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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 open.
- 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  $g = 10 \text{ m s}^{-2}$  or  $10 \text{ N kg}^{-1}$  instead of  $9.81 \text{ m s}^{-2}$  or  $9.81 \text{ N kg}^{-1}$  will mean that one mark will not be awarded. (but not more than once per clip). Accept  $9.8 \text{ m s}^{-2}$  or  $9.8 \text{ N kg}^{-1}$
- 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)            | <ul style="list-style-type: none"> <li>Determines the average coin radius/diameter using at least five coins (1)</li> <li>Determines the average coin thickness using all 20 coins (1)</li> <li>Use of <math>V = \pi r^2 t</math> (1)</li> <li>Or use of <math>V = \pi \frac{d^2}{4} t</math> (1)</li> <li><math>V</math> between <math>1.14 \times 10^{-6}</math> and <math>1.22 \times 10^{-6} \text{ m}^3</math> (1)</li> </ul> <p>Example of calculation</p> <p>Total length of 10 coins = 30.2 cm<br/> Average coin radius = 0.0151 m<br/> Total height of 20 coins = 3.3 cm<br/> Average coin thickness = 0.00165 m<br/> <math>V = \pi r^2 t</math><br/> <math>V = \pi \times (0.0151 \text{ m})^2 \times 0.00165 \text{ m}</math><br/> <math>V = 1.18 \times 10^{-6} \text{ m}^3</math></p> | 4    |
| 1(b)            | <ul style="list-style-type: none"> <li>Use of <math>\rho = m/V</math> (1)</li> <li><math>\rho</math> between 8000 and 8600 <math>\text{kg m}^{-3}</math> (1)</li> </ul> <p>Allow ecf for <math>V</math> from 1(a) for both marks.</p> <p>Example of calculation</p> <p><math>\rho = m/V</math><br/> <math>\rho = 0.0098 \text{ kg} / 1.18 \times 10^{-6} \text{ m}^3</math><br/> <math>\rho = 8300 \text{ kg m}^{-3}</math></p>  | 2    |
| 1(c)            | <p><b>EITHER</b></p> <ul style="list-style-type: none"> <li>Calculates values for 2% range of the density of brass (1)</li> <li>Statement comparing this with 1(b) and relevant conclusion made (1)</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>Calculates percentage difference between 8550 <math>\text{kg m}^{-3}</math> and the density from 1(b) (1)</li> <li>Statement comparing this with 2% and relevant conclusion made (1)</li> </ul> <p>Example of calculation</p> <p><math>8550 \text{ kg m}^{-3} \times 1.02 = 8721 \text{ kg m}^{-3}</math><br/> <math>8550 \text{ kg m}^{-3} \times 0.98 = 8379 \text{ kg m}^{-3}</math></p>   | 2    |

| Question Number | Answer  | Mark      |
|-----------------|---|-----------|
| 1(d)            | <p><b>EITHER</b></p> <ul style="list-style-type: none"> <li>• Use of a displacement can filled with water (1)</li> <li>• Multiple coins added and volume of displaced water measured using a measuring cylinder (1)</li> <li>• Volume of displaced water divided by number of coins (1)</li> <li>• Coins added slowly to prevent splashing</li> <li>    <b>Or</b> measuring cylinder read at eye level to avoid parallax</li> <li>    <b>Or</b> ensure measuring cylinder is vertical</li> <li>    <b>Or</b> displacement can is filled until overflowing and waits until drips stop (1)</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• Use of a measuring cylinder part filled with water (1)</li> <li>• Multiple coins added and the change in volume recorded (1)</li> <li>• Volume of displaced water divided by number of coins (1)</li> <li>• Coins added slowly to prevent splashing</li> <li>    <b>Or</b> measuring cylinder read at eye level to avoid parallax (1)</li> <li>    <b>Or</b> ensure measuring cylinder is vertical</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• Use of vernier/digital calipers (1)</li> <li>    <b>Or</b> use of a micrometer (screw gauge)</li> <li>• Multiple coins measured (1)</li> <li>    <b>Or</b> multiple positions measured on the same coin (1)</li> <li>• Mean radius/diameter <b>and</b> thickness/height calculated (1)</li> <li>• Corrects/checks for zero error in the measuring device (1)</li> </ul> | <b>4</b>  |
|                 | <b>Total for question 1</b>   | <b>12</b> |