



# Mark Scheme (Results)

Summer 2024

Pearson Edexcel International Advanced Level  
In Statistics S1 (WST01) 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.

## General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
  - **B** marks are unconditional accuracy marks (independent of M marks)

Marks should not be subdivided.

### 3. Abbreviations

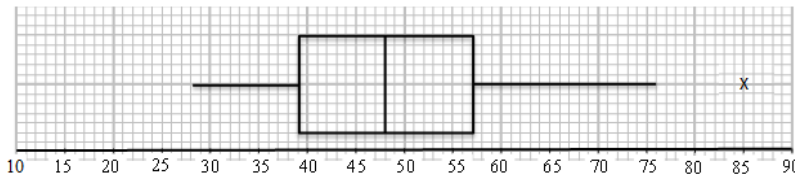
These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN:

- bod – benefit of doubt
  - ft – follow through
    - the symbol  $\surd$  will be used for correct ft
  - cao – correct answer only
  - cso – correct solution only. There must be no errors in this part of the question to obtain this mark
  - isw – ignore subsequent working
  - awrt – answers which round to
  - SC – special case
  - oe – or equivalent (and appropriate)
  - d... or dep – dependent
  - indep – independent
  - dp – decimal places
  - sf – significant figures
  - \* – The answer is printed on the paper or ag- answer given
  - $\square$  or d... – The second mark is dependent on gaining the first mark
4. All A marks are 'correct answer only' (cao), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.
  5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.

6. If a candidate makes more than one attempt at any question:
  - a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
  - b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.
7. Ignore wrong working or incorrect statements following a correct answer.

**Special notes for marking Statistics exams (for AAs only)**

- Any correct method should gain credit. If you cannot see how to apply the mark scheme but believe the method to be correct then please send to review.
- For method marks, we generally allow or condone a slip or transcription error if these are seen in an expression. We do not, however, condone or allow these errors in accuracy marks.

| Question | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                             | Marks           |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 1 (a)    | $k = 3$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                             | B1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (1)             |
| (b)      | $Q_1 = 39 \quad Q_3 = 57$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                             | B1 B1           |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (2)             |
| (c)      | "57"+1.5×("57"-"39") or "39"-1.5×("57"-"39")                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                             | M1              |
|          | 84 <b>and</b> 12 therefore only 1 outlier [85]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                             | A1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (2)             |
| (d)      |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                             | M1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | M1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | M1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | A1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (4)             |
| (e)      | A correct difference of the <b>medians</b> with supporting figures<br>e.g. On average Birch [trees grow slightly] <b>taller</b> as the <b>median</b> is larger <b>48 &gt; 45</b> oe<br><b>or</b><br>A correct difference of the <b>spread</b> with supporting figures<br>e.g. Maple has a greater spread/variation of <b>heights</b> as the <b>range</b> is larger <b>55 &gt; 48</b> (excluding outlier) oe<br>e.g. Birch has a greater spread/variation of <b>heights</b> as the <b>range</b> is larger <b>57 &gt; 55</b> (with outlier) oe |                                                                                                                                                                                                                                                                                                                                                                             | B1ft            |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (1)             |
| (f)      | 36 ,, $a < x$ where 43,, $x$ ,, 45 <b>or</b> 54 ,, $2a$ ,, 80                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                             | M1              |
|          | 36 ,, $a$ ,, "43" and 54 ,, $2a$ ,, 80                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                             | A1ft            |
|          | 36 ,, $a$ ,, 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | A1              |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                             | (3)             |
|          | <b>Notes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                             | <b>Total 13</b> |
| (a)      | <b>B1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Cao                                                                                                                                                                                                                                                                                                                                                                         |                 |
| (b)      | <b>B1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for $Q_1$ correct                                                                                                                                                                                                                                                                                                                                                           |                 |
|          | <b>B1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for $Q_3$ correct                                                                                                                                                                                                                                                                                                                                                           |                 |
| (c)      | <b>M1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for either method correct or a correct value (ft their $Q_1$ and their $Q_3$ )                                                                                                                                                                                                                                                                                              |                 |
|          | <b>A1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Both limits for outliers correct and statement about the outlier or the outlier given.                                                                                                                                                                                                                                                                                      |                 |
| (d)      | <b>M1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for a box drawn with only 2 whiskers, only one at each end (condone median line missing)                                                                                                                                                                                                                                                                                    |                 |
|          | <b>M1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for upper whisker ending at 76 (or 84 ft their upper outlier limit) and lower whisker ending at 28                                                                                                                                                                                                                                                                          |                 |
|          | <b>M1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for $Q_1$ , $Q_2$ and $Q_3$ plotted, with $Q_2 = 48$ and ft their $Q_1$ and $Q_3$                                                                                                                                                                                                                                                                                           |                 |
|          | <b>A1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for a fully correct box plot with the outlier correctly shown – must be only 1                                                                                                                                                                                                                                                                                              |                 |
| (e)      | <b>B1ft</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | for a correct comment, <b>referring to heights</b> , with reference to a <b>correctly named statistic</b> . Must <b>include the figures</b> compared.<br>Allow ‘grow more/bigger’ to imply taller<br>Ignore any reference to skew <b>SC If <math>Q_1/Q_3</math> are incorrect then allow a ft comment about spread referring to the difference in IQR if compared to 18</b> |                 |
| (f)      | <b>M1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | for either range correct. Allow $72 \leq 2a \leq 80$ or $27 \leq a \leq 40$ for 54 ,, $2a$ ,, 80<br>Condone < rather than ,,<br>May be seen as separate inequalities e.g. $2a \leq 80$ , $2a \geq 54$ is allowed for 54 ,, $2a$ ,, 80<br>A final answer of 36 ,, $a$ ,, 40 or $36 < a < 40$ implies M1                                                                      |                 |
|          | <b>A1ft</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | for both ranges correct ft their $k$ . Allow $72 \leq 2a \leq 80$ or $27 \leq a \leq 40$ for 54 ,, $2a$ ,, 80 Condone < rather than ,, May be seen as separate inequalities                                                                                                                                                                                                 |                 |
|          | <b>A1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Allow 36 to 40 or 36, 37, 38, 39, 40<br><b>NB</b> It is possible to get M1A0A1                                                                                                                                                                                                                                                                                              |                 |

| Question | Scheme                                                                                                                                     |                                                                                                                                                    | Marks           |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 2 (a)    | $[P(2X - 3 > 5) = ] 0.45$                                                                                                                  |                                                                                                                                                    | B1              |
|          |                                                                                                                                            |                                                                                                                                                    | (1)             |
| (b)      | $E(X^2) = 2^2 \times 0.25 + 4^2 \times 0.3 + 5^2 \times 0.2 + 7^2 \times 0.1 + 8^2 \times 0.15 [= 25.3]$                                   |                                                                                                                                                    | M1              |
|          | $Var(X) = 2^2 \times 0.25 + 4^2 \times 0.3 + 5^2 \times 0.2 + 7^2 \times 0.1 + 8^2 \times 0.15 - 4.6^2$<br>or<br>$Var(X) = "25.3" - 4.6^2$ |                                                                                                                                                    | M1              |
|          | $= 25.3 - 4.6^2 = 4.14^*$                                                                                                                  |                                                                                                                                                    | A1*             |
|          |                                                                                                                                            |                                                                                                                                                    | (3)             |
| (c)      | $[E(Y) = ] 13.4 = a \times 4.6 - b$                                                                                                        |                                                                                                                                                    | M1              |
|          | $[Var(Y) = ] a^2 \times 4.14 = 66.24$                                                                                                      |                                                                                                                                                    | M1              |
|          | $a = 4$                                                                                                                                    |                                                                                                                                                    | A1              |
|          | $b = 5$                                                                                                                                    |                                                                                                                                                    | A1              |
|          |                                                                                                                                            |                                                                                                                                                    | (4)             |
| (d)      | Sam throws 8 and Alex throws 2, 4 or 5<br>Sam throws 7 and Alex throws 2 or 4<br>Sam throws 5 or 4 or 2 and Alex throws 2                  |                                                                                                                                                    | M1              |
|          | $0.15 \times (0.25 + 0.3 + 0.2)$ or $0.1 \times (0.25 + 0.3)$ or $(0.2 + 0.3 + 0.25) \times 0.25$                                          |                                                                                                                                                    | M1              |
|          | $0.15 \times (0.25 + 0.3 + 0.2) + 0.1 \times (0.25 + 0.3) + (0.2 + 0.3 + 0.25) \times 0.25$                                                |                                                                                                                                                    | M1              |
|          | $= 0.355 \left( = \frac{71}{200} \right)$                                                                                                  |                                                                                                                                                    | A1              |
|          |                                                                                                                                            |                                                                                                                                                    | (4)             |
| ALT      | Alex throws 2<br>Alex throws 4 and Sam throws 7 or 8<br>Alex throws 5 and Sam throws 8                                                     |                                                                                                                                                    | M1              |
|          | $0.25$ or $0.3 \times (0.1 + 0.15)$ or $0.2 \times 0.15$                                                                                   |                                                                                                                                                    | M1              |
|          | $0.25 + 0.3 \times (0.1 + 0.15) + 0.2 \times 0.15$                                                                                         |                                                                                                                                                    | M1              |
|          | $= 0.355 \left( = \frac{71}{200} \right)$                                                                                                  |                                                                                                                                                    | A1              |
|          | <b>Notes</b>                                                                                                                               |                                                                                                                                                    | <b>Total 12</b> |
| (a)      | <b>B1</b>                                                                                                                                  | 0.45 oe                                                                                                                                            |                 |
| (b)      | <b>M1</b>                                                                                                                                  | for a correct method to find $E(X^2)$ At least 3 terms correct and added This is not implied by 25.3 on its own                                    |                 |
|          | <b>M1</b>                                                                                                                                  | for use of correct equation ft their $E(X^2)$                                                                                                      |                 |
|          | <b>A1*</b>                                                                                                                                 | for a correct expression, with all terms seen, leading to the given answer                                                                         |                 |
| (c)      | <b>M1</b>                                                                                                                                  | for writing or using a correct equation for $E(Y)$                                                                                                 |                 |
|          | <b>M1</b>                                                                                                                                  | for writing or using a correct method for $Var(Y)$                                                                                                 |                 |
|          | <b>A1</b>                                                                                                                                  | for $a = 4$ may be seen as part of the expression $4X \pm \dots$                                                                                   |                 |
|          | <b>A1</b>                                                                                                                                  | for $b = 5$ may be seen as part of the expression $\dots X - 5$                                                                                    |                 |
| (d)      | <b>M1</b>                                                                                                                                  | for recognising all the required combinations – implied by 3 correct probabilities Ignore any repeats but do not ignore any incorrect combinations |                 |
|          | <b>M1</b>                                                                                                                                  | for any one correct calculation from the 3 given                                                                                                   |                 |
|          | <b>M1</b>                                                                                                                                  | for any 2 correct calculations from the 3 given                                                                                                    |                 |
|          | <b>A1</b>                                                                                                                                  | 0.355 oe                                                                                                                                           |                 |

| Question | Scheme                                                                                                                                                 |                                                                                                                                                                                                                            | Marks    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 3(a)     | Width = 1.25 [cm]                                                                                                                                      |                                                                                                                                                                                                                            | B1       |
|          | 18.75 cm <sup>2</sup> for freq of 20 so $\frac{18.75}{20} \times 16 = 15$ cm <sup>2</sup> for a frequency of 16 or $w \times h = 15$ or $fd = 5$       |                                                                                                                                                                                                                            | M1       |
|          | [ $h = 15 \div 1.25$ or $h = 8 \div 5 \times 7.5 =$ ] 12 (cm)                                                                                          |                                                                                                                                                                                                                            | A1       |
|          |                                                                                                                                                        |                                                                                                                                                                                                                            | (3)      |
| (b)      | $Q_2 = [32 +] \frac{7}{20} \times 4$ or using $n + 1$ gives $Q_2 = [32 +] \frac{7.5}{20} \times 4$                                                     |                                                                                                                                                                                                                            | M1       |
|          | =33.4 ( $n + 1$ gives 33.5)                                                                                                                            |                                                                                                                                                                                                                            | A1       |
|          |                                                                                                                                                        |                                                                                                                                                                                                                            | (2)      |
| (c)      | $\bar{y} = \frac{104}{50} [= 2.08]$                                                                                                                    | $\sum(w - 20) = 10 \times 104 [= 1040]$ or $\sum w = 10 \times 104 + 50 \times 20 [= 2040]$                                                                                                                                | M1       |
|          | $\bar{w} = 10 \times "2.08" + 20 = 40.8^*$                                                                                                             | $\frac{"1040"}{50} + 20 = 40.8$ or $\frac{"2040"}{50} = 40.8$                                                                                                                                                              | A1*      |
|          |                                                                                                                                                        |                                                                                                                                                                                                                            | (2)      |
| (d)      | $[\text{Variance of } y =] \frac{233.54}{50} - ("2.08")^2 \left[ = \frac{861}{2500} = 0.3444 \right]$ or $10 \times \text{sd of } y = \text{sd of } w$ |                                                                                                                                                                                                                            | M1       |
|          | or $100 \times 233.54 = \sum(w^2) - 40 \times "2040" + 50 \times 400 \left[ \Rightarrow \sum(w^2) = 84954 \right]$ oe                                  |                                                                                                                                                                                                                            |          |
|          | $[\text{Variance of } w =] "0.3444" \times 100$ or $\frac{"84954"}{50} - 40.8^2 \left[ = \frac{861}{25} = 34.44 \right]$                               |                                                                                                                                                                                                                            | M1       |
|          | or $\text{sd of } y = \sqrt{"0.3444"} \left[ = \frac{\sqrt{861}}{50} = 0.5868... \right]$                                                              |                                                                                                                                                                                                                            |          |
|          | $\text{sd of } w = \sqrt{"0.3444" \times 100}$ or $\sqrt{"34.44"}$ or $10 \times \frac{\sqrt{861}}{50}$                                                |                                                                                                                                                                                                                            | M1       |
|          | = 5.868... awrt 5.87                                                                                                                                   |                                                                                                                                                                                                                            | A1       |
| (e)(i)   | The mean would not change (as 40.8 is the mean)                                                                                                        |                                                                                                                                                                                                                            | B1       |
| (ii)     | The standard deviation would decrease (as 40.8 is in the middle so data closer together)                                                               |                                                                                                                                                                                                                            | B1       |
|          | Both correct with a correct reason for why the standard deviation decreases                                                                            |                                                                                                                                                                                                                            | ddB1     |
|          |                                                                                                                                                        |                                                                                                                                                                                                                            | (3)      |
|          | Notes                                                                                                                                                  |                                                                                                                                                                                                                            | Total 14 |
| (a)      | B1                                                                                                                                                     | for width = 1.25 no need for units                                                                                                                                                                                         |          |
|          | M1                                                                                                                                                     | for sight of 15 or "their $w$ " $\times$ "their $h$ " = 15 or $fd = 5$ May be implied by $h = 12$                                                                                                                          |          |
|          | A1                                                                                                                                                     | for height = 12 no need for units                                                                                                                                                                                          |          |
| (b)      | M1                                                                                                                                                     | for $\frac{7}{20} \times 4$ or $\frac{13}{20} \times 4$ or $\frac{m - 32}{25 - 18} = \frac{4}{20}$ oe or $\frac{36 - m}{38 - 25} = \frac{4}{20}$ oe (allow 25.5 rather than 25)                                            |          |
|          | A1                                                                                                                                                     | 33.4 or if using $(n + 1)$ 33.5                                                                                                                                                                                            |          |
| (c)      | M1                                                                                                                                                     | for a correct method to find the mean of $y$ or $\sum(w - 20)$ or $\sum w$<br>( $10 \times 104 + k$ where $k \neq 20 \times 50$ is M0)                                                                                     |          |
|          | A1*                                                                                                                                                    | for a correct method to find mean of $w$ which leads to 40.8                                                                                                                                                               |          |
| (d)      | M1                                                                                                                                                     | for a correct method to find the Variance of $y$ or writing/using $10 \times \text{sd of } y = \text{sd of } w$ or a correct equation to find $\sum w^2$                                                                   |          |
|          | M1                                                                                                                                                     | for a correct method to find the Variance of $w$ or sd of $y$ ft their $\text{Var}(y)$                                                                                                                                     |          |
|          | M1                                                                                                                                                     | for a correct method to find the sd of $w$ ft their $\text{Var}(w)$                                                                                                                                                        |          |
|          | A1                                                                                                                                                     | awrt 5.87 NB an exact answer $\frac{\sqrt{861}}{5}$ scores A0                                                                                                                                                              |          |
| (e)(i)   | B1                                                                                                                                                     | for no change (No reason needed) Allow mean = 40.8 to imply no change                                                                                                                                                      |          |
| (ii)     | B1                                                                                                                                                     | for sd decreases/be smaller/go down (condone Var decreases) (No reason needed)                                                                                                                                             |          |
|          | ddB1                                                                                                                                                   | Both previous B1 awarded. For a correct reason for the sd decreasing Allow $(x - \bar{x}) = 0$<br>Allow $\sum(x - \bar{x})^2$ doesn't change and $n$ increases. Allow the values would be more concentrated about the mean |          |

| Question       | Scheme                                                                                          |                                                                                                                                                                                                                                                                              | Marks           |
|----------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 4 (a)          | $S_{dg} = 141978.84 - \frac{1456.8 \times 713.2}{8}$ or $S_{gg} = 72675.98 - \frac{713.2^2}{8}$ |                                                                                                                                                                                                                                                                              | M1              |
|                | $S_{dg} = 12105.12$                                                                             |                                                                                                                                                                                                                                                                              | A1              |
|                | $S_{gg} = 9094.2$                                                                               |                                                                                                                                                                                                                                                                              | A1              |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (3)             |
| (b)            | $r = \frac{"12105.12"}{\sqrt{16769.78 \times "9094.2"}}$                                        |                                                                                                                                                                                                                                                                              | M1              |
|                | $= 0.9802....$ awrt <b>0.98</b>                                                                 |                                                                                                                                                                                                                                                                              | A1              |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (2)             |
| (c)            | $b = \frac{"12105.12"}{16769.78} [= 0.7218...]$                                                 |                                                                                                                                                                                                                                                                              | M1              |
|                | $a = \frac{713.2}{8} - "0.7218..." \times \frac{1456.8}{8} [= -42.297....]$                     |                                                                                                                                                                                                                                                                              | M1              |
|                | $g = -42.3 + 0.722d *$                                                                          |                                                                                                                                                                                                                                                                              | A1*cso          |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (3)             |
| (d)            | for each 1 [cm] increase in length/d the girth/g increases by “0.722...”                        |                                                                                                                                                                                                                                                                              | B1              |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (1)             |
| (e)(i)<br>(ii) | 138.2 awrt <b>138</b>                                                                           |                                                                                                                                                                                                                                                                              | B1              |
|                | [unreliable] as get a negative girth                                                            |                                                                                                                                                                                                                                                                              | B1              |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (2)             |
| (f)            | $0.722x = 17.3$                                                                                 |                                                                                                                                                                                                                                                                              | M1              |
|                | $x = 23.96...$ awrt <b>24</b>                                                                   |                                                                                                                                                                                                                                                                              | A1              |
|                |                                                                                                 |                                                                                                                                                                                                                                                                              | (2)             |
|                | <b>Notes</b>                                                                                    |                                                                                                                                                                                                                                                                              | <b>Total 13</b> |
| (a)            | <b>M1</b>                                                                                       | for a correct expression for $S_{dg}$ or $S_{gg}$                                                                                                                                                                                                                            |                 |
|                | <b>A1</b>                                                                                       | for 12105.12 Allow $\frac{302628}{25}$                                                                                                                                                                                                                                       |                 |
|                | <b>A1</b>                                                                                       | for 9094.2 Allow $\frac{45471}{5}$                                                                                                                                                                                                                                           |                 |
|                |                                                                                                 | If exact answers are not seen then SC award M1A0A1 for both awrt 12100 and awrt 9090 if correct methods are seen<br>If exact answers are not seen then SC award M1A0A0 for both awrt 12100 and awrt 9090 if no working seen                                                  |                 |
| (b)            | <b>M1</b>                                                                                       | for a valid attempt at $r$ with their $S_{dg}$ not equal to 141978.84                                                                                                                                                                                                        |                 |
|                | <b>A1</b>                                                                                       | awrt 0.98                                                                                                                                                                                                                                                                    |                 |
| (c)            | <b>M1</b>                                                                                       | for a correct method to find the value of $b$ May be implied by 0.7218 or better                                                                                                                                                                                             |                 |
|                | <b>M1</b>                                                                                       | for a correct method to find $a$ ft their $b$ May be implied by $-42.29$ or better                                                                                                                                                                                           |                 |
|                | <b>A1*</b>                                                                                      | both method marks must be awarded with sight of 0.7218 or better <b>or</b> $-42.29$ or better                                                                                                                                                                                |                 |
| (d)            | <b>B1</b>                                                                                       | for a suitable contextual comment that mentions 0.722 (or better) If units are stated they must be correct.                                                                                                                                                                  |                 |
| (e)(i)         | <b>B1</b>                                                                                       | awrt 138 Allow 1.38m                                                                                                                                                                                                                                                         |                 |
| (ii)           | <b>B1</b>                                                                                       | For a correct reason eg sd = 45.8 cm so girth is nearly 3sd below mean so likely outlier<br>Allow substitution of 50 leading to $g = -6.2$ and suitable reason e.g. this is not possible/this is negative<br>Do not allow substitution of 0.5 to imply the girth is negative |                 |
| (f)            | <b>M1</b>                                                                                       | for a correct equation. implied by awrt 24                                                                                                                                                                                                                                   |                 |
|                | <b>A1</b>                                                                                       | awrt 24                                                                                                                                                                                                                                                                      |                 |

| Question | Scheme                                                                                          |                                                                                                                                                                                                      | Marks           |
|----------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 5 (a)    | $P(X < 18) = P\left(Z < \pm\left(\frac{18-15}{2}\right) [= \pm 1.5]\right)$                     |                                                                                                                                                                                                      | M1              |
|          | $= 0.9332$<br>awrt 0.933                                                                        |                                                                                                                                                                                                      | A1              |
|          |                                                                                                 |                                                                                                                                                                                                      | (2)             |
| (b)      | $\frac{x-15}{2} = 0.2533$                                                                       |                                                                                                                                                                                                      | M1B1            |
|          | $x = 15.506...$ awrt 15.5                                                                       |                                                                                                                                                                                                      | A1              |
|          |                                                                                                 |                                                                                                                                                                                                      | (3)             |
| (c)      | $P(T > \mu - 10) = 0.975$                                                                       |                                                                                                                                                                                                      | M1              |
|          | $\frac{(\mu \pm 10) - \mu}{\sigma} = \pm 1.96 \Rightarrow \sigma = \frac{10}{1.96} [= 5.10...]$ |                                                                                                                                                                                                      | M1              |
|          | $P(T > \mu - 5) = P\left(Z > \frac{\mu - 5 - \mu}{"5.10..."} [= -0.98]\right) [= 0.836...]$     |                                                                                                                                                                                                      | M1              |
|          | $P(T > \mu - 5 \mid T > \mu - 10) = \frac{"0.836..."}{"0.975"}$                                 |                                                                                                                                                                                                      | M1              |
|          | $= 0.8579...$ awrt 0.858                                                                        |                                                                                                                                                                                                      | A1              |
|          |                                                                                                 |                                                                                                                                                                                                      | (5)             |
|          | <b>Notes</b>                                                                                    |                                                                                                                                                                                                      | <b>Total 10</b> |
| (a)      | <b>M1</b>                                                                                       | for standardising correctly May be implied by $\pm 1.5$                                                                                                                                              |                 |
|          | <b>A1</b>                                                                                       | awrt 0.933 (Do not ISW)                                                                                                                                                                              |                 |
| (b)      | <b>M1</b>                                                                                       | for correct standardisation = to a z value such that 0.25,, $ z $ ,, 0.26                                                                                                                            |                 |
|          | <b>B1</b>                                                                                       | for use of awrt $\pm 0.2533$                                                                                                                                                                         |                 |
|          | <b>A1</b>                                                                                       | awrt 15.5                                                                                                                                                                                            |                 |
| (c)      | <b>M1</b>                                                                                       | for the correct probability of 0.975 – may be seen as the denominator of the fraction. May be implied by use of $ z  = 1.96$ or better                                                               |                 |
|          | <b>M1</b>                                                                                       | For $\frac{\mu + 10 - \mu}{\sigma} = 1.96$ or $\frac{\mu - 10 - \mu}{\sigma} = -1.96$ , leading to a value for $\sigma$<br>May be implied by $\pm 0.98$                                              |                 |
|          | <b>M1</b>                                                                                       | for a correct method to find $P(T > \mu - 5)$ using their value for $\sigma$ May be implied by $-0.98$ If $P(T < \mu + 5)$ is calculated then this may be implied by 0.98                            |                 |
|          | <b>M1</b>                                                                                       | for $\frac{p}{0.975}$ where $0.5 < p < 0.975$ (must be a probability not their z value) If the denominator is incorrect only follow through their $P(T > \mu - 10)$ if clearly labelled and $> 0.95$ |                 |
|          | <b>A1</b>                                                                                       | awrt 0.858                                                                                                                                                                                           |                 |

| Question | Scheme                                                                                                                                  |                                                                                                                                                                                             | Marks               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 6(a)     | 0.16 oe                                                                                                                                 |                                                                                                                                                                                             | B1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | (1)                 |
| (b)      | <b>Mark parts (b) and (c) together</b><br><b>If values are given in the diagram and the script, then the script takes precedence</b>    |                                                                                                                                                                                             |                     |
|          | $[P(C) = ]0.04 + 0.15 + 0.12 + p [= 0.31 + p]$<br>$[P(S) = ]0.1 + 0.15 + 0.12 + 0.23 [= 0.6]$<br>$[P(S \cap C) = ]0.15 + 0.12 [= 0.27]$ | $[P(C') = ]0.1 + 0.23 + q [= 0.33 + q]$<br>$[P(S') = ]1 - (0.12 + 0.15 + 0.1 + 0.23) [= 0.4]$<br>$[P(S' \cap C') = ]q$                                                                      | M1M1                |
|          | ("0.31" + p) × "0.6" = "0.27" oe                                                                                                        | ("0.33" + q) × "0.4" = q oe                                                                                                                                                                 | M1d                 |
|          | p = 0.14 oe                                                                                                                             | q = 0.22 oe                                                                                                                                                                                 | A1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | (4)                 |
|          |                                                                                                                                         |                                                                                                                                                                                             |                     |
| (c)      | q = 1 - (0.04 + 0.12 + 0.15 + 0.1 + 0.23 + "p")                                                                                         | p = 1 - (0.04 + 0.12 + 0.15 + 0.1 + 0.23 + "q")                                                                                                                                             | M1                  |
|          | q = 0.22 oe                                                                                                                             | p = 0.14 oe                                                                                                                                                                                 | A1ft                |
|          |                                                                                                                                         |                                                                                                                                                                                             | (2)                 |
| (d)(i)   | $[P((C \cup S) \cap G')] = 0.39$ oe                                                                                                     |                                                                                                                                                                                             | B1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | (1)                 |
| (ii)     | $P(C   (S \cap G)) = \frac{0.15}{0.15 + 0.1}$<br>= 0.6 oe                                                                               |                                                                                                                                                                                             | M1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | A1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | (2)                 |
| (e)      | Number of teenagers = $\frac{76}{0.15 + "p"}$ oe                                                                                        |                                                                                                                                                                                             | M1                  |
|          | Number who don't play Scrabble = $\left(\frac{76}{0.15 + p}\right) \times 0.4$ (= 104.8...)                                             |                                                                                                                                                                                             | M1                  |
|          | = 104.8... awrt 105                                                                                                                     |                                                                                                                                                                                             | A1                  |
|          |                                                                                                                                         |                                                                                                                                                                                             | (3)                 |
|          | <b>Notes</b>                                                                                                                            |                                                                                                                                                                                             | <b>Total<br/>13</b> |
| (a)      | <b>B1</b>                                                                                                                               | correct probability                                                                                                                                                                         |                     |
| (b)      | <b>M1</b>                                                                                                                               | for 2 correct probability expressions                                                                                                                                                       |                     |
|          | <b>M1</b>                                                                                                                               | all 3 correct probability expressions Allow $P(C) = 0.45$                                                                                                                                   |                     |
|          | <b>M1d</b>                                                                                                                              | dependent on the 1st M1 being awarded for use of $P(C \cap S) = P(C) \times P(S)$ oe or $P(C' \cap S') = P(C') \times P(S')$ ft their probabilities if labelled clearly                     |                     |
|          | <b>A1</b>                                                                                                                               | for 0.14 or exact equivalent or 0.22 or exact equivalent                                                                                                                                    |                     |
| (c)      | <b>M1</b>                                                                                                                               | for a correct expression for q ft their value of p or a correct expression for p ft their value of q May be implied by a correct value for q ft their p or a correct value for p ft their q |                     |
|          | <b>A1ft</b>                                                                                                                             | for 0.22 or exact equivalent ft their value of p or 0.14 or exact equivalent ft their value of q (p + q = 0.36 provided p and q are probabilities)                                          |                     |
| (d)(i)   | <b>B1</b>                                                                                                                               | for 0.39 or exact equivalent do not allow 0.04 + 0.12 + 0.23                                                                                                                                |                     |
| (ii)     | <b>M1</b>                                                                                                                               | for $\frac{0.15}{0.15 + 0.1}$                                                                                                                                                               |                     |
|          | <b>A1</b>                                                                                                                               | for 0.6 or exact equivalent                                                                                                                                                                 |                     |
| (e)      | <b>M1</b>                                                                                                                               | Relating 76 to their $P(C \cap G)$ May be implied by awrt 262                                                                                                                               |                     |
|          | <b>M1</b>                                                                                                                               | for number of teenagers × 0.4 ft their number of teenagers e.g. $0.4 \times "262"$ provided that the number of teenagers is not 76                                                          |                     |
|          | <b>A1</b>                                                                                                                               | awrt 105 ISW                                                                                                                                                                                |                     |

