Pearson Edexcel

Mark Scheme (Results)

October 2022

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH13)
Paper 01: Unit 3 Practical Skills in Physics I

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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.

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. ‘<u>resonance</u>’

1.2 Bold lower case will be used for emphasis e.g. ‘**and**’ when two pieces of information are needed for 1 mark.

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 This does not apply in ‘show that’ questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in ePen.

2.4 Occasionally, it may be decided not to insist on a 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.

2.5 The mark scheme will indicate if no unit error is to be applied by means of [no ue].

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not be prevent a mark being awarded if the answer given rounds to the answer in the MS.

3.2 Too few significant figures will mean that the final mark cannot be awarded in ‘show that’ questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.

3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.

3.4 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 mean that one mark will not be awarded (but not more than once per clip). Accept $9.8\ m\ s^{-2}$ or $9.8\ N\ kg^{-1}$

3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers may score full marks.

4.2 Some working is expected for full marks to be scored in a 'show that' question or an extended calculation question.

4.3 If a 'show that' question is worth 2 marks, then both marks will be available for a reverse working. If the question is worth 3 marks then only 2 marks will be available.

4.4 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.

4.5 The mark scheme will show a correctly worked answer for illustration only.

5. Quality of Written Expression

5.1 Questions that asses the ability to show a coherent and logically structured answer are marked with an asterisk.

5.2 Marks are awarded for indicative content and for how the answer is structured.

5.3 Linkage between ideas, and fully-sustained reasoning is expected.

6. Graphs

6.1 A mark given 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, 7 etc.

6.4 Points should be plotted to within half a small square.

6.5 Check the two points furthest from the best line.

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

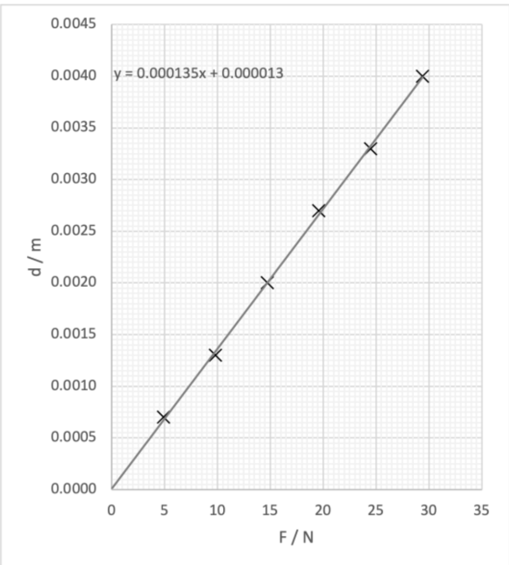
Question Number	Answer	Mark
1(a)(i)	**Mark 1(a)(i) and (ii) holistically to ensure approach used in 1(a)(i) matches the approach used in 1(a)(ii)** • Measures length of top and bottom edges, **and** calculates mean (Accept inclusion of additional measurements taken horizontally) **(1)** • Length of card = 0.065 m **(1)** <u>Example of calculation</u> Length of top edge = 6.6 cm Length of bottom edge = 6.4 cm Mean length = (6.6 cm + 6.4 cm)/2 = 6.5 cm	**2**
1(a)(ii)	**EITHER** • Use of half the range of values if multiple length values measured **Or** use of max distance from the mean if multiple length values measured **(1)** • % uncertainty = 1.5% (accept 2%) **(1)** **OR** • Use of half ruler resolution if a single length value is measured/shown in 1(a)(i) **(1)** • % uncertainty = 0.77% (accept 0.8%) **(1)** Accept uncertainty = full the resolution for MP1, giving and answer of 1.5% for MP2 for this approach. Allow e.c.f. from 1(a)(i) for both approaches. <u>Example of calculation</u> Half range = 0.1 cm % uncertainty = (0.1 cm / 6.5 cm) × 100% = 1.5%	**2**
1(b)(i)	• Use of $v = s/t$ **(1)** • v = 0.512 (m s^{-1}) to 3 s.f. **(1)** • Use of $p = mv$ **(1)** • p = 0.140 (kg m s^{-1}) to 3 s.f. **(1)** (accept p recorded to same s.f. as v, if v recorded to 1 or 2 s.f.) <u>Example of calculation</u> $v = s/t$ = 0.105 m / 0.205 s = 0.512 m s^{-1} $p = mv$ = 0.274 kg × 0.512 m s^{-1} = 0.140 kg m s^{-1}	**4**
1(b)(ii)	• Calculates percentage difference between the total momentum before and after **(1)** • The (percentage) difference is small so momentum is conserved **Or** a conclusion consistent with a comparison of student's values **(1)** <u>Example of calculation</u> Percentage difference = ((0.143 kg m s^{-1} – 0.140 kg m s^{-1})/ 0.143 kg m s^{-1}) × 100% Percentage difference = 2.1%	**2**

Question Number	Answer	Mark
1(c)	• Different force could be applied each time **Or** the force could be applied for a different time **(1)** • The time/velocity/momentum/acceleration for the moving glider is likely to be the different for each repeat **(1)** • Increasing uncertainty (in momentum) **(1)** MP3 is dependent on either of MP1 or MP2	3
1(d)	• Light gates and data logger eliminate (human) reaction time **(1)** **Or** using the stopwatch would include a (human) reaction time • Which would reduce the effect of random error (in the time for the glider to travel) **(1)** **Or** reducing the uncertainty (in time for the glider to travel)	2
	Total for question 1	**15**

Question Number	Answer	Mark
2(a)	• (*m* increases so) number of charge carriers increases **(1)** • Since $I = nAvq$, as *n* increases *I* increases **(1)** • The resistance decreases (and resistivity decreases) **(1)** MP3 is dependent on either MP1 or MP2	3
2(b)(i)	• States that points lie on a straight line **(1)** • States that the straight line passes through origin **(1)** • So $1/\rho$ is proportional to *m* **(1)** MP3 dependent on MP1 **and** MP2 If no other marks are awarded, allow only 1 mark for a straight line drawn through the origin and a statement that $1/\rho$ is proportional to *m*.	3
2(b)(ii)	• There are only four data points **(1)** • The range of masses is too small **Or** no data for masses less than 5 g **Or** no data for masses greater than 8 g **(1)**	2
	Total for question 2	**8**

Question Number	Answer	Mark
3(a)(i)	**Mark 3(a)(i) and (ii) holistically** **EITHER** • Measure the height from the paper to the top of the liquid (*v*) **(1)** • Measure the height from the paper to the filament/middle of the bulb (*u* + *v*) **(1)** • Subtract *v* to give *u* **(1)** **OR** • Measure the height from the filament/middle of the bulb to the top of the liquid (*u*) **(1)** • Measure the height from the paper to the filament/middle of the bulb (*u* + *v*) **(1)** • Subtract *u* to give *v* **(1)** **OR** • Measure the height from the paper to the top of the liquid (*v*) **(1)** • Move the ruler so that zero aligns with the lens **(1)** • Measure the distance from the lens to the filament/middle of the bulb (*u*) **(1)**	3
3(a)(ii)	• Identifies relevant source of uncertainty **(1)** • Suggest suitable approach to reduce/eliminate the uncertainty **(1)** <u>Examples</u> • Parallax error when measuring the height of the bulb/lens with the ruler • Use a set square from rule to bulb/lens • Metre rule not vertical • Use a set square to ensure metre rule is perpendicular to the base/paper • Zero error when measuring the height from the lens to the bulb • Check zero on the rule is aligned with top of the liquid • Filament sealed within glass, so cannot measure distance directly • Measure to the middle of the bulb	2

Question Number	Answer		Mark
3(b)(i)	• Use of $P = \frac{1}{u} + \frac{1}{v}$ • P = 4.30 (D) to 3 s.f. <u>Example of calculation</u> $P = \frac{1}{u} + \frac{1}{v}$ $P = \frac{1}{0.615\text{ m}} + \frac{1}{0.374\text{ m}} = 4.2998\text{ D}$ $P = 4.30\text{ D}$	**(1)** **(1)**	**2**
3(b)(ii)	• Use of $P = \frac{n_{\text{lens}} - n_{\text{air}}}{n_{\text{air}}} \left(\frac{1}{r}\right)$ • with n_{air} = 1 • n_{lens} = 1.3 Allow e.c.f from 3(b)(i) <u>Example of calculation</u> mean P = (4.28 D + 4.31 D + 4.30 D)/3 = 4.297 D $n_{\text{lens}} = Pr + 1$ $n_{\text{lens}} = (4.297\text{ D} \times 0.070\text{ m}) + 1$ $n_{\text{lens}} = 1.3$	**(1)** **(1)** **(1)**	**3**
	Total for question 3		**10**

Question Number	Answer		Mark
4(a)	• No repeat measurements • Inconsistent d.p. for d **Or** all values of d should be recorded to the same d.p. **Or** measurements of d are not all recorded to the same resolution (of the device)	**(1)** **(1)**	**2**
4(b)	• Labels axes with quantities and units • Sensible scales • Plotting • Line of best fit  	**(1)** **(1)** **(2)** **(1)**	**5**

F/N	d/ m
4.9	0.0007
9.8	0.0013
14.7	0.002
19.6	0.0027
24.5	0.0033
29.4	0.004

Question Number	Answer		Mark
4(c)(i)	**EITHER** • Re-arranges equation and compares to *y* = *mx* (+ *c*) • Shows that $m = \frac{l^3}{4wh^3E}$ **OR** • Re-arranges equation to $\frac{d}{F} = \frac{l^3}{4wh^3E}$ • States that $\frac{d}{F} = \text{gradient}$ of the graph plotted	**(1)** **(1)** **(1)** **(1)**	**2**
4(c)(ii)	• Calculates gradient using large triangle • Gradient in the range 1.30×10^{-4} to 1.40×10^{-4} (m N^{-1}) <u>Example of calculation:</u> Gradient = (0.0035 – 0.0010) / (26 – 7.5) = 1.35×10^{-4}	**(1)** **(1)**	**2**
4(c)(iii)	• Use of $\text{gradient} = \frac{l^3}{4wh^3E}$ **Or** use of substituted values of *F* and *d* into $E = \frac{l^3F}{4wh^3d}$ • *E* value in the range 2.41 GPa to 2.60 GPa Ecf for gradient value in (c)(ii) – but not power of 10 errors in substitution of *l*, *w*, or *h* <u>Example of calculation:</u> $E = \frac{l^3}{4wh^3m}$ $E = \frac{(0.30\text{ m})^3}{4\times 0.020\text{ m}\times(0.010\text{ m})^3\times 1.35\times10^{-4}\text{ m N}^{-1}} = 2.5\times10^9\text{ Pa}$	**(1)** **(1)**	**2**
4(d)	• A thinner beam would cause a larger *d* (for the same force) • Reducing <u>percentage</u> uncertainty (in *d*) MP2 dependent on MP1	**(1)** **(1)**	**2**
4(e)	• Identifies physics relating to health & safety • Suggests a relevant safety issue <u>Examples</u> • Glass is brittle, so will snap/break • Sharp edges could cause injury by causing cuts • Glass is stiffer, so a larger force/mass would be needed • A large mass could cause injury if the mass falls on feet	**(1)** **(1)**	**2**
	Total for question 4		**17**

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