Pearson Edexcel

Mark scheme (Unused)

January 2022

Pearson Edexcel
International Advanced Subsidiary Level
in Physics (WPH13)
Paper 1

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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. 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 a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

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.

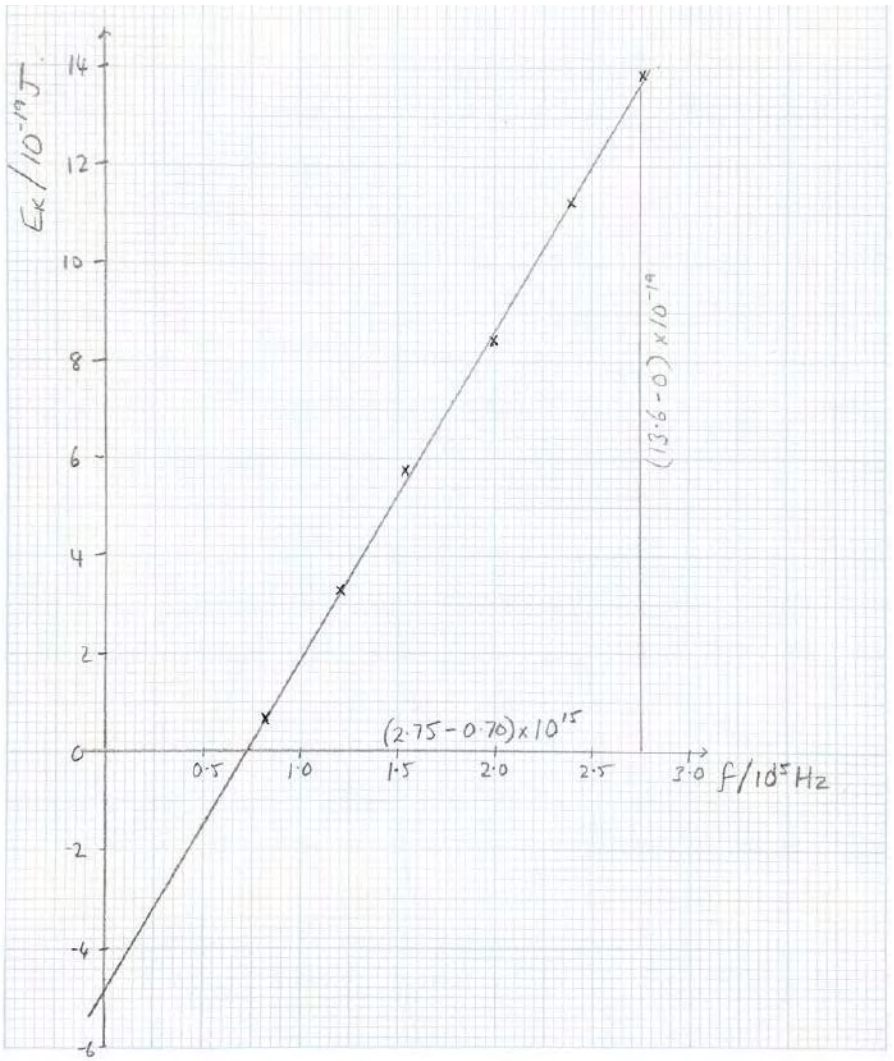
6.4 Points should be plotted to within 1 mm.

- 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
1ai	Use a water bath and measure temperature of water Use ice to bring water down to 0 °C	(1) (1)	**2**
1aii	Minimise the time between removing ball from the water bath and dropping it Because the ball changes temperature as soon as it is removed from the water bath **OR** Keep the ball in the water for sufficient time So that ball is at same temperature as the water **OR** Stir the water To ensure the water is all at the same temperature (ai and aii to be marked holistically)	(1) (1) (1) (1) (1) (1)	**2**
1b	Keep ball near to the metre rule View bounce height perpendicular to the metre rule Measure to the bottom of the ball Use a video camera [Scrutiny comment: the bottom of the ball should be in line with the zero on the metre rule when the ball is released?]	(1) (1) (1) (1)	**Max 2**
1c	Hot water can cause burns Handle ball with tongs **Or** wear safety glasses to prevent splashes to eyes **Or** Clamp beaker to avoid knocking it over when ball removed quickly	(1) (1)	**2**
1d	**Max two from:** No unit for temperature Temperature does not start at zero Mean not given to consistent significant figures Only mean bounce height recorded	 (1) (1) (1) (1)	**2**
1e	There is a linear relationship (But) it is not proportional **Or** the line does not pass through the origin **Or** best fit line drawn that does not pass through origin	(1) (1)	**2**
1fi	Zero error (allow systematic error)	(1)	**1**
1fii	Subtract 2.1 °C from all readings	(1)	**1**
	Total for question		**14**

Question Number	Answer		Mark
2a	Measure x using a second metre rule	(1)	
	Ensure second metre rule is vertical using a set square	(1)	
	(allow spirit level or plumb line instead of set square, **Or** align with door or window frame)		
	Use set square (between second metre rule and loaded metre rule) to reduce parallax error	(1)	**3**
2b	Micrometer or vernier callipers	(1)	
	Repeat and calculate a mean	(1)	
	Take readings at different places along the metre rule	(1)	**3**
2ci	Mean x = 278 (mm)	(1)	
	Use of half range **Or** maximum difference from the mean	(1)	
	%U = 2 % (1 or 2 sf)	(1)	**3**
	Example Calculation.		
	Mean x = (272+276+279+283)/4 = 278 mm		
	%U = (5.5 / 278) × 100 = 2.0 %		
2cii	Use of $E = \frac{4l^3W}{xwt^3}$	(1)	
	$E = 1.14 \times 10^{10}$ (Pa) (ecf from ci)	(1)	
	Use of 4% of given value of E.	(1)	
	E is above upper limit so student's results do not agree	(1)	**4**
	(allow method using 2% uncertainty in value of x)		
	Example Calculation.		
	$E = (4 \times (0.800\ \text{m})^3 \times 5.80\ \text{N}) / (0.278\ \text{m} \times 3.00 \times 10^{-2}\ \text{m} \times (5.00 \times 10^{-3}\ \text{m})^3)$		
	$E = 1.14 \times 10^{10}$ (Pa)		
	10.8×10^9 Pa × 1.04 = 1.12×10^{10} Pa		
	Total for question		**13**

Question Number	Answer		Mark
3a	Compares $E_k = hf - \phi$ to y=mx+c (may be implicit)	(1)	
	Identifies h as gradient [or m] and states this is constant	(1)	**2**
3b	y-axis labelled E_k / 10^{-19} J and x-axis labelled f / 10^{-15} Hz	(1)	
	Sensible scales	(1)	
	Plotting	(2)	**5**
	Line of best fit	(1)	
3c	ϕ in range 4.6×10^{-19} J to 5.0×10^{-19} J	(1)	
	Large triangle for gradient	(1)	
	h in range 6.5 – 6.7 Js	(1)	**3**
	Example Calculation.		
	ϕ found from y axis intercept		
	Gradient = 13.6×10^{-19} J / $(2.75 \times 10^{-15} - 0.70 \times 10^{-15}) = 6.6 \times 10^{-34}$ Hz		
	h = gradient = 6.6×10^{-34} Js		
			
	Total for question		**10**

Question Number	Answer		Mark
4ai	Vernier reading = 3.34 cm	(1)	**2**
	s = 0.08 cm	(1)	
	Example Calculation.		
	3.34 cm – 3.26 cm = 0.08 cm		
4aii	Uncertainty = 0.01 cm	(1)	**2**
	Percentage uncertainty = 13 % (allow ecf from ai)	(1)	
	Example Calculation.		
	Uncertainty = 2 × 0.005 cm = 0.01 cm		
	Percentage uncertainty $= \frac{0.01}{0.08} \times 100 = 13\ \%$		
4bi	There is a whole number of wavelengths path difference between the light arriving from the two different slits / sources	(1)	**2**
	So the waves arrive at the screen in phase	(1)	
4bii	Uncertainty in locating the centres of the bands is constant	(1)	**2**
	Measuring a larger distance decreases the percentage error	(1)	
4ci	Use of $w = \frac{\lambda D}{s}$ with $w = \frac{60}{5}$ mm	(1)	**2**
	$\lambda = 6.7 \times 10^{-7}$ m	(1)	
	Example Calculation.		
	$w = \frac{60}{5} = 12$ mm		
	$\lambda = \frac{0.012\ \text{m} \times 3.0 \times 10^{-4}\ \text{m}}{5.4\ \text{m}} = 6.67 \times 10^{-7}\ \text{m}$		
4cii	$\%U_D = 0.19\ \%$	(1)	**3**
	$\%U_w = 1.7\ \%$	(1)	
	$\%U_s$ is the largest value so *s* is most significant	(1)	
	Example Calculation.		
	$\%U_D = (0.01\ \text{m} / 5.4\ \text{m}) \times 100 = 0.19\ \%$		
	$\%U_w = (1\ \text{mm} / 60\ \text{mm}) \times 100 = 1.7\ \%$		
	3.2 % > 1.7 % and 0.19 %		
	Total for question		**13**

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