect (straight) back (to car)	**(1)**		**1**
12(c)(ii)	Little/no reflection (detected) **Or** Pulse does not hit the post **Or** Post is not wide enough to reflect (enough of the ultrasound)	**(1)**		**1**
	Total for question 12			**6**

Question Number	Acceptable Answer		Additional Guidance	Mark
13(a)	Use of $n_1\sin\theta_1 = n_2\sin\theta_2$ r for violet light = 31.9(°) **Or** r for red light = 32.3(°) Use of trigonometry to calculate horizontal distances whilst in block Violet distance = 3.98 (cm) **Or** Red distance = 4.05 (cm) Distance between points = 0.070 cm	**(1)** **(1)** **(1)** **(1)** **(1)**	Example of calculation $n_1\sin\theta_1 = n_2\sin\theta_2$. In air, n_1 = 1.000 and θ_1 = 54.00° so, for violet light, $\sin r = \frac{\sin(54.00°)}{1.532}$, so r = 31.9° For red light, $\sin r = \frac{\sin(54.0°)}{1.513}$, so r = 32.3° For violet light, $\tan(31.9°) = \frac{x}{6.40\text{ cm}}$, so x = 3.98 cm For red light, $\tan(32.3°) = \frac{x}{6.40\text{ cm}}$, so x = 4.05 cm Distance between points = 4.05 cm − 3.98 cm = 0.070 cm Accept answers in mm or metres e.g. 0.70mm Answers can vary according to number of significant figures used in interim calculations – correct answers can be between 0.06cm and 0.07cm	5
13(b)	**EITHER** Use of $\sin C = 1/n$ Critical angle violet = 40.7(°) **Or** critical angle red = 41.4(°) Red light refracts out of the glass as $i < C$ **Or** Angle of refraction for red light is 83(°) Violet light undergoes total internal reflection as $i > C$ **OR** Use of $n_1\sin\theta_1 = n_2\sin\theta_2$ Calculates $(n)\sin\theta$ as 0.99 for red **Or** 1.01 for violet	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	Example of calculation $\sin C = \frac{1}{1.532}$, C = 40.7° (violet), $\sin C = \frac{1}{1.513}$, C = 41.4° (red) Allow MP3 & 4 for comparison of numbers e.g. red light refracts out of the glass as 41°< 41.4°, violet light undergoes total internal reflection as 41°>40.7° Example of calculation $n\sin\theta$ for violet light = 1.532 sin (41.00°) = 1.01. $n\sin\theta$ for red light = 1.513 sin (41.00°) = 0.99.	4

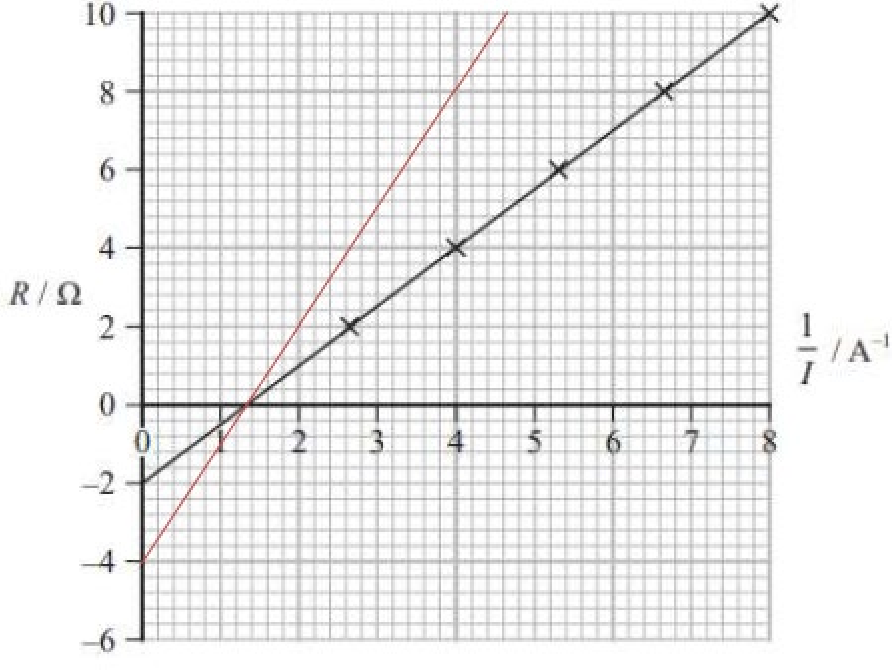
	Red light refracts out of the glass as (n)sinθ < 1 **(1)** **Or** Angle of refraction for red light is 83(°) **(1)** Violet light undergoes total internal reflection as (n)sinθ > 1	For MP3, ignore references to the fact that red light partially reflects as well as refracts	
	Total for question 13		**9**

Question Number	Acceptable Answer		Additional Guidance	Mark
14(a)	Uses $R = V/I$ for resistor **Or** uses potential divider uses $R = V/I$ for thermistor **Or** calculates whole circuit resistance and subtracts 11.5(Ω) R for thermistor = 19 (Ω) Temperature = 33-35°C	(1) (1) (1) (1)	<u>Example of calculation</u> $R = V/I$, $I = V/R$ (for resistor), $I = \frac{3.42\text{ V}}{11.5\ \Omega} = 0.297\text{ A}$ $R = V/I$ (for thermistor) = $\frac{9.00 - 3.42\text{ V}}{0.297\text{ A}}$ / = 18.8 Ω	4
14(b)	Increased e.m.f. leads to greater current (Increased current leads) to greater temperature Resistance of <u>thermistor</u> would decrease (The proportion of the total p.d. across thermistor would decrease so) voltmeter reading would more than double so student is incorrect	(1) (1) (1) (1)		4
	Total for question 14			**8**

Question Number	Acceptable Answer	Additional Guidance	Mark
***15**	This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully sustained reasoning. **Indicative content** IC1 Electrons/atoms have fixed/discrete energy levels IC2 (For an) electron to move to a higher energy level IC3 Photon has to have a certain frequency/energy **Or** Photon energy = hf IC4 Each photon only interacts with one electron IC5 When the electron drops back down, photon/light is released IC6 Violet has the correct energy to raise an electron (according to the photon model) **Or** Violet has an energy equal to the difference in energy levels (in the atom, according to the photon model) **Or** wave model would allow energy to build up so red/green would cause light to be emitted (which does not happen) **Or** wave model would not cause an immediate release of light	Allow converse for red/green light Allow "wave model would allow energy to build up so any colour/frequency would work"	**6**

Question Number	Acceptable Answer		Additional Guidance	Mark
16(a)	Use of sum of e.m.f. = sum of p.d. **Or** Total resistance of circuit = $R + r$ Correct rearrangement/substitution leading to given equation	(1) (1)	Example of rearrangment $\mathcal{E} = I\,(R + r)$, so $R = \frac{\mathcal{E}}{I} = R + r$, so $R = \frac{\mathcal{E}}{I} - r$	2
16(b)	**EITHER** Gradient calculation (to calculate ε) ε = 1.5 V r = 2 Ω **OR** r = 2 Ω (read from y-intercept) Use of co-ordinates from the graph with the formula **Or** gradient calculation (to calculate ε) ε = 1.5 V	(1) (1) (1) (1) (1) (1)	 Do not award MP3 if r is negative. Do not award MP1 if r is negative. Allow variations in the values of ε and r based on correct gradient calculations.	3

16(c)	(As R increases,) circuit resistance increases So current decreases As $P = I^2r$, the power decreases (MP3 dependent on MP2) **OR** Greater share of resistance / p.d. for variable resistor So p.d. across r decreases As $P = \frac{V^2}{r}$, the power decreases (MP3 dependent on MP2) **OR** Current decreases p.d. across r decreases As $P = VI$, the power decreases (MP3 dependent on MP2)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	MP1 requires idea of share/proportion/ratio	**3**
16(d)	Graph is clearly steeper than initial graph and is a straight line Exactly 2 × original gradient y-intercept at −4 Ω	**(1)** **(1)** **(1)**		**3**

				
	Total for question 16			**11**

Question Number	Acceptable Answer		Additional Guidance	Mark
17(a)	Oscillations / waves <u>reflect</u> from (each) end of the cable The (reflected) waves interfere / superpose A node forms where there is destructive interference **Or** An antinode forms where there is constructive interference	**(1)** **(1)** **(1)**	For "end" allow "road" or "main cable"	**3**
17(b)	Point X has a large / maximum amplitude At point X the <u>displacement</u> varies (between maximum and zero) At point Y the cable always has zero <u>displacement</u> **Or** At point Y the cable is stationary	**(1)** **(1)** **(1)**		**3**
17(c)(i)	Calculates mass per unit length μ = 24.1 (kg m^{-1})	**(1)** **(1)**	<u>Example calculation</u> $\mu = \dfrac{2.10 \times 10^3 \text{ kg}}{87.0 \text{ m}}$ μ = 24.14 kg m^{-1}	**2**
17(c)(ii)	Use of factor of 500 Use of $W = mg$ Use of $v = \sqrt{\frac{T}{\mu}}$ Use of $v = f\lambda$ with λ = 320 m **or** λ = 7 m **Or** Use of $v = f\lambda$ with f = 280 Hz Lowest frequency produced by standing wave on longest cable = 1.1 Hz **Or** Lowest frequency produced by standing wave on shortest cable = 48 Hz	**(1)** **(1)** **(1)** **(1)** **(1)**	<u>Example calculation</u> $W = 140 \times 10^6 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 1.37 \times 10^9 \text{ N}$ $T = \dfrac{1.37 \times 10^9 \text{N}}{500} = 2.74 \times 10^6 \text{ N}$ $v = \sqrt{\dfrac{2.74 \times 10^6 \text{ N}}{24 \text{ kg m}^{-1}}} = 338 \text{ m s}^{-1}$ $f = \dfrac{338 \text{ m s}^{-1}}{320} = 1.06$ Hz **or** $f = \dfrac{338 \text{ m s}^{-1}}{7} = 48.3$ Hz Lowest frequency waves produced < 280 Hz so humming is not produced by standing waves on the suspending cables	**6**

	Or Length of cable needed to give lowest frequency of 280 Hz = 0.60 m **(1)** Calculated frequency compared to 280Hz with consistent conclusion **Or** Calculated length of cable compared to 3.5m or 160m with consistent conclusion		
	Total for question 17		**14**

Question Number	Acceptable Answer	Additional Guidance	Mark
18(a)	Use of resistors in parallel formula **(1)** Resistance of parallel section of circuit calculated as 1.33(Ω) **(1)** Total circuit resistance = 2Ω + their parallel resistance **Or** Use of ratio of resistance: p.d. **(1)** Use of $I = V/R$ to calculate total circuit current (3A) **Or** Use of $I = V/R$ to calculate p.d. across resistor A (6V) **(1)** Use of $P = VI$, $P = V^2/R$ or $P = I^2R$ **(1)** A = 18W, B = 2W, C = 2W, D = 8W **(1)**	**<u>Example of calculation</u>** $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ (for parallel combination) $\frac{1}{Rp} = \frac{1}{2} + \frac{1}{4}$ $R_p = 1.33\ \Omega$ Total resistance in circuit = (1.33 + 2.00) = 3.33 Ω $I = V/R$ (for whole circuit) = $\frac{10.0\text{ V}}{3.33\ \Omega}$ = 3.00 A For resistor A, $P = I^2R$ = (3.00 A)^2 × 2.00 Ω = 18 W Current through D = $\frac{2}{3}$(3.00 A) = 2.00 A For D, $P = I^2R$ = (2.00 A)^2 × 2.00 Ω = 8 W For B and C, $P = I^2R$ = (1.00 A)^2 × 2.00 Ω = 2 W	6
18(b)	(With resistor D removed there is:) Greater circuit resistance **Or** Lower circuit current **Or** Lower p.d. across A **(1)** As $P = VI$, the power in A would be less (MP2 dependent on MP1) **(1)**	Do not award MP1 if any of the three statements are quoted incorrectly Allow reference to $P = V^2/R$ or $P = I^2R$	2
18(c)	(As p.d increases,) current increases **(1)** (Increase of current linked to) increase in temperature **(1)** The lattice vibrations increase **(1)** Increased rate of collisions between electrons and atoms/ions/lattice **(1)**	Accept “filament heats up” Accept “ions”, “atoms” for “lattice” Accept “frequency” for “rate”	4
	Total for question 18		**12**