Mark Scheme (Results)

June 2025

Pearson Edexcel GCE
In Physics (8PH0)
Paper 02 Core Physics II

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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. '<u>resonance</u>'

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.

Section A

Question Number	Answer	Mark
1	**C** $\mathrm{W\,m^{-2}}$	**1**
	Incorrect Answers: A – Incorrect units B – Incorrect units D – Incorrect units	
2	**D** $\tan^{-1}\left(\frac{0.35}{2.00}\right)$	**1**
	Incorrect Answers: A – Incorrect use of trigonometry B – Incorrect use of trigonometry C – Values inverted	
3	**B** $0.5x$	**1**
	Incorrect Answers: A – Incorrect for parallel springs C – Incorrect for parallel springs D – Incorrect for parallel springs	
4	**B** The path difference of the waves is λ.	**1**
	Incorrect Answers: A – phase difference would be $2n\pi$ C – frequency of resultant wave is unchanged D – displacement of the resultant would be sum of the two waves	
5	**D** $\frac{3\pi}{2}$	**1**
	Incorrect Answers: A – Incorrect phase difference B – Incorrect phase difference C – Incorrect phase difference	

6	**C** no change increases	**1**
	Incorrect Answers: A – both incorrect B – speed incorrect D – number of photoelectrons incorrect	
7	**D** small slow	**1**
	Incorrect Answers: A – both incorrect B – diameter incorrect C –speed incorrect	
8	**A** $V\rho g$	**1**
	Incorrect Answers: B – incorrect C – incorrect D – incorrect	

(Total for Multiple Choice Questions = 8 marks)

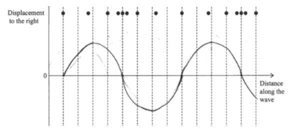
Question Number	Acceptable answers	Additional guidance	Mark
9(a)	An explanation that makes reference to the following points: • (The plane that) contains the oscillations / vibrations (of the wave) **(1)** • (The plane) including the direction of propagation of the wave **(1)**		**2**
9(b)(i)	An explanation that makes reference to the following points: • (Planes of polarisation of filters are) at 90° **or** at right angles **or** perpendicular **(1)** • Light transmitted by the first filter is absorbed by the second **(1)**	[do not allow all light absorbed. Must refer to each filter absorbing different components of light]	**2**

9(b)(ii)	• Calculates gradient = 75 (degrees $cm^3\ g^{-1}$) **(1)** **EITHER** • Calculates kl (0.75) **(1)** • Compares their gradient to kl (0.75) with conclusion consistent with their gradient **(1)** **OR** • Calculates k using their gradient **(1)** • Compares their value for k with 0.050 (degrees $cm^2\ g^{-1}$) with conclusion consistent with their calculated k **(1)** **OR** • Calculates l using their gradient **(1)** • Compares their value for l with 15 (cm) with conclusion consistent with their calculated l **(1)**		[Accept 73 – 80] Example of calculation kl = 0.05 degrees $cm^2\ g^{-1} \times$ 15 cm = 0.75 degrees $cm^3\ g^{-1}$	**3**

(Total for Question 9 = 7 marks)

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>*10</td>
<td>
This question assesses a student’s ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.
Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning.
<table>
<tr><th>IC points</th><th>IC mark</th><th>Max linkage mark</th><th>Max final mark</th></tr>
<tr><td>6</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>5</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>4</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>3</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Indicative content:
IC1 The soundwave is emitted in <u>pulses</u>
IC2 (The pulses) reflect from the seabed.
IC3 The reflected pulses are detected/received (by the transducer at sea level)
IC4 The time between the emission and detection (of the pulse) is measured/recorded
IC5 The distance travelled (by the pulses) is calculated by speed of sound (in water) × time taken to return
IC6 Depth of ocean is half the calculated distance
</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>
</table>
Accept a correct factor of 2
</td>
<td>6</td>
</tr>
</table>

(Total for Question 10 = 6 marks)

Question Number	Acceptable answers	Additional guidance	Mark
11(a)	• sine wave drawn from first dotted line **(1)** • Min 1 wavelength with zero displacement at lines 5,9,(13) **(1)**	 [ignore their drawing between axis and first dotted line]	**2**
11(b)(i)	• $V = \pi r^2 \times L$ **(1)** • Use of $\rho = \frac{m}{V}$ **(1)** • μ = 0.00054 (kg m^{-1}) **(1)**	[V= 1.5x10^{-7}] [No ue for show that] <u>Example of calculation</u> $m = \pi\left(\frac{7.6 \times 10^{-4}\ \mathrm{m}^2}{2}\right)^2 \times 0.33\ \mathrm{m} \times 1200\ \mathrm{kg\ m^{-3}} = 1.8 \times 10^{-4}\ \mathrm{kg}$ $\mu = \frac{1.8 \times 10^{-4}\ \mathrm{kg}}{0.33\ \mathrm{m}} = 0.00054\ \mathrm{kg\ m^{-1}}$	**3**
11(b)(ii)	• Use of $v = \sqrt{\frac{T}{\mu}}$ **and** $v = f\lambda$ **(1)** **Or** Use of $f = \frac{1}{\lambda}\sqrt{\frac{T}{\mu}}$ **(1)** • Recognises $\lambda = 2L$ **(1)** • $\mu = 1.1 \times 10^{-3}$ (kg m^{-1}) so string 3 used	[Allow $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ for MP1 and MP2] [No ue] <u>Example of calculation</u> $2 \times 0.33\ \mathrm{m} \times 277\ \mathrm{s^{-1}} = \sqrt{\frac{3.9\ \mathrm{kg} \times 9.81\ \mathrm{m\ s^{-1}}}{\mu}}$ $\mu = 1.1 \times 10^{-3}$ kg m^{-1} string 3	**3**

(Total for Question 11 = 8 marks)

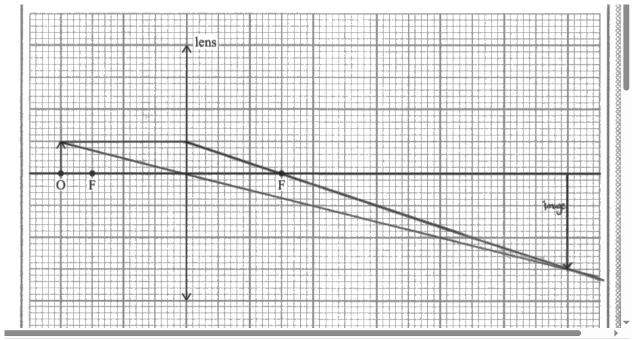
Question Number	Acceptable answers		Additional guidance	Mark
12(a)	• Use of $\sin C = \frac{1}{n}$ • $C = 38°$	**(1)** **(1)**	<u>Example of calculation</u> $\sin C = \frac{1}{1.63}$ $C = 37.84°$ [No ue as given in diagram and in (b)]	**2**
12(b)	• Use of $n = \frac{c}{v}$ • Use of $n_1 \sin\theta_1 = n_2 \sin\theta_2$ with $\theta = 40°$ [$r = 24°$] • Uses geometry to determine angle of incidence at the glass-air interface [$\theta = 36.52°$] • Recognises that n(glass to air) = $\frac{1}{n(\text{air to glass})}$ • $\theta = 68°$	**(1)** **(1)** **(1)** **(1)** **(1)**	[1.58] e.g. Internal angles totalling 180° Accept answers using 1/(candidates value for n in MP1) [answer of 15° not MP4 and MP5 - has used 1.58 instead of 1/1.58 [accept answers written on diagram] [No ue] <u>Example of calculation</u> $n = \frac{3.0 \times 10^8}{1.9 \times 10^8} = 1.58$ At air-glass interface $\sin r = \frac{\sin 40}{1.58}$ $r = 24°$ At glass-air interface $i = 90 - (180 - (90 - 24) - 60) = 36°$ $\sin r = \frac{\sin 36}{(^1/_{1.58})}$ $r = 68°$	**5**

(Total for Question 12 = 7 marks)

Question Number	Acceptable answers	Additional guidance	Mark
13(a)(i)	• Uses $\varepsilon = \frac{\Delta x}{x}$ **(1)** • Strain = 0.07 or 7 % **(1)** • Uses uncertainty is half the range **(1)** **Or** the difference between the mean and the furthest datum point • Uncertainty = 0.008 m **(1)**	[mean Δx = 12.9 cm] <u>Example of calculation</u> Mean extension = $\frac{(1.29 + 1.21 + 1.37)\times10^{-1}\text{ m}}{3} = 1.29 \times 10^{-1}$ m $\varepsilon = \frac{1.29\times10^{-1}\text{ m}}{1.960\text{ m}} = 0.07$ $\frac{(1.37 - 1.21)\times10^{-1}\text{m}}{2} = 0.008$ m	**4**
13(a)(ii)	• Use of $\Delta E_{el} = \frac{1}{2}F\Delta x$ **(1)** • 6 J (ecf for mean Δx from (a)(i)) **(1)**	<u>Example of calculation</u> $\Delta E_{el} = \frac{1}{2} \times 90$ N $\times$ 0.129 m = 5.8 J	**2**
13(a)(iii)	• Measure diameter with micrometer/screw gauge/ calipers **(1)** • Take multiple readings at different locations / orientations **(1)** • Calculate a mean **(1)** • Calculate cross-sectional area of the wire using $A = \frac{\pi d^2}{4}$ **(1)**	Accept $A = \pi r^2$ **and** $r = \frac{\text{diameter}}{2}$	**4**

13(b)	An explanation that makes reference to the following points: **Max 4 from any two of:** • (steel has a) greater Young Modulus **Or** (steel is) stiffer **(1)** • So less strain / deformation under a given stress/load **(1)** **OR** • Elastic limit (for steel) is at a greater stress **(1)** • So can return to its original size / length up to a greater stress **(1)** **OR** • Steel has a greater plastic region **(1)** • So can absorb more energy before fracture **(1)** **OR** • has a greater breaking stress **(1)** • more stress/force can be applied before it breaks **(1)**	[Accept answers wrt iron] [do not accept any properties not shown on the graph eg less likely to rust] [allow yield point is at a greater stress]]	**4**

(Total for Question 13 = 14 marks)

Question Number	Acceptable answers		Additional guidance	Mark
14(a)	**Any two of the following rays drawn [maximum 2 marks for ray drawing]** • Continuous straight line joining the top of the object and the centre of the lens and extended to the right hand side of the lens. • Straight line joining the top of the object and F on the left hand side of lens, extended up to the lens. Then continued parallel to the principal axis on the right hand side of the lens. • Straight line drawn from the top of the object parallel to the principal axis up to the lens. Then continued through and beyond F on the right hand side of the lens. • Correct image drawn in position consistent with their rays **and** within range 11-13 cm	(1) (1) (1) (1)	 	3
14(b)	• Use of $m = \frac{v}{u}$ • Use of $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ • Use of $P = \frac{1}{f}$ • Use of $P = P_1 + P_2$ • Power of lens = 5.3 D so the student used lens X	(1) (1) (1) (1) (1)	<u>Example of calculation</u> $v = 0.71 \times 20$ cm = 14.2 cm $P = \frac{1}{0.20\text{ m}} + \frac{1}{0.142\text{ m}} = 12.04$ D $P_2 = P - P_1$ =12.0 D – 6.7 D = 5.34 D	5

(Total for Question 14 = 8 marks)
(Total for Section A = 58 marks)

Section B

Question Number	Acceptable answers	Additional guidance	Mark
15(a)(i)	An explanation that makes reference to the following points: • The electron in the hydrogen atom is excited **Or** the electron is promoted to a higher energy level **(1)** • (After a short time) the electron returns to its normal/ground state emitting a <u>photon</u> **(1)** • The energy of the photon is equal to the difference in the (discrete) energy levels of the atom **(1)** • Wavelength (of emitted photon) is inversely proportional to the change in energy **Or** Frequency (of emitted photon) is proportional to the change in energy **Or** Reference to $E = hf$ / $E = \frac{hc}{\lambda}$ **(1)**	[not promoted alone] [accept falls back down] [not de-excites alone] [must be a <u>change</u> in energy, allow ΔE]	**4**
15(a)(ii)	• Use of $E = hf$ **and** $v = f\lambda$ **(1)** • $\Delta E = (-)3.01 \times 10^{-15}$ J **(1)** • Conversion between eV and J **(1)** • (so) $\Delta E = (-)1.9$ (eV) means a transition of (−)1.51 eV to (−)3.39 eV **(1)**	<u>Example of calculation</u> $\Delta E = \dfrac{6.63 \times 10^{-34}\ \text{m}^2\ \text{kg s}^{-1} \times 3.00 \times 10^{8}\ \text{m s}^{-1}}{6.6 \times 10^{-7}\ \text{kg}}$ $\Delta E = -3.01 \times 10^{-15}$ J $= \frac{-3.01 \times 10^{-19}\ \text{J}}{1.6 \times 10^{-19}\ \text{J C}^{-1}}$ = -1.88 eV Transition -1.51 eV to -3.39 eV	**4**

15(a)(iii)	An explanation that makes reference to the following points: • One electron absorbs and re-emits one <u>photon</u> **(1)** • A greater rate of emitted <u>photon</u>s means a higher intensity radiation **(1)**	[Accept more photons means higher intensity]	**2**

15(b)	• Use of $p = mv$ **(1)** • Equates the total momentum before collision to total momentum after collision **(1)** • v of hydrogen = 5400 (m s^{-1}) **(1)** • Compares their calculated value with 5000 (m s^{-1}) with conclusion consistent with their calculated value **(1)**	Accept reverse calculations using v = 5000 m s^{-1} to calculate a minimum initial velocity of H and compare to 2210 m s^{-1} <u>Example of calculation</u> $2.66 \times 10^{-26}\ \mathrm{kg} \times 2210\ \mathrm{m\ s^{-1}} = (2.66 \times 10^{-26}\ \mathrm{kg} \times 1870\ \mathrm{m\ s^{-1}}) + (1.67 \times 10^{-27}\ \mathrm{kg} \times v)$ v = 5416 m s^{-1} > 5000 m s^{-1} so can escape	**4**

(Total for Question 15 = 14 marks)

Question Number	Acceptable answers		Additional guidance	Mark
16(a)(i)	• Use of $\lambda = 2\pi r$ • 3.3×10^{-10} m	**(1)** **(1)**	<u>Example of calculation</u> $\lambda = 2\pi \times 5.3 \times 10^{-11}$ m $\lambda = 3.3 \times 10^{-10}$ m	**2**
16(a)(ii)	An explanation that makes reference to the following points: • The wavelength of the standing wave is determined by the energy of the electron • The wavelengths are discrete and (to fit the circumference of the orbit) only certain orbits are possible	 **(1)** **(1)**	[Accept reference to $E_k = \frac{h^2}{2m\lambda^2}$ to link wavelength to discrete energy levels]	**2**
16(b)(i)	• Use of $\lambda = \frac{h}{p}$ **and** $p = mv$ • 1.2×10^{-10} (m)	**(1)** **(1)**	<u>Example of calculation</u> $\lambda = \frac{6.63 \times 10^{-34}\ \text{m}^2\ \text{kg s}^{-1}}{9.11 \times 10^{-31}\ \text{kg} \times 5.9 \times 10^{6}\ \text{m s}^{-1}} = 1.23 \times 10^{-10}$ m [no ue]	**2**

16(b)(ii)	An explanation that makes reference to the following points: • The (de Broglie) wavelength of an electron decreases (with increasing speed) **(1)** • Smaller wavelength means a smaller path difference for waves to be in phase (so smaller rings/pattern) **Or** The diffraction angle is smaller for shorter wavelengths (and the rings become smaller) **(1)**	[Accept $\lambda \propto \frac{1}{v}$ with terms defined] [Allow there is less diffraction]	**2**

(Total for Question 16 = 8 marks)

(Total for Section B = 22 marks)
TOTAL FOR PAPER = 80 MARKS

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