Pearson Edexcel

Mark Scheme (Results)

June 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:

<u>'Show that' calculation of weight</u>

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:

$80\text{ cm} \times 50\text{ cm} \times 1.8\text{ cm} = 7200\text{ cm}^3$

$7200\text{ cm}^3 \times 0.70\text{ g cm}^{-3} = 5040\text{ g}$

$5040 \times 10^{-3}\text{ kg} \times 9.81\text{ N/kg}$

$= 49.4\text{ N}$

5. 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)	To ensure (the conditions for) SHM **Or** To ensure angle is small **Or** To ensure the time period is independent of amplitude	(1) (1) (1)	**1**
1 (a)(ii)	Velocity is at a maximum (So) uncertainty in time is reduced **Or** This is the (only) fixed point (in the oscillation) Whereas amplitude may vary (because of damping)	(1) (1) (1) (1)	**2**
1 (b)(i)	Mean $10T$ / s = <u>10.24</u> Calculation of mean T / s from value of $10T$ with consistent sig figs	(1) (1)	**2**
1 (b)(ii)	Use of half range (Accept furthest from mean) %U = 0.83 % (Accept 0.8%, 0.830%. Allow ecf (b) (i)) (Whole range scores MP2 only) <u>Example of calculation</u> Half range = (10.32 s – 10.15 s)/2 = 0.085 s %U = 0.085 s × 100 % / 10.24 s = 0.83 %	(1) (1)	**2**
1 (c)(i)	Correct expression for T^2 Clear logical method using formula for T to arrive at value of 2 <u>Example of calculation</u> $T_s^2 = 4\pi^2 l/g$ $T_d^2 = 4\pi^2 (2l)/g = 8\pi^2 l/g$ $T_d^2 / T_s^2 = 8\pi^2 l/g \div 4\pi^2 l/g = 2$	(1) (1)	**2**
1 (c)(ii)	Calculation of T_d^2 / T_s^2 (= 2.04) (ecf from (b) (i)) Calculation of %U in ratio (= 3.2%) (ecf for 2 × %U in (b) (ii)) Correct calculation of upper or lower limit of calculated ratio using %U Comment comparing correct limit to 2 <u>Example of calculation</u> $T_d^2 / T_s^2 = 1.461^2/1.024^2 = 2.135/1.049 = 2.04$ %U = 2 × 0.83 % + 2 × (0.011 s ×100 %/1.461 s) = (1.7+1.5)% = 3.2% Lower limit = 2.04 × (100 – 3.2)% = 1.97 2 is within the lower limit so measurements support the prediction.	(1) (1) (1) (1)	

	Or Calculation of T_d^2 / T_s^2 (= 2.04) (ecf from (b) (i)) (1) Calculation of %U in ratio (= 3.2%) (ecf for 2 × %U in (b) (ii)) (1) Correct calculation of %D shown (1) Comment comparing correct values of %D with %U (1) <u>Example of calculation</u> $T_d^{\ 2}$ / T_s^2 =$1.461^2/1.024^2$= 2.135/1.049= 2.04 %U = 2 × 0.83 % + 2 × (0.011 s ×100 %/1.461 s) = (1.7 + 1.5)% = 3.2% %D = (2.04 − 2)/2 × 100% = 2 % %D is less than %U so measurements support the prediction.	**4**
	Total for Question 1	**13**

Question Number	Note that 2 (b) is to be marked holistically.		Mark
2 (a)	The alternating current generates an alternating magnetic field/flux (Hence) there is a (rate of) change of flux linkage/cutting with the secondary coil	(1) (1)	2
2 (b)	(i) *a circuit diagram to show how the primary coil should be connected with any additional components required,* A correct electrical circuit diagram including a coil, an a.c. power supply **and** ammeter (ii) *the measurements to be made with any additional apparatus required* (Induced) e.m.f. across secondary coil with voltmeter/oscilloscope (at corresponding) distance (from centre of coil) with metre rule **Or** vernier calipers Current using an ammeter **Or** number of coils (iii) *the graph to be plotted and how it would be used to determine k* Plot V against $1/d^3$ (Determine k from) gradient = kNI	(1) (1) (1) (1) (1) (1)	

Examples of alternative graphs:

y	*x*	*gradient*	*k*
V/I	$1/d^3$	kN	= gradient/N
V/N	$1/d^3$	kI	= gradient/I
V/NI	$1/d^3$	k	= gradient
log(V)	log(d)		intercept = log (kNI)

	(iv) *a statement of the main source of uncertainty* The secondary coil is not parallel to primary coil or changes alignment **Or** Measurement of d as it is difficult to align the ruler **Or** Measurement of d as it is cubed hence %U is tripled	(1)	7
	Total for Question 2		**9**

Question Number	Answer		Mark
3 (a) (i)	Maximum value on best fit line between 820 nm and 835 nm by eye Smooth curve drawn through points	(1) (1)	2
3 (a) (ii)	λ_{max} from their graph with unit	(1)	1
3 (a) (iii)	Use of $T = 2.898 \times 10^{-3} / \lambda_{max}$ Correct value to 3 sf with unit of K (e.c.f from (a)(ii)) Example of calculation $\lambda_{max} = 2.898 \times 10^{-3} / T = 2.898 \times 10^{-3} / 830 \times 10^{-9} = 3490$ K	(1) (1)	2
3 (b)	**Max 2** No repeats shown Not enough readings around the maximum value Best fit line is uncertain as it is a curve (Ignore data not even)	 (1) (1) (1)	2
	Total for Question 3		**7**

Question Number	Answer		Mark
4 (a)	Background count rate is a predictable/constant value (hence) is a <u>systematic</u> error (which can be subtracted)	(1) (1)	2
4 (b)	$\ln(C) = -\mu x + \ln(C_0)$ Compares to $y = mx + c$ where the gradient is $-\mu$ (which is constant) MP2 dependent on MP1	(1) (1)	2
4 (c) (i)	Ln(C) values correct to 3 or 4 sig figs Axes labelled with y as ln (C/s^{-1}) and x as x / mm Suitable scales chosen All plots accurate to ± 1mm Line of best fit	(1) (1) (1) (1) (1)	5
4 (c) (ii)	Calculation of gradient using a large triangle Correct μ given to 2 or 3 sig figs, positive with unit <u>Example of calculation</u> $\mu = -\frac{(4.89-4.17)}{(1-14)\text{mm}} = -\frac{0.72}{-13} = 5.54 \times 10^{-2}\ \text{mm}^{-1}$ **Or** Calculation of μ from the formula using a pair of points from best fit line (at least half the line used) Correct μ given to 2 or 3 sig figs, positive with unit	(1) (1) (1) (1)	2
	Total for Question 4		**11**

x / mm	C / s^{-1}	ln (C / s^{-1})	ln (C / s^{-1})
1.52	132	4.88	4.883
3.89	112	4.72	4.718
6.81	95	4.55	4.554
9.33	86	4.45	4.454
11.48	74	4.30	4.304
13.70	67	4.20	4.205