GradeMax



Mark Scheme (Results)

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Pearson Edexcel International Advanced Subsidiary/Advanced Level
In Physics (WPH06)
Paper 1: Experimental 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.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] (1) **1**
[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.]

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 o**f 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.

Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H	(1)	
Substitution into density equation with a volume and density	(1)	
Correct answer [49.4 (N)] to at least 3 sig fig. [No ue]	(1)	**3**

[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]

Example of calculation
$80\ cm \times 50\ cm \times 1.8\ cm = 7200\ cm^3$
$7200\ cm^3 \times 0.70\ g\ cm^{-3} = 5040\ g$
$5040 \times 10^{-3}\ kg \times 9.81\ N/kg = 49.4\ N$

5. Graphs

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

5.2 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.

5.3 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, 4, 7 etc.

5.4 Points should be plotted to within 1 mm.

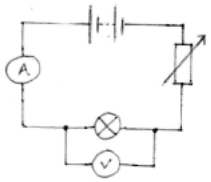
- Check the two points furthest from the best line. If both are OK award the mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these are OK, otherwise no mark.

5.5 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)(i)	Check for zero error	(1)	
	Repeat at different orientations **and** calculate a mean	(1)	**2**
1(a)(ii)	(Using a larger stack) would reduce the percentage uncertainty	(1)	
	As the uncertainty is the same in both measurements **Or** the vernier calipers have a resolution of 0.1 mm	(1)	
	The percentage uncertainty for a single coin would be 5% but 20 coins would be 0.25%	(1)	**3**
1(b)(i)	Use of $\rho = m/V$	(1)	
	8.39 (g cm^{-3})	(1)	**2**
	Example of calculation ρ = 190.4 g/(π × (1.12 cm)^2 × 5.76 cm) = 190.4 g/22.7 cm^3 = 8.39 g cm^{-3}		
1(b)(ii)	(As the value is squared) so the percentage uncertainty is doubled.	(1)	**1**
1(b)(iii)	Correct calculation of percentage uncertainty in d **and** t shown	(1)	
	Percentage uncertainty in ρ =1.4%	(1)	
	Correct calculation of upper and/or lower limit of value from (b)(i)	(1)	
	Comment comparing given density with limits (dependent on MP3)	(1)	
	Example of calculation %U in d = (0.01 cm/2.24 cm) × 100% = 0.45 % %U in t = (0.03 cm/5.76 cm) × 100% = 0.52% %U in ρ = 2 × 0.45% + 0.52% = 1.4 % Upper limit = 8.39 g cm^{-3-} × 101.4% = 8.51 g cm^{-3} The quoted value falls outside the upper limit so the coin is not made of cupronickel.		

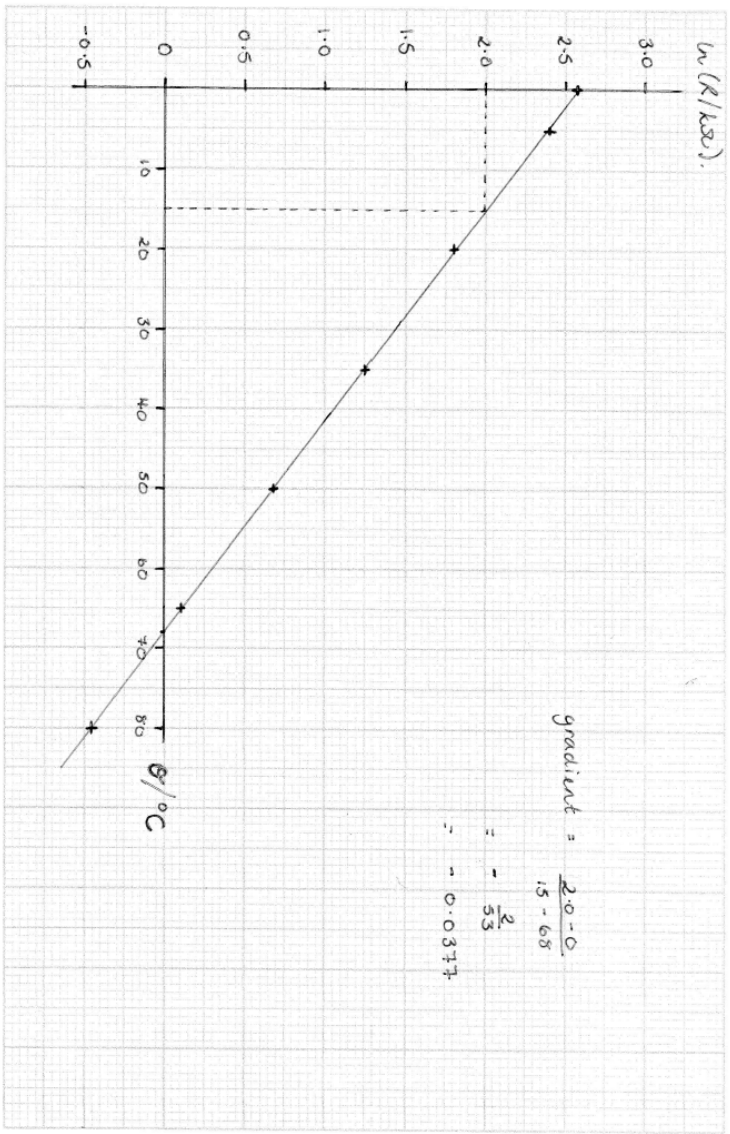
	Or Correct calculation of percentage uncertainty in d **and** t shown Percentage uncertainty in ρ =1.4% Correct calculation %D shown Comment comparing %D and %U (dependent on MP3) <u>Example of calculation</u> %U in d = (0.01 cm/2.24 cm) × 100% = 0.45 % %U in t = (0.03 cm/5.76 cm) × 100% = 0.52% %U in ρ = 2 × 0.45% + 0.52% = 1.4 % %D = (8.86 g cm^{-3} – 8.39 g cm^{-3})/8.86 g cm^{-3} × 100% = 5.3% %D is greater than %U therefore the coin is not made from cupronickel.	(1) (1) (1) (1)	**4**
			Total for Question 1 =12

Question number	Answer		Mark
2(a)	Any **ONE** from: Avoid looking directly into the laser beam Avoid using reflective surfaces	 (1) (1)	**1**
2(b)	Minima are produced when the two coherent waves arrive out of phase and destructive interference occurs.	(1) (1)	**2**
2(c)	Doubling *D* will halve its percentage uncertainty (As *D* and λ are constant) *s* also doubles **Or** (As *D* and λ are constant) the percentage uncertainty in *s* also halves (Hence) the percentage uncertainty in *d* will be halved	(1) (1) (1)	**3**
			Total for Question 2 = 6

Question number	Answer **Note: this is to be marked holistically**		Mark
3(a)	Measure the potential difference **and** current With corresponding values of light intensity	(1) (1)	**2**
3(b)	Circuit diagram including a power supply, bulb and means of varying the current Voltmeter and ammeter connected correctly 	(1) (1)	**2**
3(c)	Calculate P from $P = IV$ Plot a graph of P against F^4 As this is in the form $y = mx (+ c)$ If the relationship is valid this will be a straight line through the origin (with a gradient of k) **Or** Calculate P from $P = IV$ Plot a graph of log P against log F As log P = 4log$F$ + log k is in the form $y = mx + c$ If the relationship is valid this will be a straight line with a gradient equal to 4	(1) (1) (1) (1) (1) (1) (1) (1)	**4**
			Total for Question 3 = 8

Question number	Answer	Mark
4(a)	Any **TWO** from: Stir the water (1) Keep the thermometer close to the thermistor (1) Allow the water to cool slowly (1)	**2**
4(b)(i)	Ln R values correct to 3 or 4 sf (1) Axes labelled: y as ln(R/kΩ) and x as θ / °C (1) Suitable scales (1) Plots accurate to ± 1mm (1) Line of best fit (1)	**5**
4(b)(ii)	Calculation using large triangle shown (1) Value of α in range 0.036 to 0.040 (1) Calculated value of α positive and given to 2 or 3 s.f. (1) Unit °C^{-1} (1) <u>Example of calculation</u> gradient = $\frac{2.0-0}{15-68} = \frac{2}{-53}$ = –0.0377 α = 0.038 °C^{-1}	**4**
4(b)(iii)	Use of $R=V/I$ to determine current through thermistor (1) Use of $R=V/I$ to determine resistance of resistor (1) Correct value of resistance to 2 or 3 s.f. with unit (1) <u>Example of calculation</u> $I = V/R_0$ = 5 V/13.1 kΩ = 0.382 mA $R_1 = V/I$ = 1 V/ 0.381 mA = 2.6 kΩ	**3**
		Total for Question 4 = 14

θ / °C	R / kΩ	ln (R / kΩ)
80	0.625	-0.470
65	1.11	0.104
50	1.95	0.668
35	3.46	1.241
20	6.11	1.810
5	10.80	2.380
0	13.10	2.573



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