Mark Scheme (Results)

October 2020

Pearson Edexcel International Advanced Subsidiary/Advanced Level
In Physics (WPH016)
Paper 1: Practical Skills in Physics II

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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)	**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 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
$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$
$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$
$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg} = 49.4 \text{ N}$

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.

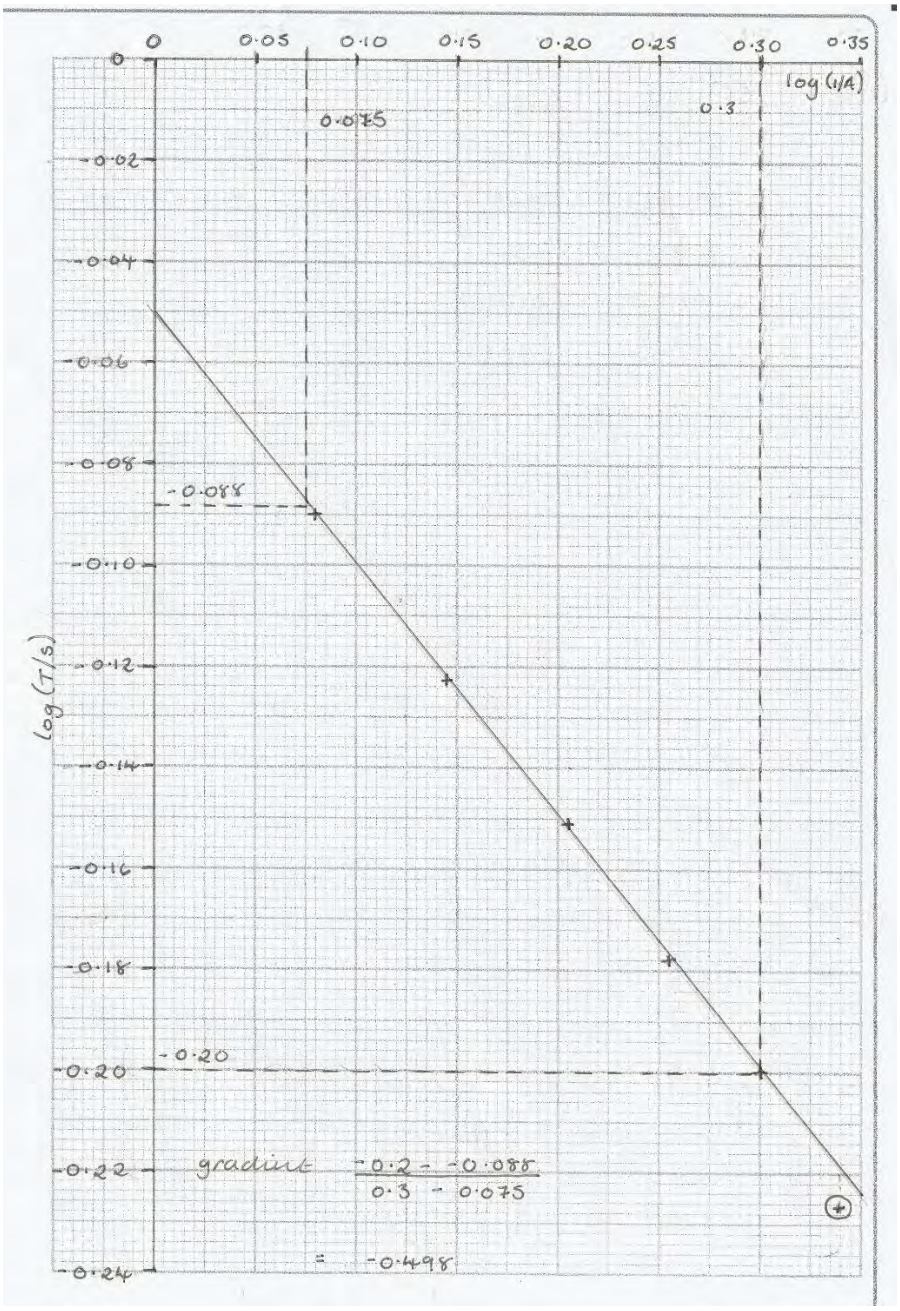
5.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question number	Answer		Mark
1(a)	Gently push the glider and check that the times to go through each light gate are similar **Or** Put a glider on the track and check it remains stationary **Or** Use a rule and/or set square to check the height of the track is the same in two places **Or** Use a spirit level to check the bubble is central [accept any valid safe alternative practical method]	(1) (1) (1) (1)	1
1(b)	Use of $t_2 = 2t_1$ Three correct calculations shown Conclusion consistent with calculation <u>Example of calculation</u> 0.70/0.34 = 2.06 0.39/0.21 = 1.86 0.55/0.28 = 1.96 As all values are approximately equal to 2 then momentum was conserved.	(1) (1) (1)	3
1(c)	(If the card is twice as long) the time should double The resolution of the timer is constant **Or** the uncertainty is constant So the percentage uncertainty for the time will halve, improving the investigation	(1) (1) (1)	3
			Total mark for Question 1 = 7

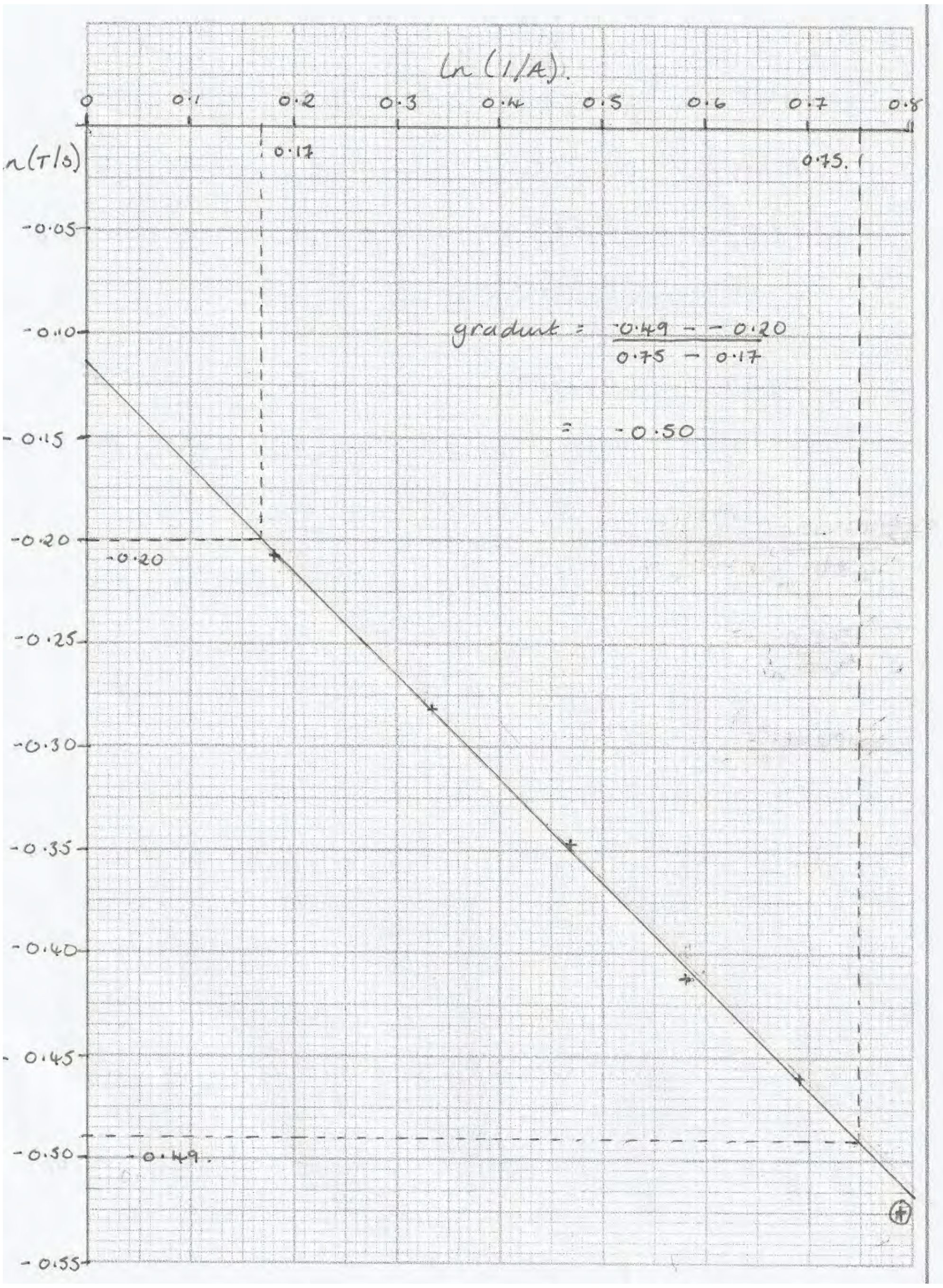
Question number	Answer		Mark
2	Any **SIX** from:		
	Measure the background count (rate)	(1)	
	Ensure the source and detector are in line	(1)	
	Use a metre rule to measure *d*	(1)	
	Measure the count (rate) several times **and** calculate a mean **Or** measure the count (rate) over a long time	(1)	
	Subtract the background count (rate)	(1)	
	Repeat for values of values of *d* up to 50 mm **Or** repeat until the count rate reaches the background count (rate)	(1)	
	Plot a graph of (corrected) count (rate) vs *d*	(1)	
	Sensible comment on safety based on distance, shielding or time	(1)	**6**
			Total mark for Question 2 = 6

Question number	Answer		Mark
3(a)	Any **THREE** from		
	Measure multiple oscillations and divide by the number of oscillations	(1)	
	Repeat **and** calculate a mean	(1)	
	Use a timing marker (at the centre of the oscillations)	(1)	
	Start timing after several oscillations have completed	(1)	**3**
3(b)(i)	Variable resistor	(1)	**1**
3(b)(ii)	log T = n log I is in the form of $y = mx$ (+ c)	(1)	
	(hence if the relationship is valid) it will be a straight line (through the origin) with a gradient of n	(1)	**2**
3(c)(i)	log$I$ values correct with minimum 2 decimal places	(1)	
	log$T$ values correct and minimum 2 decimal places	(1)	
	Axes labelled: y as log(T / s) and x as log (I / A)	(1)	
	Most appropriate scales for both axes	(1)	
	Plots accurate to ± 1mm	(1)	
	Best fit line with even spread of plots	(1)	**6**
3(c)(ii)	Correct calculation of gradient using large triangle shown	(1)	
	Value of n in range 0.49 to 0.53	(1)	
	Value of n given to 2 or 3 s.f., negative, no unit	(1)	**3**
	<u>Example of calculation</u>		
	$n = \frac{-0.2 - -0.088}{0.3 - 0.075} = \frac{-0.112}{0.225} = -0.498$		
3(c)(iii)	log T = $n$log$I$ + log$k$	(1)	
	is in the form of $y = mx + c$	(1)	
	The graph shows a (non-zero) y intercept	(1)	
	Hence the value of k is not equal to 1 (so the prediction is correct) **Or** the value of c is not zero (so the prediction is correct)	(1)	**4**
			Total mark for Question 3 = 19

I/A	T/s	log(I/A)	log(T/s)
1.20	0.813	0.079	-0.090
1.40	0.754	0.146	-0.123
1.60	0.706	0.204	-0.151
1.80	0.663	0.255	-0.178
2.00	0.631	0.301	-0.200
2.20	0.593	0.342	-0.227



I/A	*T*/s	ln(*I*/A)	ln(*T*/s)
1.20	0.813	0.182	-0.207
1.40	0.754	0.336	-0.282
1.60	0.706	0.470	-0.348
1.80	0.663	0.588	-0.411
2.00	0.631	0.693	-0.460
2.20	0.593	0.788	-0.523



Question number	Answer		Mark
4(a)(i)	Digital / vernier calipers	(1)	**1**
4(a)(ii)	Any **PAIR** from: Check for zero error to eliminate <u>systematic</u> error **OR** Repeat at different places **and** calculate a mean to reduce the effect of <u>random</u> errors [MP2 dependent on MP1]	 (1) (1) (1) (1)	**2**
4(a)(iii)	area of slot = <u>1.03</u> (cm^2) Calculation of U shown U = 0.02 (cm^2) [d.p. consistent with area] <u>Example of calculation</u> Area of slot = $a \times b$ = 0.47 cm × 2.19 cm = 1.03 cm^2 %U in Area = (0.01/0.47) × 100 + (0.005/2.19) × 100 = 2.13% + 0.23% = 2.4% U = 1.03 cm^2 × 2.4% = 0.02 cm^2 Area of slot = 1.03 cm^2 ± 0.02 cm^2	(1) (1) (1)	**3**
4(b)(i)	Use of area = $\pi d^2/4$ Area = 10.4 (cm^2) [ecf 4(a)(iii) 3 s.f. only] <u>Example of calculation</u> Whole area = $\pi d^2/4 = \pi \times (3.81\text{ cm})^2/4$ = 11.4 cm^2 Shaded area = whole area – area of slot = 11.4 cm^2 – 1.03 cm^2 = 10.4 cm^2	(1) (1)	**2**
4(b)(ii)	Calculation of %U in d using 0.005 shown Double %U in d shown U= 0.05 (cm^2) [ecf 4(a)(iii)] <u>Example of calculation</u> %U in d^2 = 2 × 0.005/3.81 × 100 = 0.26% U in whole area = 11.4 cm^2 × 0.26% = 0.03 cm^2 U in shaded area = 0.03 cm^2 + 0.02 cm^2 = 0.05 cm^2	(1) (1) (1)	**3**

4(c)(i)	Use of $\rho = \frac{m}{V}$ ρ = 8.47 (g cm^{-3}) [ecf 4(b)(i), 3 s.f. only] <u>Example of calculation</u> V = 10.4 cm^2 × 1.137 cm = 11.8 cm^3 ρ = 100 g / 11.8 cm^3 = 8.47 g cm^{-3}	(1) (1)	**2**
4(c)(ii)	Calculation of half range in *t* shown Addition of %U in *t* and %U in shaded area shown % U in ρ = 0.66% [ecf 4(b)(ii)] <u>Example of calculation</u> Half range in *t* = (11.39 – 11.35)/2 = 0.02 mm %U in *t* = (0.02/11.37) × 100 = 0.18% % U in shaded area = (0.05/10.4) × 100 = 0.48% % U in ρ = 0.18% + 0.48% = 0.66%	(1) (1) (1)	**3**
4(d)	Correct calculation of upper and/or lower limit shown [ecf 4(c)] With comparison of limit with value for brass and valid conclusion based on comparison **OR** Correct calculation of %D shown [ecf 4(c)] Comparison of %D with %U and valid conclusion based on comparison <u>Example of calculation</u> Uncertainty in $\rho = 8.47$ g cm^{-3} × 0.66% = ± 0.06 g cm^{-3} Range of ρ ισ 8.41 g cm^{-3} to 8.53 g cm^{-3} The value for brass lies within this range therefore the mass could be made of brass **OR** Uncertainty in $\rho = 8.47$ g cm^{-3} × 0.66% = ± 0.06 g cm^{-3} %D = $\frac{8.5-8.47}{8.5}$ × 100% = 0.35% As the %D is less than the %U the mass could be made of brass	(1) (1) (1) (1)	**2**
			Total mark for Question 4 = 18