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Mark Scheme (Results)

Summer 2016

Pearson Edexcel International Advanced Level in Physics (WPH03) Paper 01 Exploring Physics

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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 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	D	**1**
2	D	**1**
3	A	**1**
4	B	**1**
5	D	**1**

Question Number	Answer	Mark
6(a)	0.35 - 0.41 **(1)** (accept 0.06)	**1**
6(b)	Divides 0.03 or 0.06 by 0.38 (1) Percentage uncertainty = 8(%) or 16(%) (1) (accept 7.9 or 15.8) <u>Example of calculation</u> (0.03/0.38) × 100 % = 8% **Or** (0.06 × 0.38) 100% = 16%	**2**
6(c)	This is too high an uncertainty (for a single reading) (1) Makes a valid qualitative comment regarding the method e.g. use a light gate to reduce uncertainty or repeat and average **Or** Calculates percentage uncertainty (1) <u>Example of calculation</u> (0.38/3) × 100 = 13%	**2**
	Total for Question 6	**5**

Question 7 has to be marked holistically and in the context of the experiment described.

Question Number	Answer		Mark
7	(a) *draw a labelled diagram of the apparatus to be used* and *list additional apparatus needed*		**2**
	Either on diagram or list: ray box (accept light source or laser) **Or** optical pins	(1)	
	protractor **Or** ruler (to measure sides of triangles)	(1)	
	(b) *show on your diagram the quantities to be measured*		**2**
	normal drawn	(1)	
	angle of incidence and angle of refraction labelled	(1)	
	(c) *explain your choice of measuring instrument for **one** of these quantities,*		**2**
	Protractor to measure angle	(1)	
	Measures to 1˚ (0.5 ˚)	(1)	
	Or		
	Ruler to measure sides of triangles	(1)	
	Measures to 1 mm (0.5 mm)	(1)	
	(d) *comment on whether repeat reading are appropriate in this case*		**1**
	Yes, to obtain an average	(1)	
	(e) explain how to determine the refractive index,		**3**
	Obtain sin *i* and sin *r* [just quoting equation is not sufficient, allow statement about substitution into ref. ind. equn]	(1)	
	plot sin *i* (*y*-axis) against sin *r* (*x*-axis)	(1)	
	gradient is refractive index	(1)	
	(gradient is 1/refractive index for reversed axes)		
	(f) identify the main source of uncertainty and/or systematic error		**1**
	thickness of rays **Or** difficulty of correctly aligning pins	(1)	
	(*g*) *comment on safety*		**1**
	identification of appropriate risk and associated precaution <u>Example</u> **Or** risk of burn from hot lamps, avoid contact with lamp **Or** risk of injury from pins, handle pins carefully **Or** accept low risk as low voltage for ray box	(1)	
	Total for Question 7		**12**

Question Number	Answer	Mark
8(a)	Use a micrometer or a digital calliper (1) Repeat readings either at different orientations or different positions along the length (1)	**2**
8(b)(i)	**Max 2** Inconsistent sig figs for potential difference (1) No evidence of repetition/averaging (1) Only 5 sets of results (1) (Ignore comments about range)	**2**
8(b)(ii)	Use a variable resistor in the circuit **Or** Adjust the power supply (1)	**1**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>8(b)(iii)</td><td>Correct values (1)
Values given to 2 sig figs (1)

<table><tr><th>Length/m</th><th>Potential difference/V</th><th>Resistance/Ω</th></tr><tr><td>1.00</td><td>0.52</td><td>4.7</td></tr><tr><td>0.80</td><td>0.41</td><td>3.7</td></tr><tr><td>0.60</td><td>0.27</td><td>2.5</td></tr><tr><td>0.40</td><td>0.19</td><td>1.7</td></tr><tr><td>0.20</td><td>0.1</td><td>0.9(1)</td></tr></table></td><td>2</td></tr>
<tr><td>8(c)(i)</td><td>Axes labelled with units (1)
Sensible scales (1)
Correct plotting of candidate’s data from table (1)
Line of best fit (1)</td><td>4</td></tr>
<tr><td>8(c)(ii)</td><td>large triangle (at least half drawn line used) (1)
4.8 ± 0.8 to 2 or 3 sig figs (1)</td><td>2</td></tr>
<tr><td>8(c)(iii)</td><td>Gradient = ρ / area Or ρ = gradient × area (1)
Use of $A = \pi r^2$ ($A = 2.46 \times 10^{-7}\ m^2$) (1)
ρ in range $1.2 \times 10^{-6} \pm 0.2 \times 10^{-6}$ to 2 or 3 sig fig (1)
units Ω m (1)

ecf from (c)(ii)

<u>Example of calculation</u>
resistivity = $4.8 \times (\pi \times (0.28 \times 10^{-3})^2) = 1.18 \times 10^{-6}\ \Omega$ m</td><td>4</td></tr>
<tr><td>8(c)(iv)</td><td>Correct suggestion (1)

e.g. contact resistance
heating of wire
kinks in wire
zero error on named instrument
poor choice of line of best fit</td><td>1</td></tr>
<tr><td></td><td>Total for Question 8</td><td>18</td></tr>
</table>

(c) (i) Plot a graph of resistance on the *y*-axis and length on the *x*-axis and draw a line of best fit.

(4)

