Mark Scheme (Results)

Summer 2024

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

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Summer 2024
Question Paper Log Number: P74477A
Publications Code: 8PH0_02_2406_MS

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 means of [no ue].

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not be 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 mean that one mark will not be awarded.

(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 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

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

4.3 **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.

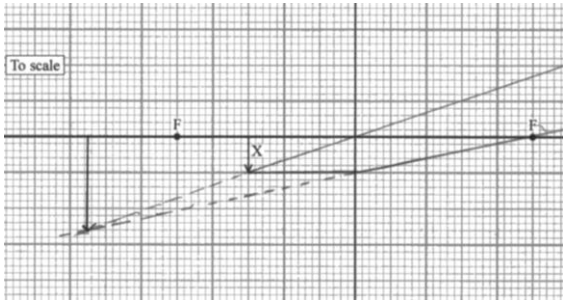
4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

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

Question Number	Answer	Mark
1	**The only correct answer is C** **A** *is not correct because* this is an eighth of a wavelength apart **B** *is not correct because* this is a quarter of a wavelength apart **D** *is not correct because* this is one wavelength apart	**1**
2	**The only correct answer is D** **A** *is not correct because* this is the power of one converging lens **B** *is not correct because* this is the power of one diverging lens **C** *is not correct because* this is the power of two converging lenses	**1**
3	**The only correct answer is A** **B** *is not correct because* the equation is arranged incorrectly **C** *is not correct because* the equation is arranged incorrectly **D** *is not correct because* the equation is arranged incorrectly	**1**
4	**The only correct answer is B** **A** *is not correct because* a real image is not formed on the same side of the lens to the object **C** *is not correct because* both comments incorrect **D** *is not correct because* a virtual image cannot be produced on a screen	**1**

5	**The only correct answer is C** **A** *is not correct because* photoelectrons are released instantly, so this statement is true **B** *is not correct because* there is a minimum frequency for photoelectrons to be released, so this statement is true **D** *is not correct because* the energy of a photon $E = hf$ so this statement is true	**1**
6	**The only correct answer is D** **A** *is not correct because* this is not a base unit **B** *is not correct because* this is not a unit for breaking stress **C** *is not correct because* this is not a base unit	**1**
7	**The only correct answer is B** **A** *is not correct because* this is missing g **C** *is not correct because* this is an incorrect arrangement **D** *is not correct because* this is an incorrect arrangement	**1**
8	**The only correct answer is B** **A** *is not correct because* no light can be transmitted when the filters are perpendicular **C** *is not correct because* no light can be transmitted when the filters are perpendicular **D** *is not correct because* no light can be transmitted when the filters are perpendicular	**1**

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
9(a)	• Use of P = 1/f **(1)** • Use of $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ with u=∞ or very large **(1)** **Or** Rays from a distant point are parallel and converge at the focal point • Distance = 1.25 m **(1)**	Example of calculation $f = \frac{1}{0.8\ \text{D}}$ = 1.25 m $\frac{1}{1.25\ m} = \frac{1}{\infty} + \frac{1}{v}$ v = 1.25 m	**3**
9(b)	• 2 rays drawn: Extended line joining centre of lens to tip of object **and** Horizontal line from tip of object to the lens, then an extended line joining the point on the lens where this line intercepts to the focal point on the right of the lens **(1)** • Image drawn where their two rays cross **(1)** • Use of $m = \frac{v}{u}$ **or** m= $\frac{\text{image height}}{\text{object height}}$ • m = (-) 2.3 – 2.7 **(1)**	Accept: line from focal point on the left hand side of lens through the tip of object to the lens, and then a parallel line joining the line from the lens through the left hand side of lens.  Example of calculation $m = \frac{v}{u}$ $m = \frac{7.5\ (\text{cm})}{3.0(\text{cm})}$ = (-) 2.5	**4**

(Total for Question 9 = 7 marks)

Question Number	Acceptable answers	Additional guidance	Mark
10(a)	• Use of $s = ut$ **(1)** • Correct use of a factor of two **(1)** • Distance = 3.1 m **(1)**	Example of calculation $1500 \text{ m s}^{-1} = \frac{2s}{4.1 \times 10^{-3} \text{ (s)}}$ s = 3.08 m	**3**
10(b)	• So reflected pulse returns before next pulse is transmitted **(1)**		**1**
10(c)	• High frequency has a short wavelength **(1)** • Short wavelengths diffract less around smaller objects **Or** Greater amount of detail can be detected **(1)**		**2**

(Total for Question 10 = 6 marks)

Question Number	Acceptable answers		Additional guidance	Mark
11(a)	• Use of correct trigonometry to determine θ • Uses d = 1/400 • Use of $n\lambda = d\sin\theta$ with n = 2 • λ = 470 nm which is outside the range	**(1)** **(1)** **(1)** **(1)**	Example of calculation $\theta = \tan^{-1}\frac{3.25\times0.5}{4} = 22.1°$ $2 \times \lambda = 2.5\times10^{-6}$ m $\sin 22.1°$ λ = 470 nm	**4**
11(b)	• Use of $\lambda = \frac{h}{p}$ **and** $p = mv$ • Calculate 10% of c • $\lambda = 2.4\times10^{-11}$ m • $\lambda \ll$ than size of gap so little/no diffraction occurs	**(1)** **(1)** **(1)** **(1)**	Example of calculation $\lambda = \frac{6.63\times10^{-34}\text{J s}}{9.11\times10^{-31}\text{kg}\times0.1\times3.0\times10^{8}\text{ m s}^{-1}}$ $\lambda = 2.4\times10^{-11}$ m	**4**

(Total for Question 11 = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
12(a)	• (Measure diameter) using micrometer / digital calipers • Repeat measurements and calculate the mean • Take measurements at different points (along the wire) **or** at different orientations	**(1)** **(1)** **(1)**		**3**
12(b)(i)	• Substitutes stress $= \frac{F}{A}$ and strain $= \frac{\Delta x}{x}$ into $E = \frac{stress}{strain}$ • Identifies gradient as $\frac{F}{\Delta x}$	**(1)** **(1)**		**2**
12(b)(ii)	• Calculates gradient of straight section • Use of $E = gradient \times \frac{x}{A}$ • E = 1.2 to 1.3 $\times$ 10^{11} N m^{-2} • Wire is made from copper because 117 GPa is closest to the calculated value **Or** Correct conclusion of the metal consistent with candidate's calculated value	**(1)** **(1)** **(1)** **(1)**	<u>Example of calculation</u> Gradient = $\frac{33}{7 \times 10^{-3}}$ = 4600 - 4900 E = 1.24 $\times$ 10^{11} N m^{-1} = 124 GPa copper	**4**

12(b)(iii)	• Use a smaller (maximum) force/load **(1)** • To avoid exceeding the limit of proportionality **Or** As the breaking force of a thinner wire is smaller **(1)** • Use small(er) increments in the force/load **(1)** • To obtain more readings (before the elastic limit is reached) **Or** to obtain enough readings (in the linear part of the graph) **(1)**		**4**

(Total for Question 12 = 13 marks)

Question Number	Acceptable answers	Additional guidance	Mark
13(a)	**Any two from** • Small object **(1)** • spherical object **(1)** • (Moving at a) slow speed **(1)** • In laminar flow **or** not turbulent flow **(1)**		**2**

***13(b)**

This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.
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 structure and lines of reasoning

Number of indicative points seen in answer	Number of marks awarded for indicative points
6	4
5-4	3
3-2	2
1	1
0	0

Indicative content

IC1 (Initially) there is a downward resultant force on the ball bearing
Or
(Initially) weight is greater than upthrust

IC2 (so) the ball bearing accelerates downwards

IC3 The (viscous) drag force increases with speed

IC4 The (viscous) drag force (at any given velocity) is greater in the more viscous fluid

IC5 Eventually resultant force is zero so ball reaches terminal velocity
Or
When weight = upthrust + drag the ball falls at a constant speed

IC6 In the higher viscosity fluid the terminal velocity is lower.

The following table shows how the marks should be awarded for structure and lines of reasoning

	Number of marks awarded for structure and lines of reasoning
Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkage between points and is unstructured	0

Linkage marks

Number of indicative content points awarded	Possible linkage marks
0, 1, 2	0
3, 4	1
5, 6	2

6

13(c)(i)	• Use of $s = ut + ½ at^2$ with $a = 0$ **(1)** • Use of $F = 6\pi\eta rv$ **(1)** • 0.037 N **(1)**	Example of calculation $v = \frac{0.75\text{ m}}{3.4\text{ s}} = 0.22\text{ m s}^{-1}$ $F = 6\pi \times 1.8\text{ Pa s} \times 5 \times 10^{-3}\text{ m} \times 0.22\text{ m s}^{-1} = 0.037\text{ N}$	**3**
13(c)(ii)	• Viscous drag force + upthrust = weight **(1)** • Upthrust and weight are unchanged (with temperature) **(1)** • (So at terminal velocity) viscous drag force is unchanged so the student is incorrect **Or** For viscous drag to be constant, if the viscosity decreases then the terminal velocity will increase so the student is incorrect ($F = 6\pi\eta rv$) **(1)**		**3**

(Total for Question 13 = 14 marks)

(Total for Section A = 56 marks)

Question Number	Acceptable answers	Additional guidance	Mark
14(a)	An explanation that makes reference to the following points: • Electrons (in the dust particles) absorb the energy of photons (in UV ray) **(1)** • One photon interacts with one electron **(1)** • And the electron is released from the surface of the dust particle (leaving dust particle charged) **(1)**		**3**
14(b)	An explanation that makes reference to the following points: • (At 90°) the photons/UV spread over a smaller area (than at angles less than 90° **)** **Or** (At 90°) the intensity of the UV is higher **(1)** • (At 90°) there is a maximum/larger number of (incident) photons (per unit area per second) **(1)** • So a greater number of (photo)electrons are released (per unit area) **Or** More electrons absorb a photon (per unit area) **(1)**		**3**
14(c)	• Conversion between eV and J **(1)** • Use of $hf = \phi + \frac{1}{2}mv_{max}^2$ **(1)** • ϕ = 4.3 (eV) therefore the mineral is Ilmenite **(1)**	Example of calculation $\phi = \frac{6.63 \times 10^{-34}\text{J s} \times 2.0 \times 10^{15}\text{ Hz}}{1.6 \times 10^{-19}\text{ C}} - 4.0$ $\phi = 4.3$ eV	**3**

14(d)	• Use of $W = mg$ with $g = 1.6$ N kg^{-1} **(1)** • Use of $F = ma$ **(1)** • $a = 4.6$ m s^{-2} **(1)** • Use trigonometry to calculate θ **(1)** • $\theta = 70°$ to the vertical (downwards) **Or** $\theta = 20°$ to the horizontal (downwards) **(1)**		Example of calculation 3.0×10^{-17} N = $m \times 1.6$ N kg^{-1} $m = 1.9 \times 10^{-17}$ kg 8.7×10^{-17} N = 1.9×10^{-17} kg $\times a$ $a = 4.6$ m s^{-2} $\cos\theta = \frac{8.2\times10^{-17}\text{ N}}{8.7\times10^{-17}\text{ N}}$ $\theta = 70°$ to the vertical	**5**

(Total for Question 14 = 14 marks)

Question Number	Acceptable answers		Additional guidance	Mark
15(a)	• Use of $n_1\sin\theta_1 = n_2\sin\theta_2$	**(1)**		**3**
	Either			
	• Angle of refraction = 55°	**(1)**		
	• So radiation is refracted	**(1)**		
	Or			
	• $C = 60°$	**(1)**	Example of calculation $1.5\sin45° = 1.3\sin\theta_2$ $\theta_2 = 55°$	
	• Angle of incidence is smaller than C so not total internal reflection	**(1)**		
15(b)i	• Number of conduction electrons increases	**(1)**		**4**
	• (so) LDR has a lower resistance	**(1)**		
	• Ratio of R_{LDR}/R decreases **or** ratio V_{LDR}/V_R decreases	**(1)**		
	• (Leading to) decreased pd across motor so speed of motor decreases	**(1)**		

15(b)ii	**Either** • Use of $R_T = R_1 + R_2$ **(1)** • Uses: ratio of pd across LDR to supply pd = ratio of resistance of LDR to total resistance **(1)** • Number of cells = 8 **(1)** **Or** • Use of $R = \frac{V}{I}$ • Use of $V_s = V_1 + V_2$ **Or** $R_T = R_1 + R_2$ • Number of cells = 8	Example of calculation $V_s = \frac{5\ V\ (270\ \Omega + 193\ \Omega)}{193\ \Omega} = 12\ \text{V}$ Number of cells = $\frac{12\ \text{V}}{1.5\ \text{V}} = 8$	**3**

(Total for Question 15 = 10 marks)
(Total for Section B = 24 marks)
(Total for Paper = 80 marks)

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