

Mark Scheme (Results)

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Pearson Edexcel International  
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(WPH06) Paper 01

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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.

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 sign in front of number as direction.]

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 mean that the final calculation mark will not be awarded.
- 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, for example in a spreadsheet.
- 2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).
- 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.

- 3.2 The use of  $g = 10 \text{ m s}^{-2}$  or  $10 \text{ N kg}^{-1}$  instead of  $9.81 \text{ m s}^{-2}$  or  $9.81 \text{ N kg}^{-1}$  will be penalised by one mark (but not more than once per clip). Accept  $9.8 \text{ m s}^{-2}$  or  $9.8 \text{ N kg}^{-1}$

#### 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:

'Show that' calculation of weight

Use of  $L \times W \times H$  ✓

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 3<sup>rd</sup> mark; if conversion to kg is omitted and then answer fudged, do not give 3<sup>rd</sup> mark]  
[Bald answer scores 0, reverse calculation 2/3]

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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 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									
<b>1(a)</b>	<table border="1" data-bbox="412 268 1166 598"> <thead> <tr> <th data-bbox="412 268 647 342">Measurement</th> <th data-bbox="647 268 898 342">Instrument</th> <th data-bbox="898 268 1166 342">Expected precision</th> </tr> </thead> <tbody> <tr> <td data-bbox="412 342 647 470">Width</td> <td data-bbox="647 342 898 470">Callipers <b>Or</b> Micrometer</td> <td data-bbox="898 342 1166 470">0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm</td> </tr> <tr> <td data-bbox="412 470 647 598">Thickness</td> <td data-bbox="647 470 898 598">Callipers <b>Or</b> Micrometer</td> <td data-bbox="898 470 1166 598">0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm</td> </tr> </tbody> </table> <p data-bbox="396 600 1089 695">Precision must be appropriate for choice of instrument and is a dependent mark 1 mark per box</p>	Measurement	Instrument	Expected precision	Width	Callipers <b>Or</b> Micrometer	0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm	Thickness	Callipers <b>Or</b> Micrometer	0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm	(1) (1)  (1) (1)  <b>4</b>
Measurement	Instrument	Expected precision									
Width	Callipers <b>Or</b> Micrometer	0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm									
Thickness	Callipers <b>Or</b> Micrometer	0.1 <b>or</b> 0.01 mm 0.01 <b>or</b> 0.001 mm									
<b>1(b)</b>	<p data-bbox="396 726 760 758">Length 0.26(%) or 0.13(%)</p> <p data-bbox="396 785 690 816">Thickness 4(%) or 2(%)</p> <p data-bbox="396 848 824 879">(Allows for use of range or half range)</p> <p data-bbox="396 972 656 1003"><u>Example of calculation</u></p> <p data-bbox="396 1008 764 1039">Length: half the range = 0.1 mm</p> <p data-bbox="396 1043 956 1075">% uncertainty = <math>(0.1\text{mm}/75.8\text{mm}) \times 100\% = 0.13\%</math></p> <p data-bbox="396 1104 805 1136">Thickness: half the range = 0.02 mm</p> <p data-bbox="396 1140 956 1171">% uncertainty = <math>(0.02\text{ mm}/ 1.00\text{ mm}) \times 100\% = 2\%</math></p>	(1)  (1)  <b>2</b>									
<b>1(c)(i)</b>	<p data-bbox="396 1199 1092 1230">Density = <math>2.46\text{ g cm}^{-3}</math> <b>or</b> <math>2460\text{ kg m}^{-3}</math> <b>Or</b> <math>2.46 \times 10^{-3}\text{ g mm}^{-3}</math></p> <p data-bbox="396 1262 573 1293">Use of <math>d = m/v</math></p> <p data-bbox="396 1297 873 1329">Correct value to 3 SF with appropriate unit</p> <p data-bbox="396 1360 656 1392"><u>Example of calculation</u></p> <p data-bbox="396 1396 667 1428">density = mass / volume</p> <p data-bbox="396 1432 1073 1463">density = <math>4.82\text{ g}/(7.58\text{ cm} \times 2.58\text{ cm} \times 0.100\text{ cm}) = 2.46\text{ g cm}^{-3}</math></p>	(1) (1)  <b>2</b>									
<b>1(c)(ii)</b>	<p data-bbox="396 1526 667 1558">Calculates %U for mass</p> <p data-bbox="396 1562 773 1593">Adds to both their answers for (b)</p> <p data-bbox="396 1650 656 1682"><u>Example of calculation</u></p> <p data-bbox="396 1709 906 1740"><math>((3\text{g}/482\text{g}) \times 100\%) + (2\% + 0.13\%) = 2.75\%</math></p>	(1) (1)  <b>2</b>									

<p><b>1(c)(iii)</b></p>	<p><b>Compares ranges</b>  Calculates range of values in their density using %U from (c)(ii) (1)  Makes comment based on overlap of values comparing with 2500 to 2700 kg m<sup>-3</sup> (dependent mark) (1)</p> <p><b>Or</b>  <b>Calculates % D</b>  finds %D in values for density (5.4%) (1)  makes comment to compare with %U in (c)(ii) (1)  <b>Or</b> %U in book value (3.8%) (dependent mark) (1)</p> <p><u>Examples of calculation</u></p> <p><b>Compares ranges</b>  Maximum value of calculated density = <math>2460 \text{ kgm}^{-3} \times 1.0275</math>  = <math>2528 \text{ kgm}^{-3}</math></p> <p>Minimum value of book value = <math>2600 - 100 = 2500 \text{ kgm}^{-3}</math>  Comparison is <math>2528 &gt; 2500</math>  Ranges overlap so it could be Crown glass  Allow ecf on their values</p> <p><b>Calculates %D</b>  %D = <math>100 \times (2600 - 2460) / 2600 = 5.4\%</math>  %U in (c)(ii) = 2.75% <b>Or</b> %U in bookvalue = <math>100 \times (100/2600) = 3.8\%</math>  %D &gt; %U therefore <b>not</b> Crown glass  Allow ecf on their values</p>	<p><b>2</b></p>
<p><b>1(d)</b></p>	<p><u>% Uncertainty</u> is reduced (1)</p> <p>Because measurement is larger  <b>Or</b> accuracy of determination of 1 slide is increased since a mean of 10 slides is taken  <b>Or</b> 1 slide might be anomalous (1)</p>	<p><b>2</b></p>
<p><b>Total for Question 1</b></p>		<p><b>14</b></p>



Question Number	Answer	Mark
2(a)	G-M tube <b>and</b> counter (allow rate-meter for both) <b>and</b> metre rule/absorbers (1)	<b>1</b>
2(b)	<p><b>Range method</b></p> <p>Background count recorded (1)</p> <p>Count rate recorded as distance between source and GM tube increased (1)</p> <p>In range 2cm (should be shorter than range for alpha) to longer than 25 cm (1)</p> <p><b>Or</b></p> <p><b>Absorber method</b></p> <p>Background count recorded (1)</p> <p>Varies distance to determine position at which count rate falls to background count (1)</p> <p>Count rate recorded using different absorbers (1)</p>	<b>3</b>
2(c)	Take them over a long time (minimum 60s) (1)	<b>1</b>
2(d)	<p><b>Range method (Max 3)</b></p> <p>Count rate should not change at short range (5 cm) (1)</p> <p>Hence no alpha (dependent mark) (1)</p> <p>At around 25 cm count rate should fall to background (1)</p> <p>Hence no gamma (dependent mark) (1)</p> <p><b>Or</b></p> <p><b>Absorber method (Max 3)</b></p> <p>No drop in count rate with paper (1)</p> <p>Hence no alpha (dependent mark) (1)</p> <p>Count rate drops to background with lead (1)</p> <p>Hence no gamma (dependent mark) (1)</p>	<b>3</b>
2(e)	Use handling tools (1)	<b>1</b>
	<b>Total for Question 2</b>	<b>9</b>

Question Number	Answer	Mark
<b>3(a)(i)</b>	BFL is a <u>smooth curve</u> passing close to all the points (1)	<b>2</b>
	With maximum clearly <25 kHz – by eye (1)	
<b>3(a)(ii)</b>	Max V <35 mV and >27 mV – must include unit (1)	<b>1</b>
<b>3(a)(iii)</b>	Peak frequency read correctly with unit from their BFL (1)	<b>1</b>
<b>3(b)</b>	Take more readings of $f$ near peak (1)	<b>1</b>
<b>Total for Question 3</b>		<b>5</b>

Question Number	Answer	Mark
<b>4(a)(i)</b>	Diagram showing displaced cone (1)	<b>2</b>
	Indication of either edge of cone as point of measurement(dependent mark) (1)	
<b>4(a)(ii)</b>	Value in range 5 mm → 10 mm (1)	<b>1</b>
<b>4(b)</b>	$\ln A = \ln A_0 - kn$ (1)	<b>2</b>
	Compares with $y = mx + c$ <b>and</b> states that $(- )k$ is the gradient (1)	
<b>4(c)(i)</b>	Ln <b>Or</b> log <u>values</u> correct in table to 3SF (1)	<b>5</b>
	Axes correct & labels shown eg $n$ and $\ln(A/\text{cm})$ (1)	
	Scales (1)	
	Plots (1)	
	BFL (1)	
<b>4(c)(ii)</b>	Large triangle – half the plotted line (1)	<b>2</b>
	$k = 0.0520 \rightarrow 0.0550$ to 3SF (1)	
<b>Total for Question 4</b>		<b>12</b>

$n$	$A/cm$	$\ln(A/cm)$	$A/m$	$\ln(A/m)$
0	20.0	3.00	0.200	-1.61
2	18.2	2.90	0.182	-1.70
4	16.2	2.79	0.162	-1.82
6	14.4	2.67	0.144	-1.94
8	13.2	2.58	0.132	-2.02
10	12.0	2.48	0.120	-2.12





