

Mark Scheme (Results)

January 2019

Pearson Edexcel International Advanced Level
In Physics (WPH06)
Paper 01 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 veing 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**

[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 sugn in front of number as direction.]

This has a clear statement of the principle of 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 the 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 advise 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 cause the final calculation mark to be lost.

2.2 Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.

2.3 There will be no unit error penalty applied in 'show that' questions or in any other question where the units to be used have been given.

2.4 The same missing or incorrect unit will not be penalised more than once within a question.

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

Use of an inappropriate numberof 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.

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 candidates demonstrates subsistution 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 the 3rd mark; if conversion to kg is omitted then the answer is fudged, do not give 3rd mark]

[Bald answer scores 0, reverse calculation 2/3]

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 the max mark.

6. Graphs

6.1 A mark 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, 4, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two 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.

6.5 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)	An error that adds a constant amount to the measurement **Or** the constant discrepancy between a measured value and the true value	(1)	**1**
1 (a) (ii)	Repeat readings are appropriate To reduce the effects of random error **Or** as ball may not be uniform **Or** as difficult to measure a sphere using vernier calipers **Or** to (identify and) remove anomalous readings	(1) (1)	**2**
1 (a) (iii)	Use of half the range of values %U = 0.46 % (accept 3 sig figs maximum) Value from range = 0.91% scores MP2 only <u>Example of calculation</u> Half range = (6.61 – 6.55) mm/2 = 0.03 mm %U = 0.03 mm × 100 % / 6.58 mm = 0.46 %	(1) (1)	**2**
1 (a) (iv)	V = 149 cm^3 (3 sig fig only) (accept 1.49 × 10^{-4} m^3) Correct calculation of %U from 3 × %U in d (ecf from (a) (iii)) Correct calculation of U using calculated values of V and %U to 1/2 sig fig <u>Example of calculation</u> $V = 4 \times \pi \times (6.58/2 \text{ cm})^3/3 = 149 \text{ cm}^3$ %U = 3 × 0.46 % = 1.4 % U = 149 cm^3 × 1.4 / 100 = 2 cm^3 V = 149 ± 2 cm^3	(1) (1) (1)	**3**
1 (b) (i)	Use of volume of tube as $\pi r^2 l$ (accept $d/2$ for r) Use of $l = 8r$ (accept $4d$) Clear algebra to show ratio of 2/3 <u>Example of calculation</u> Volume of tube = $\pi r^2 l = 8\pi r^3$ Packing fraction = $\frac{4\times4\pi r^3}{3\times8\pi r^3} = \frac{2}{3}$	(1) (1) (1)	**3**
1 (b) (ii)	Packing fraction = 0.58 (ecf volume from (a) (iv)) %U in packing fraction = 4.2% (ecf for %U in (a) (iv)) Correct calculation of upper and/or lower limit (ecf MP2) Comment comparing to 0.67 (dependent on MP3) <u>Example of calculation</u> Packing fraction = 4 × 149 cm^3/1020 cm^3 = 0.58 %U = (8 cm^3×100%/596 cm^3) + (30 cm^3×100 %/1020 cm^3) = 1.3% + 2.9% = 4.2 % Upper limit = 0.58 × 104.2 % = 0.60 0.67 is outside the upper limit so packing fraction is not 2/3.	(1) (1) (1) (1)	

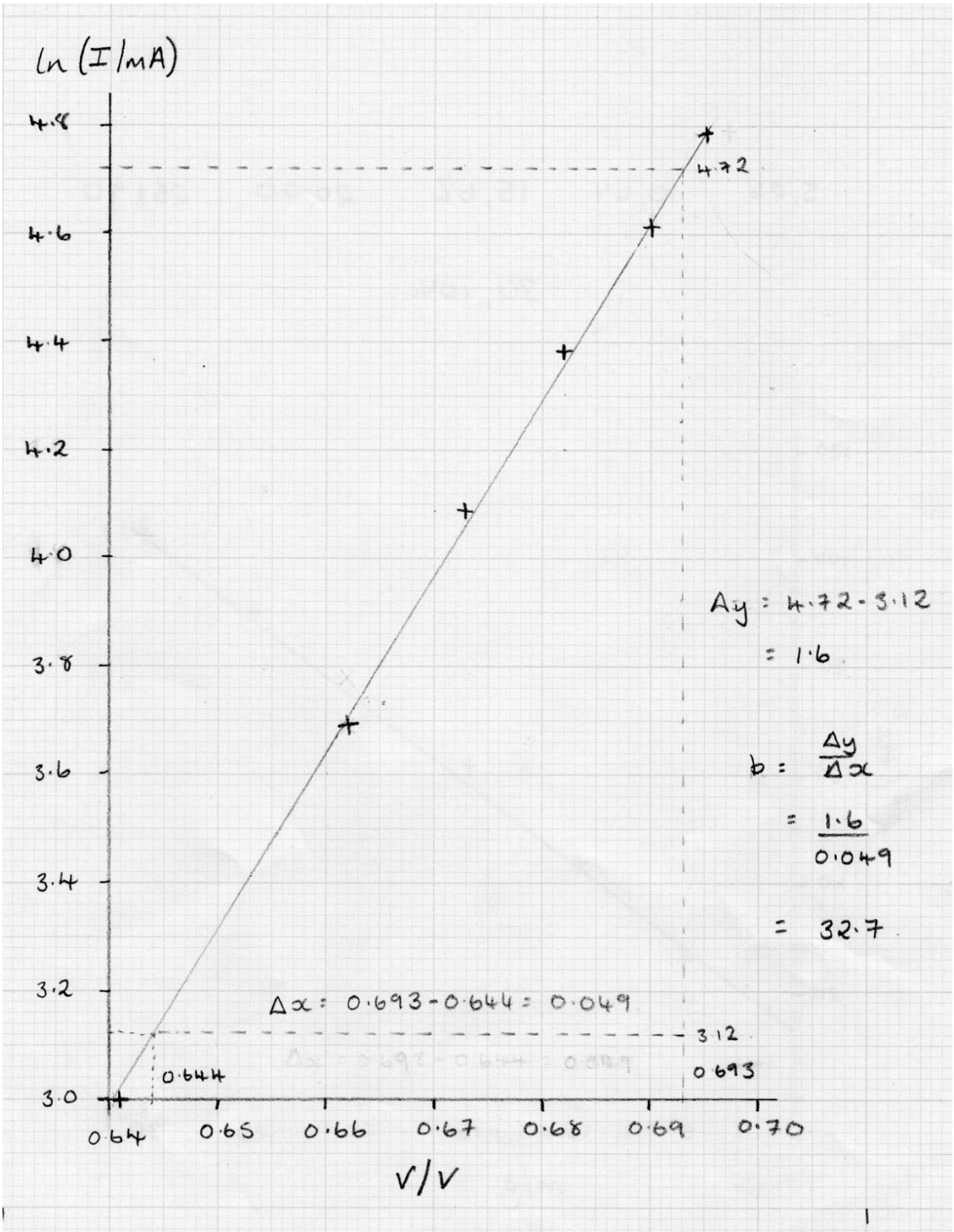
	Or (1) Packing fraction = 0.58 (ecf volume from (a) (iv)) (1) %U in packing fraction = 4.2% (ecf for %U in (a) (iv)) Correct calculation of %D comparing packing fraction to 2/3 shown (ecf from MP1) (1) Comment comparing %D with %U (dependent on MP3) (1) <u>Example of calculation</u> Packing fraction = $4 \times 149\ cm^3/1020\ cm^3 = 0.58$ %U = $(8\ cm^3 \times 100\%/596\ cm^3) + (30\ cm^3 \times 100\ \%/1020\ cm^3)$ = 1.3% + 2.9% = 4.2 % %D = $(0.67 - 0.58)/0.67 \times 100\% = 13.4\%$ %D > %U so packing fraction is not 2/3.	**4**
	Total for Question 1	**15**

Question Number			Mark
2 (a)	Identifies resolution of protractor as 1° **and** metre rule as 1mm (accept resolution of protractor as 0.5°) %U in α using stated protractor resolution %U in ratio h / s using metre ruler resolution of 1mm Correct statement comparing calculated values <u>Example of calculation</u> %U in α = 1°/5° × 100 = 20% %U in ratio h / s = 0.1cm/8.7cm × 100 + 0.1cm/100cm × 100 = 1.1+0.1 = 1.2 % Student B method is more suitable as %U is lower than Student A	(1) (1) (1) (1)	**4**
2 (b)	Mark zero point in sand directly below table edge (using metre rule and set square **Or** plumb line) **Or** align edge of sand tray with the table edge (with metre rule and set square **Or** plumb line) Measure (perpendicular) distance to marble centre (of mass) Accept reasonable methods	(1) (1)	**2**
	Total for Question 2		**6**

Question Number	Answer		Mark
3 (a)	When driving frequency is close to/at natural frequency Maximum energy transfer occurs **Or** maximum amplitude occurs	(1) (1)	**2**
3 (b)	$f^2 = k^2 m$ is in the form $y = mx$ (+ c) **Or** $f^2 = k^2 m$ shows that f^2 is directly proportional to m Hence the graph is a straight line (which supports the prediction) Since c = 0 the graph should pass through the origin **Or** but there is a non-zero y-intercept Hence this does not support the prediction **Or** there is an extra constant in the relationship **Or** there is a systematic error in a measurement. [MP2 dependent on MP1, MP4 dependent on MP3]	(1) (1) (1) (1)	**4**
	Total for Question 3		**6**

Question Number	Answer		Mark
4 (a) (i)	The voltmeter has a large/infinite resistance So potential difference across diode is too small Hence the diode does not conduct so there is no current in the lamp **Or** The voltmeter has a large/infinite resistance So there is negligible current through the voltmeter Hence, as the bulb is in series with the voltmeter the current will be too small for the lamp to light	(1) (1) (1) (1) (1) (1)	**3**
4 (a) (ii)	Place voltmeter in parallel with diode (accept remove voltmeter)	(1)	**1**
4 (b)	$\ln(I) = bV + \ln(a)$ This is in the form $y = mx + c$ where the gradient is b (which is constant) [MP2 dependent on MP1]	(1) (1)	**2**
4 (c) (i)	Ln(I) values correct to 3 sig figs Axes labelled with y as ln (I/mA) and x as V / V Suitable scales chosen for ln (I) and V All processed data plotted accurately to ± 1mm Line of best fit	(1) (1) (1) (1) (1)	**5**
4 (c) (ii)	Correct calculation using large triangle shown Correct b to 2/3 sig figs with unit of V^{-1} <u>Example of calculation</u> $b = \frac{4.72-3.12}{0.693V-0.644V} = \frac{1.6}{0.049V} = 32.7\ V^{-1}$ **Or** Correct calculation using value of y intercept and a data point over half way on best fit line shown Correct b to 2/3 sig figs with unit of V^{-1}	(1) (1)	**2**
	Total for Question 4		**13**

V / V	I / mA	ln (I / mA)
0.641	20	3.00
0.662	40	3.69
0.673	60	4.09
0.682	80	4.38
0.690	100	4.61
0.695	120	4.79



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