Pearson

Mark Scheme (Results)

June 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 schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate.

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. 'resonance'

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 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.

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 of the available space and is not an awkward scale e.g., multiples of 3, 7 etc.

5.4 Points should be plotted to within 1 mm.

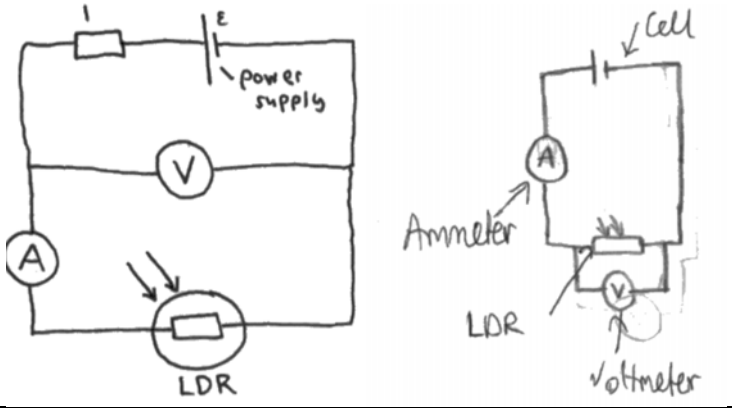
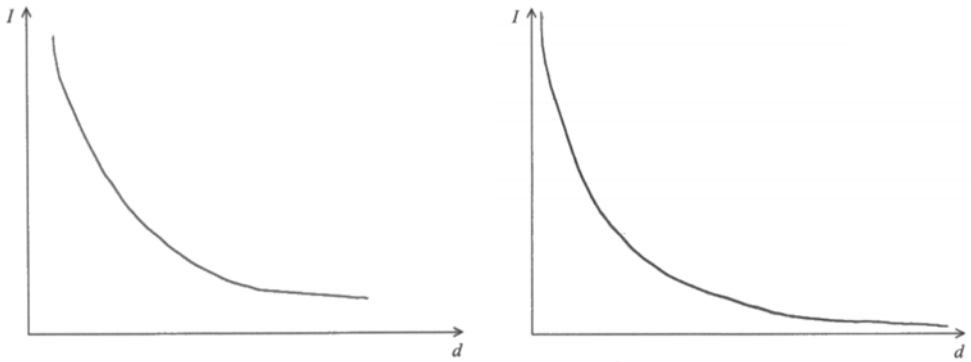
- Check the first and last points and the two points furthest from the best fit line.
  If all are within 1 mm, award 2 marks.
  If one point is 1+ mm out, award 1 mark.
  If two or more points are 1+ mm out, award 0 marks.
- For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer	Mark
1(a)	• Determines the average coin radius/diameter using at least five coins (1) • Determines the average coin thickness using all 20 coins (1) • Use of $V = \pi r^2 t$ **Or** use of $V = \pi \frac{d^2}{4} t$ (1) • V between 1.14×10^{-6} and 1.22×10^{-6} m^3 (1) Example of calculation Total length of 10 coins = 30.2 cm Average coin radius = 0.0151 m Total height of 20 coins = 3.3 cm Average coin thickness = 0.00165 m $V = \pi r^2 t$ $V = \pi \times (0.0151 \text{ m})^2 \times 0.00165 \text{ m}$ $V = 1.18\times10^{-6}$ m^3	**4**
1(b)	• Use of $\rho = m/V$ (1) • ρ between 8000 and 8600 kg m^{-3} (1) Allow ecf for V from 1(a) for both marks. Example of calculation $\rho = m/V$ $\rho = 0.0098 \text{ kg}/1.18 \times 10^{-6} \text{ m}^3$ $\rho = 8300$ kg m^{-3}	**2**
1(c)	**EITHER** • Calculates values for 2% range of the density of brass (1) • Statement comparing this with 1(b) and relevant conclusion made (1) **OR** • Calculates percentage difference between 8550 kg m^{-3} and the density from 1(b) (1) • Statement comparing this with 2% and relevant conclusion made (1) Example of calculation 8550 kg m^{-3} × 1.02 = 8721 kg m^{-3} 8550 kg m^{-3} × 0.98 = 8379 kg m^{-3}	**2**

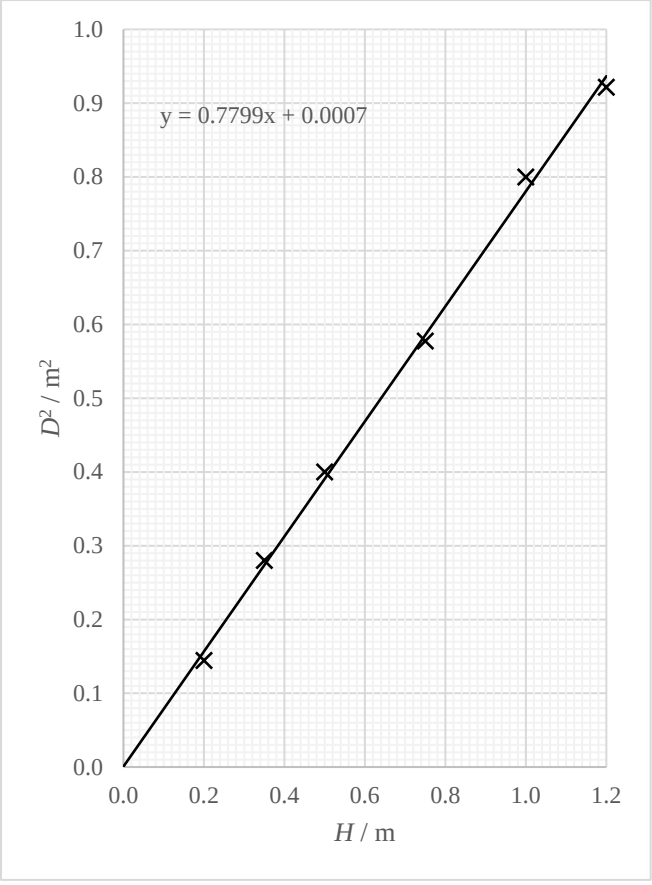
Question Number	Answer	Mark
1(d)	**EITHER** • Use of a displacement can filled with water (1) • Multiple coins added and volume of displaced water measured using a measuring cylinder (1) • Volume of displaced water divided by number of coins (1) • Coins added slowly to prevent splashing **Or** measuring cylinder read at eye level to avoid parallax **Or** ensure measuring cylinder is vertical **Or** displacement can is filled until overflowing and waits until drips stop (1) **OR** • Use of a measuring cylinder part filled with water (1) • Multiple coins added and the change in volume recorded (1) • Volume of displaced water divided by number of coins (1) • Coins added slowly to prevent splashing **Or** measuring cylinder read at eye level to avoid parallax **Or** ensure measuring cylinder is vertical (1) **OR** • Use of vernier/digital calipers (1) **Or** use of a micrometer (screw gauge) • Multiple coins measured (1) **Or** multiple positions measured on the same coin • Mean radius/diameter **and** thickness/height calculated (1) • Corrects/checks for zero error in the measuring device (1)	**4**
	Total for question 1	**12**

Question Number	Answer	Mark
2(a)	• Uncertainty is half resolution (0.5˚) (1) • Use of percentage uncertainty = (uncertainty / angle value) × 100% for either angle (1) • % uncertainty in θ_1 = 1.4% (accept 1%) **and** % uncertainty in θ_2 = 0.8% (1) If the full resolution of protractor is used (1˚) – award MP2 for use of equation and MP3 for correctly values 2.9% (3%) and 1.6% (2%) <u>Example Calculation</u> % uncertainty in θ_1 = (0.5˚ / 35˚) × 100% = 1.4% % uncertainty in θ_2 = (0.5˚ / 62˚) × 100% = 0.81%	**3**
2(b)(i)	• See $n_1 \sin\theta_1 = n_2 \sin\theta_2$ with refractive index of air $n_2 = 1$ (1) • Rearranges **and** compares with $y = mx$ (+ c) **Or** rearranges **and** compares $n_1 = \frac{\sin\theta_2}{\sin\theta_1}$ with gradient $= \frac{\Delta\sin\theta_2}{\Delta\sin\theta_1}$ (1) • Identifies n_1 = gradient (1) For MP1 accept $n \sin\theta_1 = \sin\theta_2$ For MP2 accept comparing $\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1}$ with gradient $= \frac{\Delta\sin\theta_2}{\Delta\sin\theta_1}$	**3**
2(b)(ii)	• Uses two points on the line to determine the gradient (1) • n_1 between 1.46 and 1.54 (1) MP2 dependent on MP1 MP2 allow correct use of gradient = 1/n from 2(b)(i) <u>Example Calculation</u> n_1 = (0.77 – 0.17) / (0.50 – 0.10) n_1 = 1.5	**2**

Question Number	Answer	Mark
2(c)	• Realistic cause of a systematic error in measured data suggested (1) • Suitable method to reduce effect of the cause suggested (1) MP2 dependent on MP1 <u>Examples</u> • Normal line not correctly drawn at 90˚ to the flat surface • Use a protractor/set square to check the normal line • Zero error because protractor not aligned correctly • Ensure the protractor is aligned to the normal • Ray of light not directed to centre of the flat surface **Or** incident ray not perpendicular to curved surface • Mark the position of the centre of the flat surface on paper • Block moved • Mark the position of the block on paper **Or** tape the block in position • Did not repeat measurements with angles of incidence either side of the normal • Repeat measurements (for angles of incidence on both sides of the normal) and calculate mean value	**2**
	Total for question 2	**10**

Question Number	Answer	Mark
3(a)	• Power supply (e.g., battery), ammeter and LDR connected in series (1) • Voltmeter connected in parallel with LDR (1) MP1 – accept incorrect symbol labelled as LDR **or** an LDR symbol without circle MP2 – we can accept a voltmeter in parallel with a single resistive component in the series circuit unless an LDR is given <u>Examples</u> 	**2**
3(b)	• Distance between bulb and LDR (d) measured with a metre rule (accept tape measure) (1) • Record current and potential difference and use $V = IR$ to calculate resistance **Or** use an ohmmeter or multimeter set to measure resistance (1) • Repeat for the same values of d and calculate the mean value of R **Or** use a set square/marker to reduce parallax when measuring d **Or** look down at ruler at eye-level to reduce parallax when measuring d (1)	**3**
3(c)	• Downwards curved line with decreasing gradient (1) • Line not touching/crossing either axis (1) MP2 dependent on MP1 <u>Examples</u> 	**2**
3(d)	• Use of $A = 4\pi r^2$ (1) • Use of $I = \frac{P}{A}$ (1) • I = 18 W m^{-2} (1) <u>Example Calculation</u> I = 9.0 W / (4 × π × (0.20 m)^2) = 17.9 W m^{-2}	**3**

Question Number	Answer	Mark
3(e)(i)	**Mark 3(e)(i) and (ii) holistically** • Suitable control variable (1) e.g., background light level, current in bulb, brightness/power of bulb, angle of light to LDR, temperature of the LDR	**1**
3(e)(ii)	• Suitable method of control for the control variable identified (1)	**1**
	Total for question 3	**12**

Question Number	Answer	Mark
4(a)	• (Energy is conserved, so) $mg\Delta h = \frac{1}{2}mv^2$ (1) • $v = \sqrt{2g\Delta h}$ **Or** $v^2 \propto \Delta h$ **Or** states that *m* and *g* are constants (1) • Δh is constant so *v* is always the same **Or** Δh is constant so v^2 is always the same (1) If no other marks awarded, accept GPE (decrease) and KE (increase) are the same for 1 mark If suvat equations are used to show $v = \sqrt{2as}$ or $v^2 \propto s$, do not award MP1 or MP2, but MP3 is still available	**3**
4(b)	• Inconsistent d.p. in *H* (1) • H/D should be measured to nearest mm **Or** H/D should be recorded to 3 d.p. (1) Allow "No repeats shown" for either marking point	**2**
4(c)(i)	• Correct D^2 values rounded to 2 s.f. (1) • Labels axes with quantities and units (1) • Sensible scales (1) • Plotting (2) • Line of best fit (1)  | *H* / m | D^2 / m^2 | |---|---| | 0.20 | 0.14 | | 0.35 | 0.28 | | 0.50 | 0.40 | | 0.75 | 0.58 | | 1.00 | 0.79 | | 1.20 | 0.92 |	**6**

Question Number	Answer	Mark
4(c)(ii)	• Calculates gradient using large triangle (1) • Use of $gradient = \frac{2v^2}{g}$ (1) • v between 1.92 and 1.98 (m s^{-1}) (1) Example Calculation $gradient = \frac{0.78-0.16}{1.0-0.2} = 0.775$ m $v = \sqrt{\frac{g \times gradient}{2}} = \sqrt{\frac{9.81 \text{ m s}^{-2} \times 0.775 \text{ m}}{2}} = 1.95 \text{ m s}^{-1}$	**3**
4(c)(iii)	• States actual/percentage difference between the two values **Or** identifies that their value is slower/faster (1) • Comment identifying a potential cause for the difference **Or** comment on the accuracy of the values (1) Examples • The speed given by the graph is slower • Air resistance reduced the size of *D* • The speed given by the graph is only 0.03 m s^{-1} slower than the value she calculated • The difference is only 2%, so the experiment is accurate **Or** the difference is small, so the experiment is accurate • Calculates the percentage difference between 1.98 m s^{-1} and the value from 4(c)(ii) • The percentage difference is small, so the experiment is accurate **Or** the percentage difference is large, so the experiment is not accurate	**2**
	Total for question 4	**16**