GradeMax



Mark Scheme (Results)

October 2019

Pearson Edexcel International Advanced Level In Physics (WPH13) Paper 01 Practical Skills in Physics I

GradeMax

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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.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] [Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]	✓	**1**

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

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.
   - 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 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
   - 2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.
   - 2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).
   - 2.5 Occasionally, it may be decided not to penalise a missing or incorrect 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.
   - 2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. **Significant figures**
   - 3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.
   - 3.2 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}

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.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H ✓

Substitution into density equation with a volume and density ✓

Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark]
[Bald answer scores 0, reverse calculation 2/3] **3**

Example of answer:

80 cm × 50 cm × 1.8 cm = 7200 cm^3
7200 cm^3 × 0.70 g cm^{-3} = 5040 g
5040 × 10^{-3} kg × 9.81 N/kg
= 49.4 N

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.

5.2 Usually it is part of a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

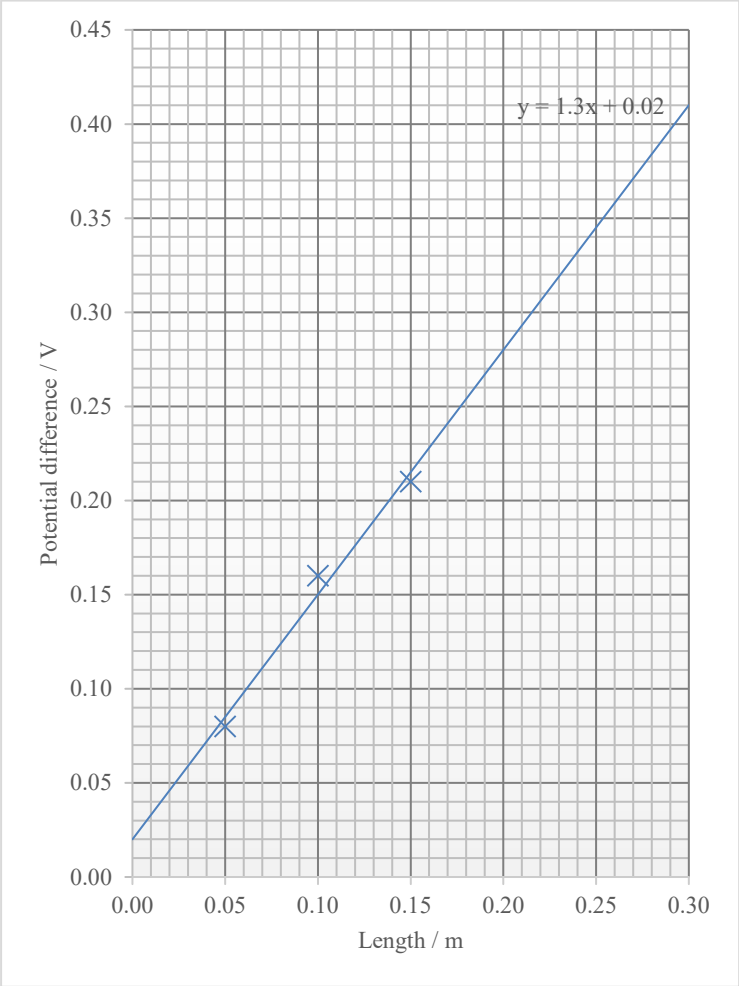
6.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer		Mark
1 (a)	• Reaction time **Or** timer not reset to zero	(1)	**(1)**
1 (b)(i)	Student – **2 marks** • Students' values of *t* are within a range of 0.16 s **Or** calculates mean *t* and difference to furthest value of *t* (0.11 s) **Or** calculates percentage uncertainty for the 5 values • Reaction time is comparable to the range **Or** difference between values can be explained by reaction time Teacher – **2 marks** • Range of the other 4 values is 0.04 s **Or** uncertainty of other 4 values is 0.02 s **Or** calculates percentage uncertainty for the other 4 values **Or** calculates percentage difference of student 4's value and the mean • Comparison between Student 4's value and the range/uncertainty of the other 4 values. **Or** the (percentage) difference between 0.75 and the other values is large	(1) (1) (1) (1)	**(4)**
1 (b)(ii)	• Attempt to calculate mean (using 4 or 5 values) • 0.89 s given to 2 s.f. (0.86 s if all 5 values used) Example of Calculation Mean time = (0.88 + 0.87 + 0.91 + 0.88) / 4 = 0.885 s	(1) (1)	**(2)**
1 (b)(iii)	• Use of half range (0.02 s) **Or** difference between mean and the value furthest from mean • Percentage uncertainty = 2 % Allow ecf of mean time from 1(b)(ii) Example of Calculation Percentage uncertainty = (0.02 / 0.89) × 100 % = 2.247 %	(1) (1)	**(2)**
1 (b)(iv)	• Use of $s = v\,t$ with $v = 330$ m s^{-1} • with a correct maximum time • Correct use of factor of 2 • Maximum distance value calculated Accept maximum time from table Allow ecf of mean and percentage uncertainty if calculating maximum time value Example of Calculation $s = 330$ m s^{-1} × (0.91 s ÷ 2) $s = 150.2$ m	(1) (1) (1) (1)	**(4)**
	Total for question 1		**13**

Question Number	Answer	Mark
2 (a)	• Measure the distance at which the plastic sphere lands with a ruler **Or** measure the launch angle with a protractor (1) • Repeat measurements (for each angle) and calculate the mean d (1) • Plot a graph of d and θ, and use to find θ for maximum d value **Or** continue changing θ until d decreases to find maximum (1) • Around the maximum d take measurements for smaller changes in angle (1)	**(4)**
2 (b)	**Max 2 from** • Parallax error when reading angle/distance (1) • Angle not zero when launcher is horizontal (1) • Air resistance on the plastic sphere so velocity reduces (1) • v not constant due to friction in the launcher tube (which depends upon angle) (1)	**(2)**
	Total for question 2	**6**

Question Number	Answer	Mark
3 (a)	• If the rod has uniform diameter it balances (horizontally) with the thread at 15 cm (1) • because the mass/moment of the rod either side of the thread is equal **Or** because the line of action of weight is through the pivot **Or** because the centre of mass would be at 15 cm (1) Accept "horizontal" as a description of the rod being balanced horizontally Accept "in the middle" as a description of 15 cm	**(2)**
3 (b)(i)	• value between 0.40 and 0.45 V (1)  	**(1)**
3 (b)(ii)	• Use of ratio of resistance = ratio of p.d. (1) **Or** Use of $V = IR$ with $R_{rod} = 0.070\ \Omega$ to calculate current • $V_{Terminal} = 1.6$ V (1) Allow ecf for use of their V value from 3(b)(i) <u>Example of Calculation</u> $V / V_T = R / R_T$ $V_T = (V \times R_T) / R$ $V_T = (0.41\ V \times 0.27\ \Omega) / 0.070\ \Omega = 1.58\ V$	**(2)**
3 (c)	• Further readings would make the line of best fit more accurate (1) • Giving a more accurate value for the p.d. of the rod (at 30cm) (1)	**(2)**
	Total for question 3	**7**

Question Number	Answer		Mark
4 (a)	• Calculates $\frac{angle\ of\ rotation}{concentration\ of\ solution}$ for two pairs of values	(1)	**(3)**
	• Calculates $\frac{angle\ of\ rotation}{concentration\ of\ solution}$ for at least one other pair of values	(1)	
	• Comparative statement consistent with their values	(1)	
	Accept equivalent calculations of $\frac{concentration\ of\ solution}{angle\ of\ rotation}$ or $k = \frac{angle\ of\ rotation}{(concentration\ of\ solution \times depth\ of\ solution)}$		
4 (b)	• Higher power lamp would have a heating effect on the solution **Or** Higher power lamp would increase the temperature of the solution	(1)	**(3)**
	• Heating would cause expansion of the sucrose solution **Or** heating would cause evaporation of the sucrose solution	(1)	
	• Which would change the concentration/density (of sucrose solution)	(1)	
4 (c)	• Comparison between $angle\ of\ rotation = k \times concentration\ of\ solution \times depth\ of\ solution$ and $y = mx\ (+c)$	(1)	**(3)**
	• Plot a graph of *angle of rotation* and *concentration of solution* **Or** plot a graph of *angle of rotation* and *concentration of solution* × *depth of solution*	(1)	
	• Correct method for calculating k for their graph described	(1)	
	Total for question 4		**9**

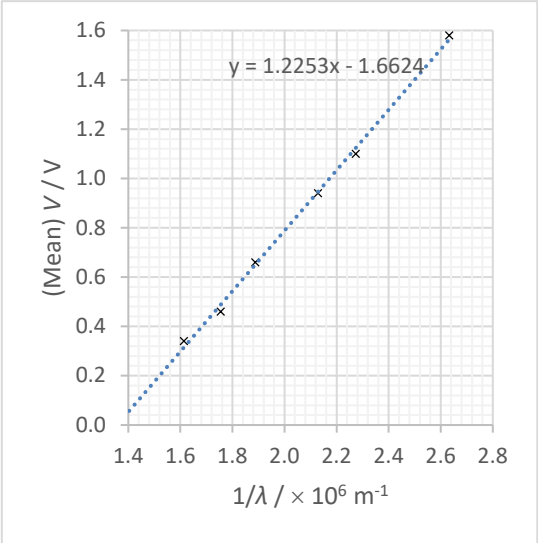
<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>5 (a)</td><td>
• Higher photon energy means higher frequency light
Or higher photon energy means using ultraviolet light (1)
• There is an increased risk when using ultraviolet light
Or using visible light is no/low risk (1)

Accept any named EM radiation with higher frequency than visible light
</td><td>(2)</td></tr>
<tr><td>5 (b)</td><td>
• Use of $W = VQ$
Or $W = eV$ (1)
• $W = (-)2.5 \times 10^{-19}$ J
Or $W = 1.58$ eV (1)

<u>Example of Calculation</u>
$W = 1.58\text{V} \times 1.6 \times 10^{-19}$ C
$W = 2.53 \times 10^{-19}$ J
</td><td>(2)</td></tr>
<tr><td>5 (c)(i)</td><td>
• Correct $1/\lambda$ values to 2 or 3 s.f. (1)
• Labels axes with quantities and units (1)
• Sensible scales (1)
• Plotting (2)
• Line of best fit (1)

<table>
<tr><th>λ / nm</th><th>$1/\lambda$ / $\times 10^6$ m^{-1}</th><th>Mean V / V</th></tr>
<tr><td>380</td><td>2.63</td><td>1.58</td></tr>
<tr><td>440</td><td>2.27</td><td>1.10</td></tr>
<tr><td>470</td><td>2.13</td><td>0.94</td></tr>
<tr><td>530</td><td>1.89</td><td>0.66</td></tr>
<tr><td>570</td><td>1.75</td><td>0.46</td></tr>
<tr><td>620</td><td>1.61</td><td>0.34</td></tr>
</table>

Accept $1/\lambda$ in nm^{-1} or pm^{-1} at this stage.



</td><td>(6)</td></tr>
<tr><td>5 (c)(ii)</td><td>
• Calculates gradient using large triangle (1)
• Use of $h = \frac{gradient \times e}{c}$ with their gradient (1)
• $h = (6.2 \text{ to } 7.0) \times 10^{-34}$ J s (1)

<u>Example of Calculation</u>
$gradient = \frac{1.4V - 0.2V}{(2.50 - 1.50) \times 10^6} = 1.2 \times 10^{-6}$ V m^{-1}
$h = \frac{1.2 \times 10^{-6} \times 1.6 \times 10^{-19}}{3.0 \times 10^8} = 6.4 \times 10^{-34}$ J s
</td><td>(3)</td></tr>
<tr><td>5 (d)</td><td>
Max two from
• Block out external light sources (1)
• Use a larger range of wavelengths/frequencies (1)
• Use filters with a narrower frequency band (1)
• Use LEDs of known frequency (1)
• Use more sensitive <u>ammeter</u> (1)
</td><td>(2)</td></tr>
<tr><td></td><td>Total for question 5</td><td>15</td></tr>
</table>

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