# GCE

# Mathematics B MEI

## H630/02: Pure Mathematics and Statistics

AS Level

# Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

# MARKING INSTRUCTIONS

## PREPARATION FOR MARKING
## RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

## MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   **Rubric Error Responses – Optional Questions**
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

**Multiple Choice Question Responses**
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

**Contradictory Responses**
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
    - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **To determine the mark within the level**, consider the following

| Descriptor | Award mark |
|---|---|
| On the borderline of this level and the one below | At bottom of level |
| Just enough achievement on balance for this level | Above bottom and either below middle or at middle of level (depending on number of marks available) |
| Meets the criteria but with some slight inconsistency | Above middle and either below top of level or at middle of level (depending on number of marks available) |
| Consistently meets the criteria for this level | At top of level |

11. **Annotations**

| Annotation | Meaning |
|---|---|
| ✓and ✗ | |
| BOD | Benefit of doubt |
| FT | Follow through |
| ISW | Ignore subsequent working |
| M0, M1 | Method mark awarded 0, 1 |
| A0, A1 | Accuracy mark awarded 0, 1 |
| B0, B1 | Independent mark awarded 0, 1 |
| E | Explanation mark 1 |
| SC | Special case |
| ^ | Omission sign |
| MR | Misread |
| BP | Blank Page |
| Seen | |
| Highlighting | |

| Other abbreviations in mark scheme | Meaning |
|---|---|
| E1 | Mark for explaining a result or establishing a given result |
| dep* | Mark dependent on a previous mark, indicated by *. The * may be omitted if only one previous M mark |
| cao | Correct answer only |
| oe | Or equivalent |
| rot | Rounded or truncated |
| soi | Seen or implied |
| www | Without wrong working |
| AG | Answer given |
| awrt | Anything which rounds to |
| BC | By Calculator |
| DR | This question included the instruction: In this question you must show detailed reasoning. |
| BP | Blank Page |
| Seen | |
| Highlighting | |

12. **Subject Specific Marking Instructions**

a. Annotations must be used during your marking. For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.

For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Award NR (No Response)
- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
- OR if there is a mark (e.g. a dash, a question mark, a picture) which isn't an attempt at the question.

Note: Award 0 marks only for an attempt that earns no credit (including copying out the question).

If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not always be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

If you are in any doubt whatsoever you should contact your Team Leader.

c. The following types of marks are available.

**M**

A suitable method has been selected and applied in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words “Determine” or “Show that”, or some other indication that the method must be given explicitly.

**A**
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

**B**
Mark for a correct result or statement independent of Method marks.

**E**
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep*’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.)
We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.
- When a value is given in the paper only accept an answer correct to at least as many significant figures as the given value.
- When a value is not given in the paper accept any answer that agrees with the correct value to 2 s.f. unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.
  NB for Specification A the rubric specifies 3 s.f. as standard, so this statement reads “3 s.f”.

Follow through should be used so that only one mark in any question is lost for each distinct accuracy error.
Candidates using a value of 9.80, 9.81 or 10 for g should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

g. Rules for replaced work and multiple attempts:
- If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
- If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
- if a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.

h. For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate’s data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors.
If a candidate corrects the misread in a later part, do not continue to follow through. E marks are lost unless, by chance, the given results are established by equivalent working. Note that a miscopy of the candidate’s own working is not a misread but an accuracy error.

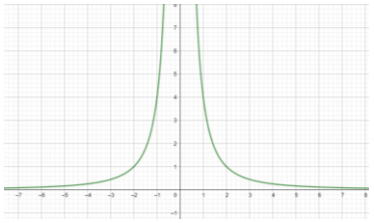
i. If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers, provided that there is nothing in the wording of the question specifying that analytical methods are required such as the bold “In this question you must show detailed

reasoning", or the command words "Show" or "Determine". Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j. If in any case the scheme operates with considerable unfairness consult your Team Leader.

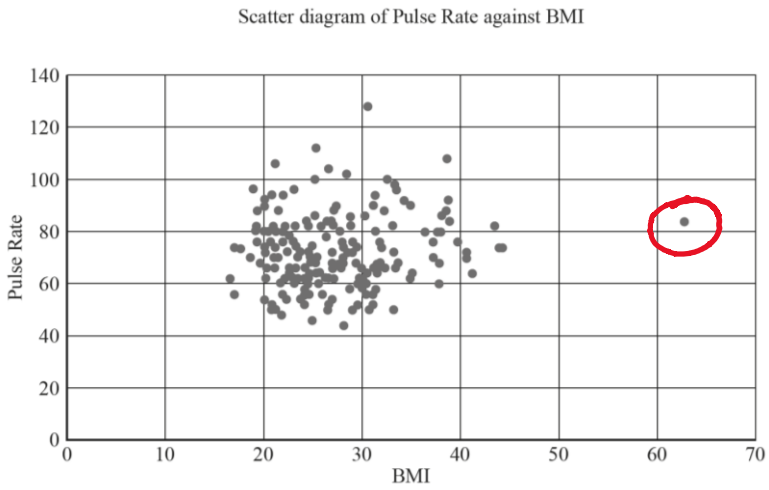
| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 1 | (a) | | The given data (on the graph) is continuous, not discrete **oe** | **E1** | **2.4** | Need a comment on the suitability of the histogram for the given data – we need a **comment on the type(s) of data**. The following score<br>-The given data was discrete, but this diagram represents continuous data<br>-The diagram is for continuous data, but the original data was discrete<br>-'It is continuous data' as the question asked about the histogram<br>- The data is discrete so there should be gaps between the bars<br>-'The histogram uses ranges e.g. 6- 7 but the data is discrete and cannot have values between 6-7' etc<br><br>Comments such as 'there are no gaps between the bars' or 'it should be a bar chart' or FD should be used or 'it is discrete data' (ambiguous) score 0 |
| | | | | **[1]** | | |
| 1 | (b) (i) | | 3.183… to 3.184 or 3.18 BC<br><br>Mark at most accurate | **B1** | **1.1** | Exact value is 3.183673469 or $3\frac{9}{49}$ or $\frac{156}{49}$ o.e.<br><br>Allow if seen in (b)(ii) if not seen in (b)(i)<br><br>SC: 3.2 allow B1 |
| | | | | **[1]** | | |
| 1 | (b) (ii) | | 1.61… to 1.62 BC<br>OR<br>1.59… to 1.60 | **B1** | **1.1** | Exact value is 1.615980989 (sample)<br><br>Exact value is 1.599406387 (population) |
| | | | | **[1]** | | |

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>$(x-3)^2$ seen<br>$(x-3)^2-8$</td><td>M1<br>A1<br>[2]</td><td>1.1<br>1.1</td><td>eg in $(x-3)^2-9+1$</td></tr>
<tr><td>2</td><td>(b)</td><td></td><td>(3, –8)</td><td>B1FT<br>[1]</td><td>1.1</td><td>FT their completed square</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>6n – 1 evaluated for any positive integer<br><br>eg 6×6 – 1 = 35 = 5×7 which is not prime</td><td>M1<br><br>A1</td><td>1.1<br><br>1.1</td><td>eg 6×1 – 1 = 5<br><table><tr><td>n</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>6n - 1</td><td>5</td><td>11</td><td>17</td><td>23</td><td>29</td><td>35</td><td>41</td><td>47</td><td>53</td></tr><tr><td>n</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr><tr><td>6n – 1</td><td>59</td><td>65</td><td>71</td><td>77</td><td>83</td><td>89</td><td>95</td><td>101</td><td>107</td></tr><tr><td>n</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td></tr><tr><td>6n – 1</td><td>113</td><td>119</td><td>125</td><td>131</td><td>137</td><td>143</td><td>149</td><td>155</td><td>161</td></tr></table><br>may see eg n = 11, 17, 23, 29- sight of any value in the table would imply the M1<br><br>Must show it’s factorisation so show it’s not prime and give a concluding comment e.g ‘not prime’<br><br>If they say ’35 is divisible by 5’ so not prime etc then A1 BUT ’35 isn’t prime’ is A0</td></tr>
<tr><td></td><td></td><td></td><td></td><td>[2]</td><td></td><td></td></tr>
</table>

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 4 | (a) | | 4 | B1 | 1.1 | |
| | | | | [1] | | |
| 4 | (b) | |  | B1<br><br>Dep B1 | 1.1<br><br>1.1 | Correct shape in both quadrants;<br><br>Must not cut either axis or bend away excessively from either axis<br>Reasonably Symmetrical about *y*-axis<br><br>Condone slight feathering, and slight asymmetry along the $y$ -axis |
| | | | | [2] | | |
| 5 | | | $\sqrt{(11-5)^2+(-1-2)^2}$ o.e.<br><br>OR<br>$\sqrt{(5-11)^2+(2-(-1))^2}$<br>$\sqrt{45}$<br>$3\sqrt{5}$ | M1<br><br><br><br>A1<br>A1 | 2.1<br><br><br><br>1.1<br>2.2a | allow one sign error<br><br><br><br><br>Condone $\sqrt{45}$ for A1A1 and $\sqrt{45}$ or $3\sqrt{5}$ only implies full marks |
| | | | | [3] | | |
| 6 | (a) | | Population because all the available data are used | E1 | 2.4 | This is an 'explain' question, so we do need 'population' and a correct justification.<br>Accept 'population as it is data from every single day the phone was used' scores<br>'Population as it is every day the phone is used' scores |
| | | | | [1] | | |
| 6 | (b) | | Negative skew | B1 | 1.2 | 'Negative' is B0 |
| | | | | [1] | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 6 | (c) | | $Q_3 = 58$ or $Q_1 = 42$ identified | B1 | 1.1 | |
| | | | IQR = 16 | B1 | 1.1 | 'IQR = 16' implies B1B1 |
| | | | | [2] | | |
| 6 | (d) | | $42 - 1.5 \times 16 = 18$ | M1 FT (c) | 1.1a | Ignore checking of upper tail<br>For calculating $Q_1 - 1.5 \times IQR$ for their values |
| | | | Smallest value is 19 which is not an outlier, so no outliers in lower tail | A1 | 1.1 | Comparison of lower bound with 19 and conclusion<br>e.g. '18 < 19 or 19 > 18 (or equivalent in words) so no' etc<br><br>If they calculate 18 then and mention 19 and 'no' then A1<br><br>'..18 so no as all values > 18' is A1<br><br>'18 so no as all values more than 18' is A1<br><br>'18 so no etc' is A0 as they need to compare to smallest value (directly or indirectly) and explain why.<br><br>Command word 'determine'- justification needed |
| | | | | [2] | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 7 | (a) | | $2^3 + 6 \times 2^2 - 2 - 30 = 0$ **so** $(x - 2)$ **is a factor** | **B1** | **1.1** | Factor theorem must be used, and a concluding statement needed<br>Statement might be at the start e.g $f(2) = 0 \Rightarrow (x - 2)$ a factor<br><br>e.g. Synthetic Division or Long Division is B0<br><br>Must see evidence of the substitution- 'show that' so<br>e.g simply $f(2) = 0$ is B0 |
| | | | | **[1]** | | |
| 7 | (b) | | $(x - 2)(x^2 + 8x + 15)$<br><br>$(x - 2)(x + 5)(x + 3)$ | **M1**<br>**A1**<br><br>**A1** | <br><br>**1.1** | By inspection or from long division, allow sign errors only<br>Fully correct linear × quadratic<br><br>Fully correct and fully factorised |
| | | | | **[3]** | | |
| | | | *Alternatively*<br><br>f($k$) evaluated, where $k$ is -3 **and** -5<br><br>$(x + 3)$ *or* $(x + 5)$ identified as a factor<br><br>$(x - 2)(x + 5)(x + 3)$ | **M1**<br><br><br><br>**A1**<br><br>**A1** | **1.1a**<br><br><br><br>**1.1** | Allow a slip with either but not both |
| 8 | (a) | | Remove any data where #N/A is in the column, as there is no data available | **B1** | **2.4** | LDS advantage<br>Comments such as exclude 20/81 year old female are B0 as this is only an extract of the full set of data<br><br>Must refer to N/A/missing data but accept 'not available/non-existent'<br><br>Remove data without a pulse reading is B0 as we could have missing BMI data too |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | | | | **[1]** | | |
| **8** | **(b)** | | (62.77, 84) ringed and no others | **B1** | **1.1** |  |
| | | | | **[1]** | | |
| **8** | **(c)** | | No evidence of a linear relationship **oe** so unlikely to be reliable | **B1** | **2.2b** | Any comment relating to interpolation or extrapolation is B0 as we want a comment on the appropriateness of the model considering the scatter diagram<br><br>Condone 'there appears to be little correlation/weak positive correlation' etc<br><br>'No/Zero correlation' is B0 e.g the PMCC could be 0.1 etc |
| | | | | **[1]** | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 8 | (d) | | None of the pulse rates are that unusual so should not be removed | B1 | 2.2b | LDS advantage<br><br>Need 'no/keep' and reason<br><br>Condone 'No as they are not outliers'<br><br>Accept 'Higher pulse rates are not uncommon' |
| | | | | [1] | | |
| 9 | (a) | | $0.1 + 0.3 + q + 2q + 3q = 1$<br>$q = 0.1$ | M1<br>A1 | 1.2<br>1.1 | Setting sum of values equal to 1 |
| | | | | [2] | | |
| 9 | (b) | | (0.1 + 0.3 + 0.1 + 0.2 =) 0.7 | B1 | 1.1 | Or $1 - p(X = 5)$ |
| | | | | [1] | | |
| 9 | (c) | | $0.1 \times 0.3$ seen or 0.03 seen | M1 | 1.1 | |
| | | | $0.1 \times 0.3 + 0.1 \times 0.3 = 0.06$ | A1 | 1.1 | 0.06 o.e $\frac{6}{100}$ or $\frac{3}{50}$ etc |
| | | | | [2] | | |
| 9 | (d) | | 0.098314…correct to 2 or more sf BC | B1 | 1.1 | By using e.g $X \sim B(50,0.3)$ and finding $P(X = 17)$ |
| | | | | [1] | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 10 | | | Cos A = $\frac{3.5^2+3.9^2-4.5^2}{2\times3.9\times3.5}$ **oe** | **M1** | **2.1** | Or Cos B = $\frac{4.5^2+3.9^2-3.5^2}{2\times3.9\times4.5}$ or Cos C = $\frac{3.5^2+4.5^2-3.9^2}{2\times4.5\times3.5}$<br><br>Correct use of cosine rule – might not see the 'Cos A' etc till next line, but must be a correct use so no 'sin' etc<br>Can be in form $a^2 = b^2 + c^2 - 2bc\text{Cos}A$ e.g.<br><br>$4.5^2 = 3.5^2 + 3.9^2 - 2 \times 3.5 \times 3.9 \times \text{Cos } A$<br>OR<br>$3.5^2 = 4.5^2 + 3.9^2 - 2 \times 4.5 \times 3.9 \times \text{Cos } B$<br>OR<br>$3.9^2 = 3.5^2 + 4.5^2 - 2 \times 3.5 \times 4.5 \times \text{Cos } C$ |
| | | | cos *A* = 0.2641… correct to 2 or more sf **soi** | **A1** | **1.1** | cos *B* = 0.66125… or cos *C* = 0.5488889 |
| | | | *A* = 74.686° correct to 2 or more sf **soi** | **A1** | **1.1** | *B* = 48.604° or *C* = 56.709° |
| | | | $\frac{1}{2} \times 3.5 \times 3.9 \times \sin 74.686$ | **M1FT** | **3.1a** | or $\frac{1}{2} \times 4.5 \times 3.9 \times \sin' 48.604'$ or $\frac{1}{2} \times 3.5 \times 4.5 \times \sin' 56.709'$<br>Must be using their included angle for their two adjacent sides<br><br>**<u>For the Final two marks:</u>**<br>They could also find an altitude, *h*, using one of the angles e.g using angle at C<br>'$h = 3.5 \text{ their } \sin C = 2.9256$ ... ' then $\frac{1}{2}bh =$<br>$\frac{1}{2}(4.5)(2.9256..) = 6.58267..$ |
| | | | awrt 6.58 or 6.6 | **A1** | **3.2a** | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | | | | [5] | | |
| 11 | | | $\frac{dy}{dx} = 6x^2 + 18x + 24$ | B1 | 2.1 | |
| | | | *their derivative* $\frac{dy}{dx} = 0$ | M1 | 1.1 | The $\frac{dy}{dx} = 0$ may be implied by their concluding statement e.g if they say 'no real roots'<br><br>Use of discriminant implies this mark |
| | | | *their* $18^2 - 4 \times 6 \times 24$ calculated (may be seen embedded in an attempt to solve their quadratic with QF etc. **If no formula quoted then the the solutions must be correct for the method mark. If the formula is quoted, we can allow one error with the substitution of values**) | M1 | 3.1a | Most common quadratics seen are:<br>$6x^2 + 18x + 24 = 0$ or $3x^2 + 9x + 12 = 0$ or $2x^2 + 6x + 8 = 0$ or $x^2 + 3x + 4 = 0$<br><br>**May have to check for their quadratic**<br><br>**NOTE:** They could also use a sketch method here: sketch their quadratic and then complete the square to show that the TP is above the $x$ – axis- will need to check their work carefully |
| | | | '$-252 < 0$' o.e. for their quadratic | A1 | 1.1 | -252 < 0 or -63 < 0 or -28 < 0 or -7 < 0 etc<br><br>May be implied by correct solutions to their quadratic<br>e.g. $\frac{-3 \pm \sqrt{7}\, i}{2}$ |
| | | | Hence $\frac{dy}{dx} = 0$ has no solutions and therefore there are no stationary points on the curve | A1* | 3.2a | Must give a concluding statement e.g. 'therefore no stationary points'. **Depends on all previous marks.**<br>Condone SPs or 'turning points' or TPs for stationary points |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | | | | **[5]** | | |
| **12** | **(a)** | | Opportunity/Convenience sampling | **B1** | **1.2** | Condone 'Opportunistic Sampling' |
| | | | | **[1]** | | |
| **12** | **(b)** | | Because every sample (of size n) does not have the same probability of being selected | **B1** | **2.4** | Accept 'all adult males registered at the surgery do not have an equal chance of being selected'<br>Accept 'everyone registered at the surgery does not have an equal chance of being selected<br><br>OR<br>'For a SRS each element from the SF must have an equal chance of selection'<br><br>OR<br>'A subset of the population cannot form a complete sampling frame'<br><br>OR<br>'The sampling frame would be incomplete'<br><br>'No random method employed in the process' B0 (need to have the idea that the SF is incomplete)<br>'Only collected data from one week' is B0 |
| | | | | **[1]** | | |

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO</th><th>Guidance</th></tr>
<tr><td>12</td><td>(c)</td><td></td><td><table><tr><td>w</td><td>50-</td><td>65-</td><td>70-</td><td>80-</td><td>90-</td><td>100-120</td></tr><tr><td>f</td><td>6</td><td>8</td><td>8</td><td>11</td><td>6</td><td>6</td></tr></table></td><td>B1</td><td>1.1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>[1]</td><td></td><td></td></tr>
<tr><td>12</td><td>(d)</td><td></td><td>$\frac{2}{3} \times their\ 6 + \frac{1}{2} \times their\ 6$<br>Or (10 x 0.4) +(10 x 0.3)<br>$\frac{7}{45}$ or $0.1\dot{5}$ or 0.15555 to 0.156<br>Mark at most accurate</td><td>M1<br>A1FT</td><td>1.1<br>1.1</td><td>IF part (c) is correct then this could be implied by ‘4 +3’<br>FT their 6, 6 and 45. May need to check their calculation.<br>May see interpolation methods, which lead to the same calc.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>[2]</td><td></td><td></td></tr>
<tr><td>12</td><td>(e)</td><td></td><td>The distribution of the weights within each class is unknown</td><td>E1</td><td>2.4</td><td>Accept ‘we assume that the values (individual weights) are equally distributed in each class interval’<br>Accept ‘the individual values (weights) are not known’<br>Accept ‘the number of people (frequency) in each category of the histogram may not be spread out equally across the category’<br>Accept ‘we don’t know exactly how many were less than 60kg and how many were more than 110kg’ (idea of correct frequency at both ends for correct probability calculation)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>[1]</td><td></td><td></td></tr>
</table>

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 13 | (a) | | $H_0 : p = 0.37$ and $H_1 : p < 0.37$ | B1 | 1.1 | Allow equivalent in words<br><br>Do not allow percentages |
| | | | | [1] | | |
| 13 | (b) | | $p$ is the probability that an adult selected at random in the United Kingdom never exercises (or plays sport) | B1 | 2.5 | Accept 'proportion' but **not** number/amount etc<br><br>B1B1 in (a)(b) if another symbol instead of $p$ used **if correctly defined**<br><br>**Underlined words needed** |
| | | | | [1] | | |
| 13 | (c) | | $P(X) \leq 35 = 0.058\ldots$ | B1 | 1.1 | |
| | | | their 0.058.. compared with 0.05 | M1 | 1.1 | may see $P(X < 35) = 0.0386$ or $P(X \leq 36) = 0.0847$ using $X \sim B(118, 0.37)$ – SC 1 mark<br><br>**Use of $P(X = 35) = 0.01961$..is M0**<br><br>There is another approach using Normal approx to Binomial to find 5% CR<br><br>$Y \sim N(43.66, 27.5058)$ which gives CV 35.033…<br>Or finding value from ND $P(Y \leq 35.5) = 0.059867$.. (must be using a continuity correction so $P(Y \leq 35) = 0.0493465$.. is M0) |
| | | | 0.058 > 0.05 or 35.033… > 35<br>or 0.059867 > 0.05<br>**and** 'so do not reject $H_0$' | A1 | 2.2b | 'accept $H_0$' is ok |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | | | There is **no evidence (or insufficient evidence)** to **suggest/support** at the 5% level that the **percentage** of **adults** (selected at random in the United Kingdom) who **never exercises** (or plays sport) **is less than 37%** | **A1*** | **2.4** | Fully correct contextual conclusion<br>No assertive statements such as 'proves that' or 'shows that' 'concludes that' etc<br>Accept percentage/proportion or probability with 0.37<br><br>Dependent on award of all other marks in (c) |
| | | | | **[4]** | | |
| **14** | | | $y = 16x^{\frac{1}{2}} + 8x^{-1}$ | **B1** | **3.1a** | May be implied by correct derivative |
| | | | $\frac{dy}{dx} = 8x^{-\frac{1}{2}} - 8x^{-2}$ | **M1** | **1.1** | At least one term of the form $\alpha x^{-\frac{1}{2}}$ or $\beta x^{-2}$ obtained |
| | | | | **A1** | **1.1** | All correct |
| | | | $x = 4, \frac{dy}{dx} = \frac{7}{2}$ | **B1FT** | **1.1** | FT their $\frac{dy}{dx}$, dep on award of **M1** |
| | | | $x = 4, y = 34$ | **B1** | **1.1** | |
| | | | $y$ – *their* 34 = (*their* $\frac{7}{2}$)($x$ –4) **oe** | **M1 FT** | **1.1** | Their 7/2 must come from substituting x = 4 into their derivative |
| | | | e.g. sub (4, '34') into their $y = mx + c$ to find their 'c' | | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | | | $y = \frac{7}{2}x + 20$ o.e. | **A1** | **3.2a** | All correct. Depends on all previous marks. We can accept any form of the equation of the line:<br>$7x - 2y + 40 = 0$ or $y - 34 = \frac{7}{2}(x - 4)$ o.e.<br><br>Once the correct equation is seen in any form we can ISW if they simplify incorrectly etc<br><br>NOTE: Final answer can be obtained from incorrect working- check their derivative |
| | | | | **[7]** | | |
| **15** | **(a)** | | $c$ = 1.14 | **B1** | **3.3** | |
| | | | | **[1]** | | |
| **15** | **(b)** | | $1.20 = 4a + 2b + 1.14$ **oe**<br>$1.25 = 16a + 4b + 1.14$ **oe**<br><br>$a = -0.00125, b = 0.0325$ | **M1**<br><br><br>**A1** | **3.3**<br><br><br>**1.1** | **both** equations. FT *their c*<br><br><br>Fractional equivalents are $a = -\frac{1}{800}$ and $b = \frac{13}{400}$<br>Equivalents in standard form is acceptable |
| | | | | **[2]** | | |
| **15** | **(c)** | | $1.29 = 1.14 + 0.0325t - 0.00125t^2$<br>$t$ = 6 and 20<br>$6 \leq t \leq 20$ | **M1**<br>**A1**<br>**A1** | **3.1b**<br>**3.4**<br>**3.5a** | FT *their a,b,c* (Can be > etc)<br><br>Set notation such as $t \in [6, 20]$ is fine but must not be soft brackets<br>$t \geq 6$ **and** $t \leq 20$ or $t \geq 6 \cap t \leq 20$ but NOT $t \geq 6$ , $t \leq 20$ |
| | | | | **[3]** | | |

| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 15 | (d) | | It will eventually predict a **negative exchange rate oe (will fall below zero etc)** | **B1** | **3.5a** | 'Exchange rate tends to zero' is B0<br><br>Must mention the variable 'exchange rate'<br>Underlined words needed |
| | | | | **[1]** | | |

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