Pearson Edexcel

Mark Scheme (Results)

October 2018

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

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

October 2018
Publications Code WPH06_01_MS_1810

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 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 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 one 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**
   - 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.

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:

<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 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] **3**
[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. **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 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) (i)	Mean t = <u>2.33 s</u> <u>Example of calculation</u> Mean t = (2.37 + 2.33 + 2.36 + 2.29 + 2.32) s / 5 = 2.33 s	(1)	**1**
1 (a) (ii)	½ range used (0.04 s) %U in mean t = 1.7 % [e.c.f. 1(a)(i)] [Accept 1.72%, 2%] [If whole range used only MP2 can be awarded] <u>Example of calculation</u> ½ range for t = (2.37 – 2.29) s / 2 = 0.04 s %U for t = 0.04 s × 100 / 2.33 s = 1.7%	(1) (1)	**2**
1 (b) (i)	The resolution of the rule is 1 mm The measurements are subtracted so the (absolute) uncertainties are added	(1) (1)	**2**
1 (b) (ii)	g = 9.7 m s^{-2} [Accept 9.71 m s^{-2}] [Allow e.c.f. from 1(a)(i)] <u>Example of calculation</u> $g = \dfrac{14 \times (0.800\text{ m})^2}{5 \times (2.33\text{ s})^2 \times 3.4 \times 10^{-2}\text{m}}$ = 9.7 m s^{-2}	(1)	**1**
1 (b) (iii)	Calculation of %U in s **and** Δh shown Doubles %U in t **and** s shown %U in g = 9.6 % [Accept 10%] [Allow ecf from 1(a) (ii)] <u>Example of calculation</u> %U in s = 0.001 m × 100 / 0.8 m = 0.125 % %U in Δh = 0.2 cm × 100 / 3.4 cm = 5.88 % %U in g = (2 × 1.72) + (2 × 0.125) + 5.88 = 3.44 + 0.25 + 5.88 = 9.57 = 9.6 %	(1) (1) (1)	**3**
1 (b) (iv)	Correct calculation of upper limit and/or lower limit shown [Allow ecf from 1(b) (ii) and 1(b) (iii)] Valid comment comparing accepted value of g and upper/lower limit [MP2 dependent on MP1] <u>Example of calculation</u> Upper limit = 9.7 m s^{-2} × 1.096 = 10.6 m s^{-2} The accepted value of g is within the range therefore the value is accurate.	(1) (1)	

	Or Correct calculation of %D shown [Allow ecf from 1(b) (ii) and 1(b) (iii)] (1) Valid comment comparing %D with %U (1) [MP2 dependent on MP1] <u>Example of calculation</u> $\%D = \frac{(9.81 - 9.7)\ \text{m s}^{-2}}{9.81\ \text{m s}^{-2}} \times 100\ \% = 1.1\ \%$ %D is less than %U so value is accurate	**2**
1 (c)	**Max 2** Light gates will eliminate (human) reaction time (1) So percentage uncertainty (in *t*) is reduced [MP2 dependent on MP1] (1) Light gates are difficult to use with small objects. [Accept sensible suggestion relating to not measuring from centre of mass] (1) Percentage uncertainty in Δh is more significant (in the calculation) so improvement will be small (1)	**2**
	Total for question 1	**13**

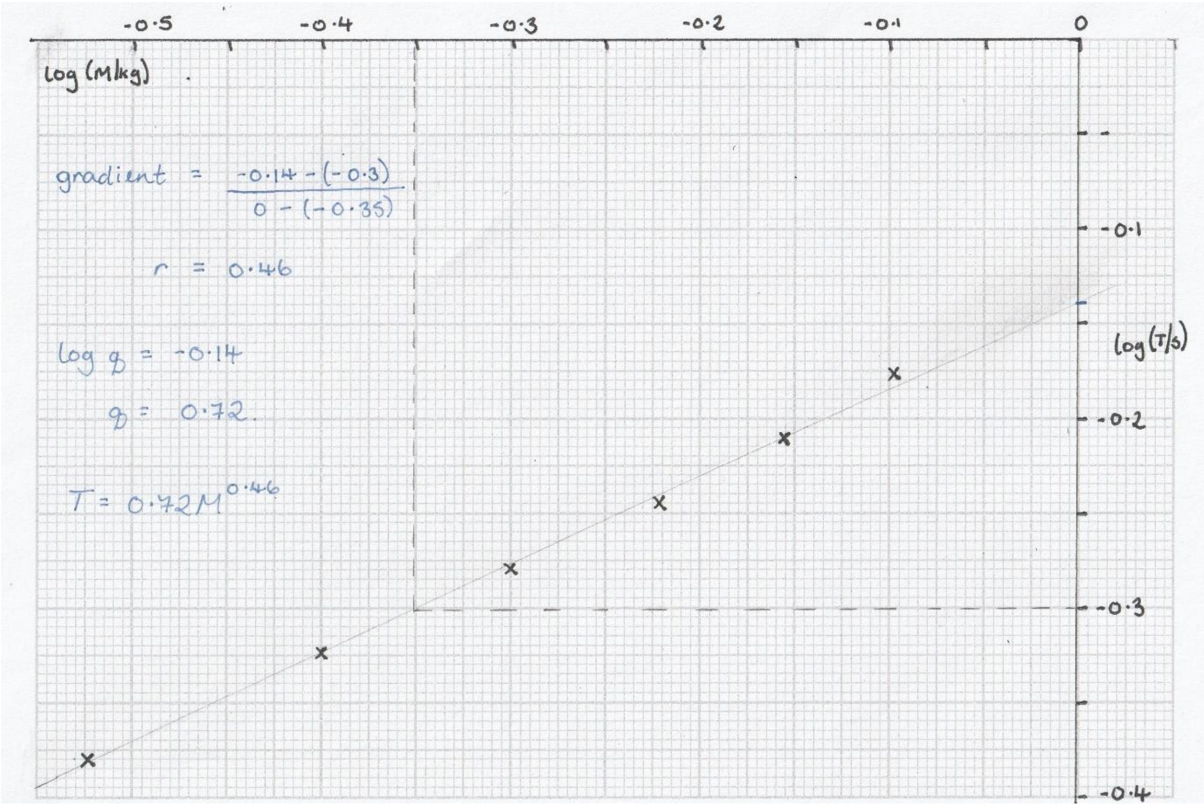
Question Number		Mark
2 a	Micrometer screw gauge **Or** <u>digital</u> (vernier) calipers with resolution 0.01 mm (1) Percentage uncertainty is 1 % which is small (1)	**2**
2 b	Distance between the source and Geiger-Muller tube (1)	**1**
2 c	Subtract the background count (rate) from measured count (rate) (1) Record the counts for a long period of time **Or** repeat and calculate a mean (1)	**2**
2 d	Any **one** from: Minimise time of use Store in a lead-lined box Do not point source towards the body Use forceps/tongs to handle the source (1) [Do not accept comments related to protective clothing or goggles]	**1**
	Total for question 2	**6**

Question Number	Answer		Mark
3 (a)	Manipulation of formula to give $C = 2W / V^2$ **Or** $C/2 = W / V^2$ **Or** states W / V^2 is constant Three values calculated correctly Comment consistent with calculated values <u>Example of calculation</u> $2 \times 8.47 \times 10^{-3}$ J / (6.0 V)^2 = 4.71×10^{-4} $2 \times 4.76 \times 10^{-3}$ J / (4.5 V)^2 = 4.70×10^{-4} $2 \times 2.11 \times 10^{-3}$ J / (3.0 V)^2 = 4.69×10^{-4}	(1) (1) (1)	3
3(b)(i)	Time taken for charge/potential difference to fall to 1/*e* **Or** 37 % of initial value **Or** Time taken for charge/potential difference to fall by (1 – 1/*e*) **Or** 63% of initial value	(1) (1)	1
3 (b)(ii)	Use graph to determine time constant **Or** $t_{½}$ **Or** coordinates of two points R = 200 kΩ [Allow e.c.f from 3(a)] <u>Example of calculation</u> $R = \frac{95 \text{ s}}{4.7 \times 10^{-4} \text{ F}} = 202 \times 10^3\ \Omega$	(1) (1)	2
	Total for question 3		**6**

Question Number	Answer		Mark
4 (a)	Use the marker to determine start and end of oscillation more accurately Use multiple oscillations to reduce the percentage uncertainty Repeat and calculate mean to reduce the effect of random errors	(1) (1) (1)	**3**
4 (b)	log *T* = *r* log *M* + log *q* is in the form *y* = m*x* + c Gradient = *r* (which is constant)	(1) (1)	**2**
4 (c) (i)	log *M* values correctly calculated to 3 or 4 sf log *T* values correctly calculated to 3 or 4 sf Axes labelled: *x* axis as log(*M*/kg), *y* axis as log(*T*/s) [if ln values calculated the label must be ln] Suitable scales used. At least half grid used in **both** directions Log values plotted accurately Best fit line drawn to *x* = 0	(1) (1) (1) (1) (1) (1)	**6**
4 (c) (ii)	Calculation of gradient using large triangle shown Correct value of *r* (positive, no unit) Correct value of *q* States relationship using calculated values of *q* and *r* [Accept constants to maximum 3 SF, accept √ for *r*] Example of calculation $r = \frac{-0.14 - -0.3}{0 - -0.35} = 0.46$ log *q* = –0.14, $q = 10^{-0.14} = 0.72$ $T = 0.72\ M^{0.46}$	(1) (1) (1) (1)	**4**
	Total for question 4		**16**

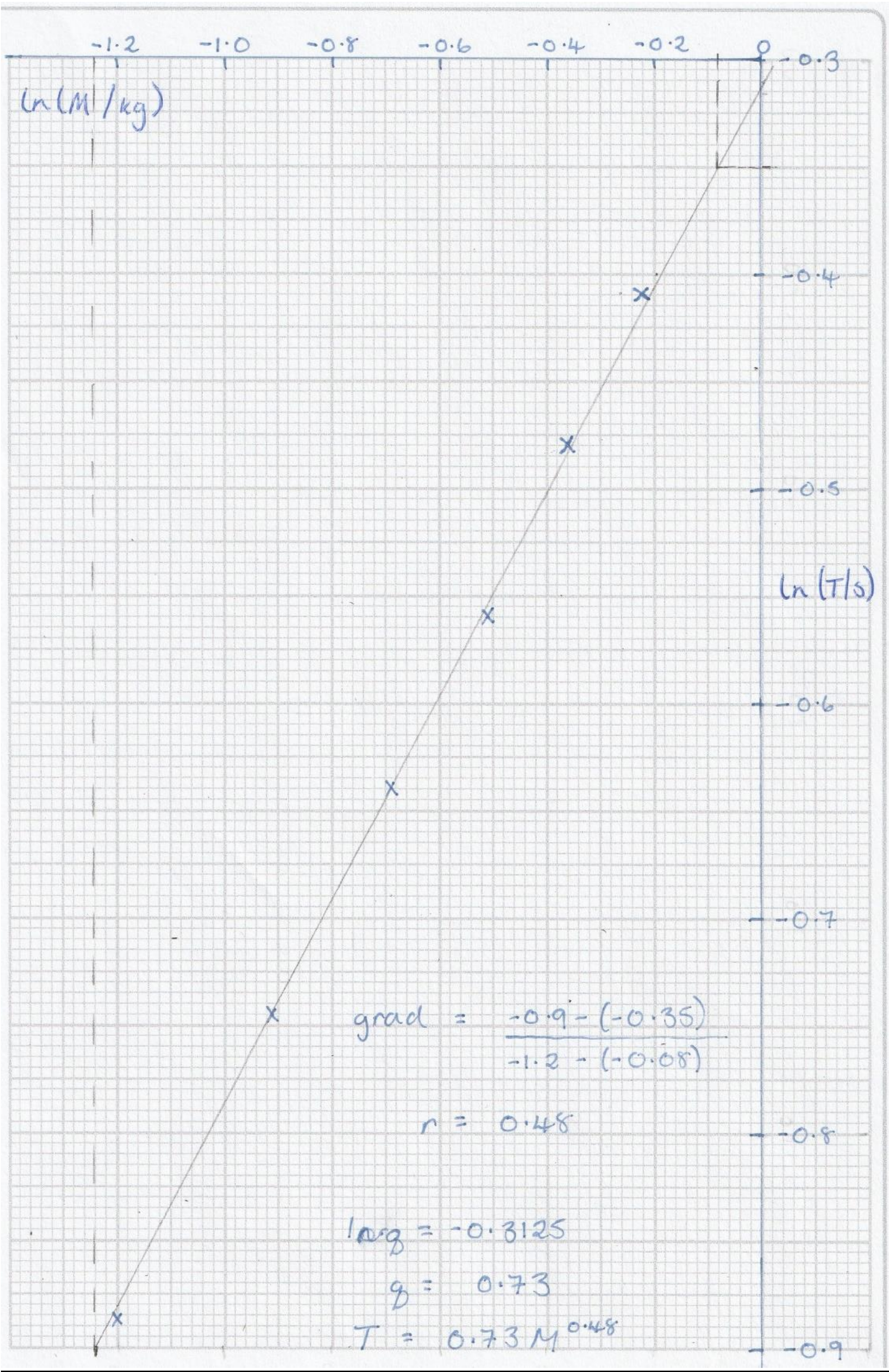
Use of log values

m/kg	T/s	log M	log T	log M	log T
0.300	0.416	-0.523	-0.381	-0.5229	-0.3809
0.400	0.475	-0.398	-0.323	-0.3979	-0.3233
0.500	0.526	-0.301	-0.279	-0.3010	-0.2790
0.600	0.570	-0.222	-0.244	-0.2218	-0.2441
0.700	0.618	-0.155	-0.209	-0.1549	-0.2090
0.800	0.664	-0.0969	-0.178	-0.09691	-0.1778



Use of ln values

m/kg	T/s	ln M	ln T	ln M	ln T
0.300	0.416	-1.20	-0.877	-1.204	-0.8771
0.400	0.475	-0.916	-0.744	-0.9163	-0.7444
0.500	0.526	-0.693	-0.642	-0.6931	-0.6425
0.600	0.570	-0.511	-0.562	-0.5108	-0.5621
0.700	0.618	-0.357	-0.481	-0.3567	-0.4813
0.800	0.664	-0.223	-0.409	-0.2231	-0.4095



Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom