



# Mark Scheme (Results)

January 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

The total number of marks for the paper is 75.

Edexcel Mathematics mark schemes use the following types of marks:

### 'M' marks

These are marks given for a correct method or an attempt at a correct method. In Mechanics they are usually awarded for the application of some mechanical principle to produce an equation, e.g. resolving in a particular direction; taking moments about a point; applying a suvat equation; applying the conservation of momentum principle; etc.

The following criteria are usually applied to the equation. To earn the M mark, the equation

- (i) should have the correct number of terms
- (ii) each term needs to be dimensionally correct

For example, in a moments equation, every term must be a 'force x distance' term or 'mass x distance', if we allow them to cancel 'g' s.

For a resolution, all terms that need to be resolved (multiplied by sin or cos) must be resolved to earn the M mark.

'M' marks are sometimes dependent (DM) on previous M marks having been earned, e.g. when two simultaneous equations have been set up by, for example, resolving in two directions and there is then an M mark for solving the equations to find a particular quantity – this M mark is often dependent on the two previous M marks having been earned.

### 'A' marks

These are dependent accuracy (or sometimes answer) marks and can only be awarded if the previous M mark has been earned. e.g. M0 A1 is impossible.

### 'B' marks

These are independent accuracy marks where there is no method (e.g. often given for a comment or for a graph).

A and B marks may be f.t. – follow through – marks.

## General Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes:

- bod means benefit of doubt
- ft means follow through
  - the symbol  $\surd$  will be used for correct ft
- cao means correct answer only
- cso means correct solution only, i.e. there must be no errors in this part of the question to obtain this mark
- isw means ignore subsequent working
- awrt means answers which round to

- SC means special case
- oe means or equivalent (and appropriate)
- dep means dependent
- indep means independent
- dp means decimal places
- sf means significant figures
- \* means the answer is printed on the question paper
- $\square$  means the second mark is dependent on gaining the first mark

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.

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 a candidate makes more than one attempt at any question:

- If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
- If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

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 Number | Scheme                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks   |
|-----------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 1 (a)           | $2 \times 36 = 72 \quad 8 \times 4 = 32$                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | M1 A1   |
|                 |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (2)     |
| (b)             | $[13] + \frac{(204 - 184)}{120} \times 2$                      | $[13] + \frac{(204.5 - 184)}{120} \times 2$                                                                                                                                                                                                                                                                                                                                                                                                                                                      | M1      |
|                 | $= \frac{40}{3} = \text{awrt } 13.3$                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A1      |
|                 |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (2)     |
| (c)             | Symmetrically distributed/No skew as the mean $\approx$ median |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | B1      |
|                 |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (1)     |
| (d)             | $\frac{32}{4} + 152 + \frac{120}{2} [= 220]$                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | M1      |
|                 | $\frac{'220'}{408} \times \frac{'219'}{407}$                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | M1      |
|                 | $\frac{365}{1258}$ or 0.2901... awrt 0.29                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A1      |
|                 |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (3)     |
|                 | Notes                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Total 8 |
| (a)             | M1                                                             | For any equivalent method to find either frequency<br>Maybe implied by either correct frequency<br>Also maybe implied by two frequencies which add to 104<br>Also maybe implied by a correct scale on the fd axis , at least 3 labels                                                                                                                                                                                                                                                            |         |
|                 | A1                                                             | For 72 and 32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |         |
| (b)             | M1                                                             | For any equivalent method to find the median<br>e.g. $\frac{Q_2 - 13}{15 - 13} = \frac{204 - 184}{304 - 184}$ or $\frac{15 - Q_2}{Q_2 - 13} = \frac{304 - 204}{204 - 184}$<br>allow working downwards $[15] - \frac{(304 - 204)}{120} \times 2$                                                                                                                                                                                                                                                  |         |
|                 | A1                                                             | awrt 13.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |
| (c)             | B1                                                             | For a correct identification of skew [which must either be symmetric/no skew or (slight) negative skew] with a correct supporting reason.<br>Condone mean < median so negative skew<br>Allow use of 'their median' in the comparison provided 'their median' ... 13.2<br>Allow $Q_1 = \text{awrt } 10.8$ or awrt 10.9 and $Q_3 = \text{awrt } 15.1$ and $Q_2 - Q_1 > Q_3 - Q_2$ so negative skew.<br>Comments referring only to the diagram (being symmetrical therefore no skew) send to review |         |
| (d)             | M1                                                             | For a correct method to find the number of plants between 8cm and 14cm (may be implied by sight of 220)                                                                                                                                                                                                                                                                                                                                                                                          |         |
|                 | M1                                                             | For $\frac{n}{408} \times \frac{n-1}{407}$ or $\left(\frac{n}{408}\right)^2$ with 210 ,, n ,, 230                                                                                                                                                                                                                                                                                                                                                                                                |         |
|                 | A1                                                             | awrt 0.29 may see $\frac{3025}{10404}$ from $\left(\frac{220}{408}\right)^2$                                                                                                                                                                                                                                                                                                                                                                                                                     |         |

| Question Number | Scheme                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks    |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2 (a)(i)        | Mean = 71.83...                                                                                                                                 | awrt 71.8                                                                                                                                                                                                                                                                                                                                                                                                                 | B1       |
| (ii)            | Standard deviation = $\sqrt{\frac{62802}{12} - \left(\frac{862}{12}\right)^2}$ or variance = $\frac{62802}{12} - \left(\frac{862}{12}\right)^2$ |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | $\sqrt{73.47...} = 8.571...$                                                                                                                    | 8.57 * (to 3s.f.)                                                                                                                                                                                                                                                                                                                                                                                                         | A1*      |
|                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           | (3)      |
| (b)             | $S_{xx} = 62802 - \frac{862^2}{12} [= \frac{2645}{3} = 881.66...]$                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | $r = \frac{512.67}{\sqrt{413.67 \times 881.66...}}$                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | = 0.8489...                                                                                                                                     | awrt 0.849                                                                                                                                                                                                                                                                                                                                                                                                                | A1       |
|                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           | (3)      |
| (c)             | Mean = $\frac{5}{9} \times (71.8 - 32)$                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | = 22.11...                                                                                                                                      | awrt 22.1                                                                                                                                                                                                                                                                                                                                                                                                                 | A1ft     |
|                 | Standard deviation = $\frac{5}{9} \times 8.57...$                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | = 4.76...                                                                                                                                       | awrt 4.76                                                                                                                                                                                                                                                                                                                                                                                                                 | A1       |
|                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           | (4)      |
| (d)             | $r = '0.8489...' / \text{same (as for } x \text{ and } y)$                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                           | M1       |
|                 | $r$ not affected by (linear) coding oe                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                           | A1       |
|                 |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           | (2)      |
| Notes           |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           | Total 12 |
| (a)(i)          | <b>B1</b>                                                                                                                                       | awrt 71.8 Allow $\frac{431}{6}$ oe                                                                                                                                                                                                                                                                                                                                                                                        |          |
| (ii)            | <b>M1</b>                                                                                                                                       | A correct method to find the standard deviation or the variance ft their mean for M1 only<br>Also allow s.d. = $\sqrt{\frac{S_{xx}}{n}}$                                                                                                                                                                                                                                                                                  |          |
|                 | <b>A1*</b>                                                                                                                                      | Must see at least one simplification of working <b>and</b> the given answer 8.57.<br>e.g. $\sqrt{73.47...}$ or 8.572 or 8.571... or $\frac{23\sqrt{5}}{6}$ or $\sqrt{\frac{2645}{36}}$ therefore s.d. = 8.57* (to 3s.f.)<br>$\sqrt{\frac{62802}{12} - 71.8^2}$ scores M1A0 (use of 71.8 or 71.83 always scores M1A0).<br>To get required accuracy must see at least 71.833 used i.e. $\sqrt{\frac{62802}{12} - 71.833^2}$ |          |
| (b)             | <b>M1</b>                                                                                                                                       | A correct method to find $S_{xx}$ (implied by awrt 882)                                                                                                                                                                                                                                                                                                                                                                   |          |
|                 | <b>M1</b>                                                                                                                                       | A correct method to find PMCC using their value of $S_{xx}$                                                                                                                                                                                                                                                                                                                                                               |          |
|                 | <b>A1</b>                                                                                                                                       | awrt 0.849                                                                                                                                                                                                                                                                                                                                                                                                                |          |
| (c)             | <b>M1</b>                                                                                                                                       | A correct method to find the mean ft their mean in part (a)                                                                                                                                                                                                                                                                                                                                                               |          |
|                 | <b>A1ft</b>                                                                                                                                     | awrt 22.1 ft their mean in part (a)                                                                                                                                                                                                                                                                                                                                                                                       |          |
|                 | <b>M1</b>                                                                                                                                       | A correct method to find the standard deviation<br>(do not isw if any further calculation is done after multiplying by $\frac{5}{9}$ )                                                                                                                                                                                                                                                                                    |          |
|                 | <b>A1</b>                                                                                                                                       | awrt 4.76                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| (d)             | <b>M1</b>                                                                                                                                       | $r =$ their part (b) provided $-1 \leq r \leq 1$ allow 2 s.f. on the ft                                                                                                                                                                                                                                                                                                                                                   |          |
|                 | <b>A1</b>                                                                                                                                       | Any correct reasoning but M1 must be scored.<br>Allow e.g. 'addition/subtraction <b>and</b> multiplication/division does not affect $r$ ' ,                                                                                                                                                                                                                                                                               |          |

| Question Number | Scheme                                                                                                                                                                                   |                                                                                                                                                | Marks          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 3 (a)           | $1 - p, \frac{7}{8}$ and $\frac{9}{10}$ in the correct place on tree diagram                                                                                                             |                                                                                                                                                | B1             |
|                 |                                                                                                                                                                                          |                                                                                                                                                | (1)            |
| (b)             | $\frac{1}{8}p + \frac{1}{10}(1 - p) = 0.11$                                                                                                                                              |                                                                                                                                                | M1 A1ft        |
|                 | $p = \frac{2}{5}$                                                                                                                                                                        |                                                                                                                                                | A1             |
|                 |                                                                                                                                                                                          |                                                                                                                                                | (3)            |
| (c)             | $\frac{2}{5} \times \frac{1}{8} = \frac{1}{20}$                                                                                                                                          |                                                                                                                                                | M1 A1ft        |
|                 |                                                                                                                                                                                          |                                                                                                                                                | (2)            |
| (d)             | $P(Y12   R) = \frac{\frac{2}{5} \times \frac{7}{8}}{1 - 0.11}$ or $P(Y12   R) = \frac{\frac{2}{5} \times \frac{7}{8}}{\frac{2}{5} \times \frac{7}{8} + \frac{3}{5} \times \frac{9}{10}}$ |                                                                                                                                                | M1             |
|                 | $= \frac{35}{89}$                                                                                                                                                                        |                                                                                                                                                | A1             |
|                 |                                                                                                                                                                                          |                                                                                                                                                | (2)            |
|                 | <b>Notes</b>                                                                                                                                                                             |                                                                                                                                                | <b>Total 8</b> |
| (a)             | <b>B1</b>                                                                                                                                                                                | For a fully correct tree diagram with all 3 correct labels.<br>Allow if $1 - p$ is seen and crossed out/replaced with a numerical probability. |                |
| (b)             | <b>M1</b>                                                                                                                                                                                | For $\frac{1}{8}p$ or $\frac{1}{10}(1 - p)$ seen in an equation for $p$                                                                        |                |
|                 | <b>A1ft</b>                                                                                                                                                                              | For a fully correct equation in $p$ or correct ft equation based on their tree diagram                                                         |                |
|                 | <b>A1</b>                                                                                                                                                                                | oe correct answer scores 3 out of 3                                                                                                            |                |
| (c)             | <b>M1</b>                                                                                                                                                                                | For $p \times \frac{1}{8}$ ft their $p$ , provided $p$ is a probability                                                                        |                |
|                 | <b>A1ft</b>                                                                                                                                                                              | For a correct answer ft their $p$ , provided $p$ is a probability.<br>Correct answer scores 2 out of 2                                         |                |
| (d)             | <b>M1</b>                                                                                                                                                                                | For a correct ratio of probabilities.<br>Can ft their $p$ , provided $p$ is a probability                                                      |                |
|                 | <b>A1</b>                                                                                                                                                                                | For $\frac{35}{89}$ (Allow awrt 0.393)                                                                                                         |                |

| Question Number | Scheme                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks           |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 4 (a)           | LQ = 28 or UQ = 48                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                      | B1              |
|                 | '48'+1.5('48'-'28')[= 78]                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                      | M1              |
|                 | 90 > 78 so, 90 is an outlier*                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                      | A1*             |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | (3)             |
| (b)             | $b = \frac{1735.6}{1667.6} [= 1.04...]$                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                      | M1              |
|                 | $a = 38.2 - 'b'(42.2) [= -5.72....]$                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                      | M1              |
|                 | $s = -5.72 + 1.04f$ *                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                      | A1*             |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | (3)             |
| (c)             | For every <b>extra mark</b> (oe) in <b>French/f</b> , <b>Spanish/s goes up</b> (oe) by [on average] <b>1.04 marks</b>                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                      | B1              |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | (1)             |
| (d) (i)         | $s = -5.72 + 1.04 \times 55 = 51.48$ awrt 51.5                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                      | M1 A1           |
|                 | (ii) $s = -5.72 + 1.04 \times 18 = 13$                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                      | A1              |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | (3)             |
| (e)             | <ul style="list-style-type: none"><li>• The first estimate is an interpolation/The second estimate is an extrapolation</li><li>• 55 is within the range of data/18 is not within the range of data</li><li>• 55 is closer to the mean/18 is further away from the mean</li></ul> <p>.....so 51.5 is the more reliable estimate</p> |                                                                                                                                                                                                                                                                                                                                                                                                                      | M1              |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | A1              |
|                 |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                      | (2)             |
|                 | <b>Notes</b>                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Total 12</b> |
| (a)             | <b>B1</b>                                                                                                                                                                                                                                                                                                                          | For either LQ or UQ correct (may be seen in calculation for M1)                                                                                                                                                                                                                                                                                                                                                      |                 |
|                 | <b>M1</b>                                                                                                                                                                                                                                                                                                                          | Correct use of $Q_3 + 1.5 \times (Q_3 - Q_1)$ ft their LQ and their UQ provided their UQ > their LQ                                                                                                                                                                                                                                                                                                                  |                 |
|                 | <b>A1*</b>                                                                                                                                                                                                                                                                                                                         | For both LQ and UQ correct and identifying 90>78 or 90 is an outlier<br>Answer is given so no incorrect working can be seen                                                                                                                                                                                                                                                                                          |                 |
| (b)             | <b>M1</b>                                                                                                                                                                                                                                                                                                                          | For a correct method to find the gradient                                                                                                                                                                                                                                                                                                                                                                            |                 |
|                 | <b>M1</b>                                                                                                                                                                                                                                                                                                                          | For a correct method to find the intercept (division by 11 is M0)                                                                                                                                                                                                                                                                                                                                                    |                 |
|                 | <b>A1*</b>                                                                                                                                                                                                                                                                                                                         | Cao (dep on both M marks) must see printed answer $s = -5.72 + 1.04f$                                                                                                                                                                                                                                                                                                                                                |                 |
| (c)             | <b>B1</b>                                                                                                                                                                                                                                                                                                                          | For a correct numerical interpretation of the gradient in context which must include <u>marks</u> at least once                                                                                                                                                                                                                                                                                                      |                 |
| (d) (i)         | <b>M1</b>                                                                                                                                                                                                                                                                                                                          | For a correct substitution into the regression equation.<br>May be seen in (i) or (ii) or implied by one correct answer                                                                                                                                                                                                                                                                                              |                 |
|                 | <b>A1</b>                                                                                                                                                                                                                                                                                                                          | awrt 51.5 Allow 51 or 52                                                                                                                                                                                                                                                                                                                                                                                             |                 |
| (ii)            | <b>A1</b>                                                                                                                                                                                                                                                                                                                          | 13 or awrt 13.0                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| (e)             | <b>M1</b>                                                                                                                                                                                                                                                                                                                          | For any equivalent correct reason<br>Ignore extraneous non-contradictory comments<br>For the second bullet point <b>must</b> be clear that they are referring to French marks (24,, $f$ ,, 68).<br>Do <b>not</b> allow comments that refer to the range of Spanish marks e.g. ‘51.5’ is within the range of data/‘13’ is not within the range of data’<br>Do <b>not</b> allow ‘55 is closer to the median (than 18)’ |                 |
|                 | <b>A1</b>                                                                                                                                                                                                                                                                                                                          | For clearly identifying the estimate from part (d)(i): 51.5 or 55 or (i) or ‘the first estimate’, etc.                                                                                                                                                                                                                                                                                                               |                 |

| Question Number | Scheme                                                                                                           |                                                                                                                                                                     | Marks   |
|-----------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 5 (a)           | $P(X < 38.8) = P\left(Z < \frac{38.8 - 40}{4}\right) [= P((Z < -0.3))]$                                          |                                                                                                                                                                     | M1      |
|                 | $= 1 - 0.6179 = 0.3821 *$                                                                                        |                                                                                                                                                                     | A1*     |
|                 |                                                                                                                  |                                                                                                                                                                     | (2)     |
| (b)             | $P(\text{Qualify}) = 1 - (0.3821)^3$ or $1 - 0.3821 + 0.3821 \times (1 - 0.3821) + 0.3821^2 \times (1 - 0.3821)$ |                                                                                                                                                                     | M1      |
|                 | $[= 0.9442]$                                                                                                     |                                                                                                                                                                     |         |
|                 | $P(X > 44) = P\left(Z > \frac{44 - 40}{4}\right) [= P((Z > 1))]$                                                 |                                                                                                                                                                     | M1      |
|                 | $[= 1 - 0.8413] = 0.1587$                                                                                        |                                                                                                                                                                     | A1      |
|                 | $P(X > 44 \text{ on 2nd attempt}   \text{Qualify}) = \frac{0.3821 \times '0.1587'}{'0.9442'}$                    |                                                                                                                                                                     | M1      |
|                 | $0.06422\dots$ awrt 0.0642                                                                                       |                                                                                                                                                                     | A1      |
|                 |                                                                                                                  |                                                                                                                                                                     | (5)     |
|                 | Notes                                                                                                            |                                                                                                                                                                     | Total 7 |
| (a)             | M1                                                                                                               | For standardising using 38.8, 40 and 4 (allow $\pm$ )                                                                                                               |         |
|                 | A1*                                                                                                              | Must see $1 - 0.6179$ or we must see 0.38209 or 0.38208... or better<br>Answer is given so no incorrect working can be seen (but condone poor probability notation) |         |
| (b)             | M1                                                                                                               | For a correct method to find the probability of qualifying                                                                                                          |         |
|                 | M1                                                                                                               | For standardising using 44, 40 and 4 (implied by $1 - 0.8413$ or awrt 0.1587)                                                                                       |         |
|                 | A1                                                                                                               | awrt 0.16                                                                                                                                                           |         |
|                 | M1                                                                                                               | For a correct ratio of probabilities ft their 0.1587 and their 0.9442.<br>Use of 0.6179 in the denominator is M0                                                    |         |
|                 | A1                                                                                                               | awrt 0.0642                                                                                                                                                         |         |

| Question Number | Scheme                                                       |                                                                                                                                                                                                                                                                         | Marks          |     |
|-----------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|
| 6 (a)           | $P(B A) = \frac{P(B \cap A)}{P(A)}$                          |                                                                                                                                                                                                                                                                         |                |     |
|                 | $0.3 = \frac{P(B \cap A)}{x} \Rightarrow P(B \cap A) = 0.3x$ |                                                                                                                                                                                                                                                                         | M1             |     |
|                 | $P(A \cup B) = P(A) + P(B) - 'P(A \cap B)'$                  |                                                                                                                                                                                                                                                                         | M1             |     |
|                 | $0.65 = x + y - 0.3x \Rightarrow 0.65 = 0.7x + y$            |                                                                                                                                                                                                                                                                         |                |     |
|                 | $14x + 20y = 13 *$                                           |                                                                                                                                                                                                                                                                         | A1*            |     |
|                 |                                                              |                                                                                                                                                                                                                                                                         | (3)            |     |
| (b)(i)          | $P(B \cup C) = P(B) + P(C)$ or $P(B \cap C) = 0$             |                                                                                                                                                                                                                                                                         | M1             |     |
|                 | $0.85 = \frac{1}{2}x + 2y$                                   |                                                                                                                                                                                                                                                                         | A1             |     |
|                 | (ii)                                                         | Attempt to solve the 2 equations simultaneously                                                                                                                                                                                                                         |                | M1  |
|                 |                                                              | $x = 0.5 \qquad y = 0.3$                                                                                                                                                                                                                                                |                | A1  |
|                 |                                                              |                                                                                                                                                                                                                                                                         |                | (4) |
| (c)             | $P(B A) = 0.3$ <b>and</b><br>$P(B) = '0.3'$                  | $P(A) \times P(B) = '0.5' \times '0.3'$ <b>and</b><br>$P(A \cap B) = 0.3 \times '0.5'$ or<br>$P(A \cap B) = '0.5' + '0.3' - 0.65$                                                                                                                                       | M1             |     |
|                 | So, $A$ and $B$ are statistically independent                |                                                                                                                                                                                                                                                                         | A1ft           |     |
|                 |                                                              |                                                                                                                                                                                                                                                                         | (2)            |     |
|                 | <b>Notes</b>                                                 |                                                                                                                                                                                                                                                                         | <b>Total 9</b> |     |
| (a)             | <b>M1</b>                                                    | Use of $P(B A) = \frac{P(B \cap A)}{P(A)}$ assuming independence is M0 e.g. $P(B \cap A) = P(B) \times P(A) [= xy]$<br>May be implied by $P(B \cap A) = 0.3x$ (may be seen on a Venn diagram)                                                                           |                |     |
|                 | <b>M1</b>                                                    | Use of $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ with substitution of $P(A \cup B)$ , $P(A)$ and $P(B)$ (the equation may be seen in a Venn diagram)<br>$0.65 = x + y - 0.3x$ implies M1M1                                                                              |                |     |
|                 | <b>A1*</b>                                                   | Answer is given so no incorrect working can be seen                                                                                                                                                                                                                     |                |     |
| (b)(i)          | <b>M1</b>                                                    | Use of $P(B \cup C) = P(B) + P(C)$ or sight of $P(B \cap C) = 0$                                                                                                                                                                                                        |                |     |
|                 | <b>A1</b>                                                    | Any correct second equation in $x$ and $y$ which need not be simplified.                                                                                                                                                                                                |                |     |
| (ii)            | <b>M1</b>                                                    | Attempt to solve the 2 equations simultaneously. Either a correct substitution seen or a correct method to eliminate $x$ or $y$                                                                                                                                         |                |     |
|                 | <b>A1</b>                                                    | For $x = 0.5$ and $y = 0.3$                                                                                                                                                                                                                                             |                |     |
| (c)             | <b>M1</b>                                                    | For finding all of the probabilities needed for a test for independence (probabilities must be labelled) ft their values of $x$ and $y$<br>$P(B A)$ <b>and</b> $P(B)$ or $P(A)$ , $P(B)$ <b>and</b> $P(A \cap B)$<br>For $P(A \cap B)$ we <b>must</b> see working shown |                |     |
|                 | <b>A1ft</b>                                                  | For a correct ft conclusion for their values of $x$ and $y$ (must have scored M1)                                                                                                                                                                                       |                |     |

| Question Number | Scheme                                                                                                                                            |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | Marks           |    |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------|----------------|-----------------|----|
| 7 (a)           | $\frac{k+4}{8} = 1 \quad [k = 4^*]$                                                                                                               |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | B1*             |    |
|                 |                                                                                                                                                   |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | (1)             |    |
| (b)             | <b>x</b>                                                                                                                                          | 1                                                                                                                                                                                            | 2                                            | 3                                                                                                                                          | 4                                   |                |                | M1 M1<br>A1     |    |
|                 | <b>P(X = x)</b>                                                                                                                                   | $\frac{1}{13}$                                                                                                                                                                               | $\frac{7}{26} - \frac{1}{13} = \frac{5}{26}$ | $\frac{15}{26} - \frac{7}{26} = \frac{4}{13}$                                                                                              | $1 - \frac{15}{26} = \frac{11}{26}$ |                |                |                 |    |
|                 |                                                                                                                                                   |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | (3)             |    |
| (c)             | 4                                                                                                                                                 |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | B1ft            |    |
|                 |                                                                                                                                                   |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | (1)             |    |
| (d)             | $E(X) = 1 \times \frac{1}{13} + 2 \times \frac{5}{26} + 3 \times \frac{4}{13} + 4 \times \frac{11}{26} \left[ = \frac{40}{13} \right]$            |                                                                                                                                                                                              |                                              | <b>Y</b>                                                                                                                                   | 7                                   | 20             | 33             | 46              | M1 |
|                 |                                                                                                                                                   |                                                                                                                                                                                              |                                              | <b>P(Y = y)</b>                                                                                                                            | $\frac{1}{13}$                      | $\frac{5}{26}$ | $\frac{4}{13}$ | $\frac{11}{26}$ |    |
|                 | $E(X^2) = 1^2 \times \frac{1}{13} + 2^2 \times \frac{5}{26} + 3^2 \times \frac{4}{13} + 4^2 \times \frac{11}{26} \left[ = \frac{135}{13} \right]$ |                                                                                                                                                                                              |                                              | $E(Y) = 7 \times \frac{1}{13} + 20 \times \frac{5}{26} + 33 \times \frac{4}{13} + 46 \times \frac{11}{26} \left[ = 34 \right]$             |                                     |                |                | M1              |    |
|                 | $\text{Var}(X) = \frac{135}{13} - \left( \frac{40}{13} \right)^2 \left[ = \frac{155}{169} \right]$                                                |                                                                                                                                                                                              |                                              | $E(Y^2) = 7^2 \times \frac{1}{13} + 20^2 \times \frac{5}{26} + 33^2 \times \frac{4}{13} + 46^2 \times \frac{11}{26} \left[ = 1311 \right]$ |                                     |                |                | M1              |    |
|                 | $\text{Var}(13X - 6) = 13^2 \times \frac{155}{169}$                                                                                               |                                                                                                                                                                                              |                                              | $\text{Var}(13X - 6) = 1311 - 34^2$                                                                                                        |                                     |                |                | M1              |    |
|                 | $= 155$                                                                                                                                           |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | A1              |    |
|                 |                                                                                                                                                   |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | (5)             |    |
|                 | <b>Notes</b>                                                                                                                                      |                                                                                                                                                                                              |                                              |                                                                                                                                            |                                     |                |                | <b>Total 10</b> |    |
| (a)             | <b>B1*</b>                                                                                                                                        | $\frac{k+4}{8} = 1$ oe Allow verification method $\frac{4+4}{8} = 1$ provided they conclude $k = 4$                                                                                          |                                              |                                                                                                                                            |                                     |                |                |                 |    |
| (b)             | <b>M1</b>                                                                                                                                         | For a correct method to find one probability from $x = 2, x = 3$ or $x = 4$ (implied by any one correct probability from $x = 2, x = 3$ or $x = 4$ )                                         |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>M1</b>                                                                                                                                         | For a correct method to find a second probability from $x = 2, x = 3$ or $x = 4$ (implied by any two correct probabilities from $x = 2, x = 3$ or $x = 4$ )                                  |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>A1</b>                                                                                                                                         | For a fully correct probability distribution.<br>Need not be in a table, but 1, 2, 3 and 4 must be associated with correct probability                                                       |                                              |                                                                                                                                            |                                     |                |                |                 |    |
| (c)             | <b>B1ft</b>                                                                                                                                       | Must be consistent with the highest probability in their distribution in part (b).<br>If no distribution is found, then the answer must be 4                                                 |                                              |                                                                                                                                            |                                     |                |                |                 |    |
| (d)             | <b>M1</b>                                                                                                                                         | For a correct method to find $E(X)$ (implied by awrt 3.08) ft their table use of $\sum xF(x)$ is M0<br>or for a correct probability distribution for $13X - 6$ ft their probabilities in (b) |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>M1</b>                                                                                                                                         | For a correct method to find $E(X^2)$ (implied by awrt 10.4) ft their table use of $\sum x^2F(x)$ is M0<br>or for a correct method to find $E(Y)$ ft their table                             |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>M1</b>                                                                                                                                         | Use of $E(X^2) - E(X)^2$ ft their $E(X^2)$ and their $E(X)$ or<br>for a correct method to find $E(Y^2)$ ft their table                                                                       |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>M1</b>                                                                                                                                         | Use of $13^2 \text{Var}(X)$ ft their $\text{Var}(X)$<br>or use of $E(Y^2) - E(Y)^2$ ft their $E(Y^2)$ and their $E(Y)$                                                                       |                                              |                                                                                                                                            |                                     |                |                |                 |    |
|                 | <b>A1</b>                                                                                                                                         | Cao                                                                                                                                                                                          |                                              |                                                                                                                                            |                                     |                |                |                 |    |

| Question Number | Scheme                                                                                                                                                                          |                                                                                                                                                | Marks                                |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 8 (a)           | $P(X > \mu + 2k) = 0.2$                                                                                                                                                         | or                                                                                                                                             | $P(X < \mu - 2k) = 0.2$              |
|                 | or $P(X < \mu + 2k) = 0.8$                                                                                                                                                      | or                                                                                                                                             | $P(X > \mu - 2k) = 0.8$              |
|                 | $\frac{\mu + 2k - \mu}{6} = 0.8416$                                                                                                                                             | or                                                                                                                                             | $\frac{\mu - 2k - \mu}{6} = -0.8416$ |
|                 | $k = 2.5248...$                                                                                                                                                                 | awrt 2.52                                                                                                                                      | A1                                   |
|                 |                                                                                                                                                                                 |                                                                                                                                                | (4)                                  |
| (b)             | $P\left(Y > \frac{3}{2}\mu\right) \Rightarrow P\left(Z > \frac{\frac{3}{2}\mu - \mu}{\sigma}\right) \Rightarrow P\left(Z > \frac{\frac{1}{2}\mu}{\sigma}\right)$                |                                                                                                                                                | M1                                   |
|                 | $\mu = \frac{3}{2}\sigma^2 \Rightarrow P\left(Z > \frac{\frac{1}{2}\left(\frac{3}{2}\sigma^2\right)}{\sigma}\right) \left[ = P\left(Z > \frac{3}{4}\sigma\right) \right]$       |                                                                                                                                                | M1                                   |
|                 | or                                                                                                                                                                              |                                                                                                                                                |                                      |
|                 | $\sigma = \sqrt{\frac{2\mu}{3}} \Rightarrow P\left(Z > \frac{\frac{1}{2}\mu}{\sqrt{\frac{2\mu}{3}}}\right) = \left[ P\left(Z > \frac{1}{2}\sqrt{\frac{3\mu}{2}}\right) \right]$ |                                                                                                                                                |                                      |
|                 | $\frac{1}{2}\frac{\mu}{\sigma} = k$ and $2\mu = 3\sigma^2$                                                                                                                      |                                                                                                                                                |                                      |
|                 | $\frac{3}{4}\sigma = 1.5$ or $\frac{1}{2}\sqrt{\frac{3\mu}{2}} = 1.5$ or $3\sigma^2 = 6\sigma$                                                                                  |                                                                                                                                                | M1                                   |
|                 | $\mu = 6$ only, $\sigma = 2$ only                                                                                                                                               |                                                                                                                                                | A1 A1                                |
|                 |                                                                                                                                                                                 |                                                                                                                                                | (5)                                  |
|                 | Notes                                                                                                                                                                           |                                                                                                                                                | Total 9                              |
| (a)             | M1                                                                                                                                                                              | For any of the given tail probability statements which may be seen on a diagram<br>Also may be implied by awrt $\pm 0.84$ seen                 |                                      |
|                 | M1                                                                                                                                                                              | For standardising using $\mu$ and 6 and setting = to $z$ value, where $0.8 <  z  < 0.9$<br>Implied by $(\pm)\frac{k}{3} = (\pm)0.84$ or better |                                      |
|                 | A1                                                                                                                                                                              | For a fully correct standardisation with a compatible $z$ value. $ z $ must be 0.8416 or better                                                |                                      |
|                 | A1                                                                                                                                                                              | awrt 2.52 (Allow 2.525) Answer only 2.52 is M1M1A0A1 Answer only 2.5248 is M1M1A1A1                                                            |                                      |
| (b)             | M1                                                                                                                                                                              | For standardising using $\frac{3}{2}\mu$ , $\mu$ and $\sigma$                                                                                  |                                      |
|                 | M1                                                                                                                                                                              | For substitution of $\mu = \frac{3}{2}\sigma^2$ into their standardisation or setting up two equations in $\mu$ and $\sigma$                   |                                      |
|                 | M1                                                                                                                                                                              | For their expression for $\sigma$ only or $\mu$ only used with $\pm 1.5$                                                                       |                                      |
|                 | A1                                                                                                                                                                              | $\mu = 6$ or $\sigma = 2$                                                                                                                      |                                      |
|                 | A1                                                                                                                                                                              | $\mu = 6$ and $\sigma = 2$ must reject any other values if found                                                                               |                                      |

