

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

October 2021

Question Paper Log Number P67156A

Publications Code WPH13_01_2110_MS

All the material in this publication is copyright

© Pearson Education Ltd 2021

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 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 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)	<ul style="list-style-type: none"> Heating (to 100 °C) – suitable method described (1) Cooling (to 10 °C) – suitable method described (1) 	2
1(b)	<ul style="list-style-type: none"> Use of uncertainty = half resolution (0.005 V) (1) Percentage uncertainty = 0.07 (%) (1) <p>Accept use of resolution (0.01 V), giving percentage uncertainty of 0.15% for MP2 only</p> <p><u>Example calculation</u> Percentage uncertainty = $(0.005/6.85) \times 100\%$ Percentage uncertainty = 0.073%</p>	2
1(c)(i)	<ul style="list-style-type: none"> Line of best fit drawn up to V axis (1) Value between 8.2 and 8.6 (V) (1) <p>MP1 – accept a straight line of best fit covering at least the first 5 plots MP2 – if a line of best fit is drawn, the value given must match the y-axis intercept ± 1 mm and be within the range stated</p>	2
1(c)(ii)	<ul style="list-style-type: none"> Use of $12\text{ V} = \sum \text{p.d.}$ (1) Use of $V = IR$ (1) Correct value calculated with unit (1) <p>Note – ecf from 1(c)(i) applies</p> <p>MP1 & 2 can be awarded for correct use of the potential divider ratios rule (e.g., $V_{\text{fixed res}} / 12\text{ V} = 4700\ \Omega / (4700\ \Omega + R_{\text{therm}})$)</p> <p><u>Example calculation</u> $V_{\text{therm}} = 8.4\text{ V}$ $V_{\text{fixed}} = 3.6\text{ V}$ $V = IR$ $3.6\text{ V} = I \times 4.7 \times 10^3\ \Omega$ $I = 3.6\text{ V} / 4.7 \times 10^3\ \Omega = 7.7 \times 10^{-4}\text{ A}$ $V = IR$ $8.4\text{ V} = 7.7 \times 10^{-4}\text{ A} \times R$ $R = 8.4\text{ V} / 7.7 \times 10^{-4}\text{ A} = 1.1 \times 10^4\ \Omega$</p>	3

1(d)	<ul style="list-style-type: none"> Calculates $V \times \theta$ for at least two pairs of values from the graph/table Or calculates proportional change for at least two pairs of values (1) Conclusion consistent with values calculated (1) <p>Do not award MP2 if temperatures are not converted to Kelvin</p> <p><u>Example calculation</u></p> <p>Pair 1 $V \times \theta = 3.5 \text{ V} \times (60 + 273 \text{ K}) = 1170 \text{ V K}$</p> <p>Pair 2 $V \times \theta = 5.7 \text{ V} \times (30 + 273 \text{ K}) = 1730 \text{ V K}$</p>	2
	Total for question 1	11