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# A-LEVEL

# Mathematics

Statistics 1B – MS1B

Mark scheme

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6360  
June 2015

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Version/Stage: 1.0: Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from [aqa.org.uk](http://aqa.org.uk)

## Key to mark scheme abbreviations

|              |  |
|--------------|--|
| M            | mark is for method   |
| m or dM      | mark is dependent on one or more M marks and is for method         |
| A            | mark is dependent on M or m marks and is for accuracy              |
| B            | mark is independent of M or m marks and is for method and accuracy |
| E            | mark is for explanation  |
| ✓ or ft or F | follow through from previous incorrect result                      |
| CAO          | correct answer only  |
| CSO          | correct solution only  |
| AWFW         | anything which falls within  |
| AWRT         | anything which rounds to   |
| ACF          | any correct form   |
| AG           | answer given   |
| SC           | special case   |
| OE           | or equivalent  |
| A2,1         | 2 or 1 (or 0) accuracy marks                                       |
| -x EE        | deduct x marks for each error                                      |
| NMS          | no method shown  |
| PI           | possibly implied   |
| SCA          | substantially correct approach                                     |
| c            | candidate  |
| sf           | significant figure(s)  |
| dp           | decimal place(s)   |

### No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

**General Notes for MS1B**

- GN1** There is no allowance for misreads (MR) or miscopies (MC) unless specifically stated in a question
- GN2** In general, a correct answer (to accuracy required) without working scores full marks but an incorrect answer (or an answer not to required accuracy) scores no marks
- GN3** When applying AFWF, a slightly inaccurate numerical answer that is subsequently rounded to fall within the accepted range cannot be awarded full marks.
- GN4** Where percentage equivalent answers are permitted in a question, then penalise by **one accuracy mark** at the first **correct** answer but only if no indication of percentage (eg %) is shown
- GN5** In questions involving probabilities, do **not** award **accuracy** marks for answers given in the form of a ratio or odds such as 11/30 given as 11:30 or 11:19
- GN6** Accept decimal answers, providing that they have **at least two** leading zeros, in the form  $c \times 10^{-n}$  (eg 0.00524 as  $5.24 \times 10^{-3}$ )

| Q            | Solution  | Marks           | Total    | Comments   |
|--------------|---|-----------------|----------|--|
| 1<br>(a)     | Using summary data with shown method:<br><br>$r_{xy} = \frac{3629670}{\sqrt{76581640 \times 694250}}$ $= \underline{\underline{0.49 \text{ to } 0.5}}$  | M1<br><br>A1    | 2        | Used; accept (all 3 values) $\div 10$<br>Can be implied by a <b>correct</b> answer<br><br>AWFW (0.497791)  |
|              | Using summary data without shown method<br><b>or</b><br>using raw data with or without shown method:<br><br>$r_{xy} = \underline{\underline{0.49 \text{ to } 0.5}}$ $r_{xy} = \underline{\underline{0.4 \text{ to } 0.6}}$  | (B2)<br>(B1)    |          | AWFW<br>AWFW   |
| (b)          | <b>Moderate/some</b><br><br><b>positive</b> (linear) correlation<br><br>between<br><br><b>gas and electricity consumptions</b>  | Bdep1<br><br>B1 | 2        | Dependent on $0.4 \leq r_{xy} \leq 0.6$<br>OE; must <b>qualify strength</b><br>and state <b>positive</b><br><br>Providing $-1 < r_{xy} < +1$<br>OE; must be in context |
| <b>Notes</b> | 1 Only accept phrases stated; ignore additional comments unless contradictory<br>2 Use of any of the following terms (even in conjunction with moderate/some): “strong or high or big or good or low or little or small or weak or slight or medium or average or reasonable or pretty” $\Rightarrow$ Bdep0<br>3 Accept “relationship/association/link” but not “trend” instead of “correlation”<br>4 As gas consumption increases then electricity consumption increases $\Rightarrow$ Bdep0 B1<br>5 Do <b>not</b> accept “between $x$ and $y$ ” or “between kWh” or “between consumptions” or “between gas and electricity” without further clarification |                 |          |  |
|              |   | <b>Total</b>    | <b>4</b> |  |

| Q        | Solution   | Marks                                     | Total    | Comments  |
|----------|--|---|----------|---|
| 2<br>(a) | <p>Mid-points (<math>d</math>):</p> <p>65.5 66.5 67.5 68.5 69.5 70.5 71.5</p> <p>Mean = <b><u>68.2 to 68.3</u></b></p> <p>or</p> <p>or</p> <p>Var(<math>n</math>) = <b><u>2.42</u></b></p> <p>or</p> <p>or</p> <p>Var(<math>n-1</math>) = <b><u>2.46</u></b></p> <p>Var(<math>n</math>) or Var(<math>n-1</math>) = <b><u>2.4 to 2.5</u></b></p>  | <p>M1</p> <p>A1</p> <p>B2</p> <p>(B1)</p> | <p>4</p> | <p><b>At least four seen or implied (only) from</b></p> <p><math>\sum fd = 4095</math></p> <p>or mean = 68.2 to 68.3 AFWW</p> <p>or mean = 68.5 CAO</p> <p>AWFW (68.25)</p> <p>(2.42083)</p> <p>AWRT (<math>\sum fd^2 = 279629</math>)</p> <p>(2.46186)</p> <p>AWFW</p> |
| Notes    | <p>1 Value of variance stated as <math>1.55^2</math> to <math>1.57^2</math> and not evaluated <math>\Rightarrow</math> B1</p> <p>2 Value of variance or standard deviation stated as 1.55 to 1.57 <math>\Rightarrow</math> B0</p> <p>3 If, and only if, M0 A0 B0, then award M1 for <b>seen</b> attempt at <math>\sum f \times (d / LCB / UCB) \div 60</math> or <math>(4095 / 4065 / 4125) \div 60</math></p> |   |          |   |
| (b)      | <p>Mean = <math>\frac{(68.2 \text{ to } 68.3)}{25.4}</math></p> <p>= <b><u>2.68 to 2.69</u></b></p> <p>Var(<math>n</math>) or Var(<math>n-1</math>) = <math>\frac{(2.4 \text{ to } 2.5)}{25.4^2}</math></p> <p>= <b><u>0.0037 to 0.0039</u></b></p>  | <p>B1</p> <p>B1</p>                       | <p>2</p> | <p>AWFW (2.68701)</p> <p>AWFW (0.0037523 or 0.0038159)</p> <p>Accept <math>(3.7 \text{ to } 3.9) \times 10^{-3}</math> (see GN6)</p>  |
|          |  | <b>Total</b>                              | <b>6</b> |   |

| Q      | Solution  | Marks        | Total   | Comments    |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|--------|---|--------------|---|-------------|--|--|--|--|--|---|----|---|-------|-----|----|------|------|------|---------------|---|-------------|-------------|-------------|---------------|-------|--|------|------|-------------|------|----|----------|---|
| 3      | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="3" style="text-align: center;">Arrive</td> <td></td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">E</td> <td style="text-align: center;">OT</td> <td style="text-align: center;">L</td> <td style="text-align: center;">Total</td> </tr> <tr> <td rowspan="2" style="text-align: center; vertical-align: middle;">Dep</td> <td style="text-align: center;">OT</td> <td style="text-align: center;">0.16</td> <td style="text-align: center;">0.56</td> <td style="text-align: center;">0.08</td> <td style="text-align: center;"><b>0.8(0)</b></td> </tr> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;"><b>0.06</b></td> <td style="text-align: center;"><b>0.09</b></td> <td style="text-align: center;"><b>0.05</b></td> <td style="text-align: center;"><b>0.2(0)</b></td> </tr> <tr> <td colspan="2" style="text-align: center;">Total</td> <td style="text-align: center;">0.22</td> <td style="text-align: center;">0.65</td> <td style="text-align: center;"><b>0.13</b></td> <td style="text-align: center;">1.00</td> </tr> </table> |              |   | Arrive      |  |  |  |  |  | E | OT | L | Total | Dep | OT | 0.16 | 0.56 | 0.08 | <b>0.8(0)</b> | L | <b>0.06</b> | <b>0.09</b> | <b>0.05</b> | <b>0.2(0)</b> | Total |  | 0.22 | 0.65 | <b>0.13</b> | 1.00 | B2 | <b>2</b> | In (b) & (c), accept any equivalent fractional answer with den ≤ 100 or the equivalent percentage answer with %- sign (see GN4) |
|        |   |              |   | Arrive      |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   | E            | OT  | L           | Total  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| Dep    | OT  | 0.16         | 0.56  | 0.08        | <b>0.8(0)</b>  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        | L   | <b>0.06</b>  | <b>0.09</b>                                     | <b>0.05</b> | <b>0.2(0)</b>  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| Total  |   | 0.22         | 0.65  | <b>0.13</b> | 1.00   |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (a)    |   | (B1)         | All 6 correct CAO<br><br>Any 3 of 6 correct CAO |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (b)(i) | $P(OT_D \cap OT_A) =$   | <b>0.56</b>  | B1  | <b>(1)</b>  | CAO/OE; even 0.56/1  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (ii)   | $P(L_D) =$  | <b>0.2</b>   | B1  |             | CAO/OE; even 0.2/1   |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              |   | <b>2</b>    |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (c)(i) | $P(L_A   L_D) = \frac{0.05}{0.2} =$   | <b>0.25</b>  | M1  | <b>(2)</b>  | (c's 0.05)/(c's (b)(ii))<br>Can be implied by a <b>correct</b> answer  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | A1  |             | CAO/OE; not 0.25/1   |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (ii)   | $P(L'_A   OT_D) = \frac{0.16 + 0.56}{0.8} \quad \text{or} \quad \frac{0.8 - 0.08}{1 - 0.2} \quad \text{or} \quad \frac{0.72}{0.8}$ $\frac{0 < p < 0.8}{0.8}$  | <b>0.9</b>   | B2  | <b>(3)</b>  | Can be implied by a <b>correct</b> answer                              |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | (B1)  |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | B1  |             | CAO/OE; not 0.9/1  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              |   | <b>5</b>    |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| (d)    | $P(E_A \cap OT_A \cap L_A   OT_D) =$ $\frac{0.16}{0.8} \times \frac{0.56}{0.8} \times \frac{0.08}{0.8} \quad \text{or} \quad 0.2 \times 0.7 \times 0.1$ $\times (3! \text{ or } 6)$   | <b>0.084</b> | M2  | <b>4</b>    | <b>All three correct</b> (equivalent) fractions or decimals multiplied |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | (M1)  |             | <b>At least one correct</b> (equivalent) fraction or decimal           |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | m1  |             | Dependent on M2  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | A1  |             | CAO  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| Notes  | 1 Do not penalise the <b>correct answer</b> quoted to more than three decimal places (eg 0.0840)  |              |   |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
| SCs    | 2 Answers given as 84/1000 or 42/500 or 21/250 or 8.4% or $8.4 \times 10^{-2}$ (see GN6) ⇒ M1 M1 m1 A0  |              |   |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        | 1 Answers of 0.014 or 0.042 (CAO/OE) even without working ⇒ M2 mo A0  |              |   |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        | 2 $(0.16 \times 0.56 \times 0.08) \Rightarrow$ M1 m0 A0 (ignore any additional integer multiplier)  |              |   |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        | 3 $\left(\frac{0.16}{1} \times \frac{0.56}{1} \times \frac{0.08}{1}\right) \Rightarrow$ M1 but $\left(\frac{0.16}{p_1} \times \frac{0.56}{p_2} \times \frac{0.08}{p_3}\right) \Rightarrow$ M0 (when all $p_i \neq 0.8$ )  |              |   |             |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |
|        |   |              | <b>Total</b>                                    | <b>13</b>   |  |  |  |  |  |   |    |   |       |     |    |      |      |      |               |   |             |             |             |               |       |  |      |      |             |      |    |          |   |

| Q            | Solution  | Marks   | Total      | Comments  |
|--------------|---|---|------------|---|
| 4<br>(a)     | Scatter diagram:<br><br><b>4 points</b><br><b>2 or 3 points</b>   | B2<br>(B1)  | <b>2</b>   | Within red box on overlay<br>(Ignore any additional points or any labelling of points)  |
| (b)<br>(i)   | $b$ (gradient/slope) = <u>0.4 to 0.41</u><br>$b$ (gradient/slope) = <u>0.35 to 0.45</u><br><br>$a$ (intercept) = <u>1.2 to 1.4</u><br>$a$ (intercept) = <u>0.45 to 2.35</u><br><br>Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$<br><br><b>or</b><br>Attempt at $S_{xx}$ & $S_{xy}$<br><br>Attempt at substitution into correct corresponding formula for $b$<br>$b = \underline{0.40 to 0.41}$ $a = \underline{1.2 to 1.4}$  | B2<br>(B1)<br><br>B2<br>(B1)<br><br>(M1)<br><br>(m1)<br>(A1 A1) | <b>(4)</b> | AFWW (0.40517)<br>AFWW<br><br>For answers as fractions, see Note 7<br><br>AFWW (1.30186)<br>AFWW<br><br>209 4455 99 & <b>2077.1</b><br>(all 4 attempted)      ( $\sum y^2 = 937.02$ )<br><br>484 & <b>196.1</b><br>(both attempted)      ( $S_{yy} = 82.02$ )<br><br>AFWW      ( $\bar{x} = 19$ & $\bar{y} = 9$ ) |
| <b>Notes</b> | 1 Treat rounding of correct, but <b>not</b> of incorrect, answers as ISW                      2 Written form of equation is <b>not</b> required<br>3 Award 4 marks for $y = (1.2 to 1.4) + (0.4 to 0.41)x$ <b>or</b> for $(1.2 to 1.4) + (0.4 to 0.41)x$<br>4 Values of $a$ and $b$ interchanged and equation $y = ax + b$ <b>used</b> for drawing line $\Rightarrow$ max of 4 marks<br>5 Values of $a$ and $b$ interchanged and equation $y = a + bx$ used for drawing line $\Rightarrow$ 0 marks<br>6 Values are <b>not</b> identified or simply $b/a = \#$ and $a/b = \#$ , then 0.35 to 0.45 $\Rightarrow$ B1 and 0.45 to 2.35 $\Rightarrow$ B1 but accept, for example, as identification, [ $b = \#, a = \#$ with $y = a + bx$ but no substitution for $b$ & $a$ ] <b>or</b> [slope/gradient( $b$ ) = #, intercept( $a$ ) = #]<br>7 Answers in fractions can score at most B1 B1 or M1 m1<br>8 Some/all of marks can be scored in (b)(ii), (c) & (d)(i), even if some/all of marks are lost in (b)(i), but marks lost in (b)(i) <b>cannot</b> be recouped by subsequent working in (b)(ii), (c) or (d)(i) |   |            |   |
| <b>Notes</b> | Scatter diagram<br><br>Line must be (approximately) straight;<br><b>not</b> dog leg, curve or wavy  | <b>line</b><br><br>B2   | <b>(2)</b> | From <b>at least</b> $x = 8$ to $x = 30$ (allow a tolerance of 2 squares (ie 4 mm) on line length)<br><b>and</b> within red tolerance lines on overlay, even if drawn by eye  |
| <b>Notes</b> | 1 If, and only if, B0, then award M1 for <b>seen</b> use of an equation for <b>at least two</b> points<br>2 If, and only if, B0, then award M0 for points or line marked on scatter diagram without supportive working  |   |            |   |
|              |   |   | <b>6</b>   |   |
|              | <b>Parts (a) &amp; (b)(i)</b>   | <b>Total</b>  | <b>8</b>   |   |



| Q              | Solution  | Marks   | Total      | Comments  |
|----------------|---|---|------------|---|
| <b>4</b>       | <b>Continued</b>  |   |            |   |
|                | <b>Parts (a) &amp; (b)(i)</b>   | <b>Total</b>  | <b>8</b>   |   |
| <b>(b)(ii)</b> | <i>b</i> : each/every/one/an additional tile takes<br>or <b>increase per tile</b> is<br><br>(on average) <i>b</i> hours/ <b>60<i>b</i></b> mins   | B1<br><br>BF1   | <b>(2)</b> | F on <i>b</i> providing <b>0.35 ≤ <i>b</i> ≤ 0.45</b><br>and <b>correct units</b> are stated                              |
| <b>Notes</b>   | 1 To score any marks, an explanation must indicate change in <i>x</i> affecting change in <i>y</i> , <b>not</b> change in <i>y</i> affecting change in <i>x</i><br>2 Reference <b>only</b> to correlation ⇒ B0 BF0    |   |            |   |
| <b>SC</b>      | 1 As <i>x</i> /number of tiles increases then <i>y</i> /time increases by <i>b</i> /60 <i>b</i> (OE; value of <i>b</i> (0.35 ≤ <i>b</i> ≤ 0.45) must be stated but context and/or units are <b>not</b> required) ⇒ B1 |   |            |   |
|                | <i>a</i> : time to replace no/zero tiles,<br>start-up time, minimum time,<br>time for travelling, preparation,<br>erecting ladders, obtaining materials, etc  | BF1   | <b>(1)</b> | OE; in context<br>Reference to the value of <i>a</i> is not<br>required<br>F on <i>a</i> providing <b><i>a</i> &gt; 0</b> |
|                |   |   | <b>3</b>   |   |
| <b>(c)</b>     | $y(15) = \underline{7 \text{ to } 8}$   | B1  | <b>1</b>   | AWFW (7.37934)<br>From calculation/graph/guesswork<br>Hours <b>not</b> required   |
| <b>Note</b>    | 1 Accept (420 to 480) minutes only if “minutes/mins” are stated   |   |            |   |
| <b>(d)(i)</b>  | $r_6 = 8.8 - a - b \times 20 =$<br>$r_6 =$  | $\underline{-0.6 \text{ to } -0.61}$<br>$\underline{0.5 \text{ to } 0.7}$ | B2<br>(B1) | <b>2</b><br>AWFW; do not ignore sign (−0.60517)<br>AWFW; ignore sign  |
| <b>Note</b>    | 1 If, and only if, B0, then attempted use of $\pm(8.8 - a - b \times 20) \Rightarrow$ M1 providing $0.35 \leq b \leq 0.45$ and $0.45 \leq a \leq 2.35$  |   |            |   |
| <b>(ii)</b>    | Value will be/is always:<br><br><b><u>0 or zero or nought or nothing</u></b>  | B1  | <b>1</b>   | CAO; accept nothing else, but ignore<br>zeros after decimal point (eg 0.00)<br>Ignore any explanation                     |
|                |   | <b>Total</b>  | <b>15</b>  |   |

| Q                         | Solution   | Marks                      | Total   | Comments   |
|---------------------------|--|----------------------------|---|--|
| <b>5</b><br><b>(a)(i)</b> | $P(X < 1.9) = P\left(Z < \frac{1.9 - 1.81}{0.08}\right)$ $= P(Z < 1.125) = \underline{\mathbf{0.87}}$  | M1                         | <b>(2)</b>  | Accept percentage equivalent answers in (a) but see GN4  |
|                           |  | A1                         |   | Standardising 1.9 with 1.81 and 0.08 but allow (1.81 – 1.9)<br>AWRT (0.86971)  |
| <b>(ii)</b>               | $P(X > 1.85) = P(Z > 0.5) = 1 - P(Z < 0.5)$ $= 1 - 0.69146 = \underline{\mathbf{0.31}}$  | M1<br>A1                   | <b>(2)</b>  | Area change; can be implied by <b>any final answer &lt; 0.5</b><br>AWRT (0.30854)  |
| <b>(iii)</b>              | $P(1.81 < X < 1.85)$ $= (0.691 \text{ to } 0.692) - 0.5$ <b>or</b> $= 0.5 - (0.308 \text{ to } 0.309)$ $= \underline{\mathbf{0.19}}$   | B1<br>B1                   | <b>(2)</b>  | Can be implied by a <b>correct</b> answer<br>AWRT (0.19146)  |
|                           |  |                            | <b>6</b>  |  |
| <b>(b)(i)</b>             | $z = \text{or} < \frac{9.25 - \mu}{\sigma} \quad \text{or} \quad 9.25 = \mu + z\sigma$ $0.88 \Rightarrow z = \underline{\mathbf{1.17 \text{ to } 1.18}}$   | M1<br>B1                   | <b>2</b>  | Either expression <b>or</b> with $z$ replaced by 1.17 to 1.18 (AWFW)<br>AWFW (ignore sign) (1.175)   |
|                           |  | <b>Notes</b>               | 1 Allow $\bar{x}$ /mean instead of $\mu$ and/or $s$ /sd instead of $\sigma$<br>2 Result of $9.25 - \mu = z\sigma$ stated without any prior evidence $\Rightarrow$ M0<br>3 Working back from the given answer $9.25 - \mu = z \times \sigma \Rightarrow$ M0<br>4 The M1 cannot be scored for work in (b)(ii)<br>5 The $z$ -value of 1.17 to 1.18 (AWFW) must be seen in (b)(i) to score B1; seen only in (b)(ii) scores B0 |  |
| <b>(ii)</b>               | $P(Y > 8.75) = 0.975 \Rightarrow z = \underline{\mathbf{1.96}}$ <p>Thus</p> $9.25 - \mu = +1.175\sigma$ $8.75 - \mu = -1.96\sigma$ <p>giving</p> $0.5 = 3.135\sigma$ $\sigma = \underline{\mathbf{0.16}}$ $\mu = \underline{\mathbf{9 \text{ to } 9.1}}$ | B1<br>M1<br>Adep1<br>Adep1 | <b>4</b>  | AWRT (ignore sign)<br>(1.17 to 1.18) AFWW (ignore sign)<br>(1.96) AFWT (ignore sign)<br>A valid method for solution of two equations that are correct except for signs of $z$ -values (see Note 1)<br>AWRT (0.15949)<br>Dependent on <b>two fully correct equations</b> including signs of $z$ -values<br>AWFW (9.06260) |
|                           |  | <b>Note</b>                | 1 Accept method as shown or substitution for either $\mu$ or $\sigma$ from one equation into the other, even if $z$ -value signs are incorrect  |  |
|                           |  | <b>Total</b>               | <b>12</b>   |  |

| Q            | Solution  | Marks                                  | Total      | Comments   |
|--------------|---|--|------------|--|
| <b>6</b>     | Accept 3 dp rounding of probabilities from tables   |  |            | Accept percentage equivalent answers in (a) & (b) but see GN4  |
| <b>(a)</b>   |   |  |            |  |
| <b>(i)</b>   | $P(X \leq 15) = \underline{0.694 \text{ to } 0.695}$  | B1                                     | <b>(1)</b> | AWFW (0.6946)  |
| <b>(ii)</b>  | $P(X > 10)$<br>$= 1 - 0.1215$<br>$= \underline{0.878 \text{ to } 0.879}$<br>$= 1 - 0.0644 \text{ or } 0.935 \text{ to } 0.936$  | M1<br>A1<br>(M1)                       | <b>(2)</b> | AWFW (0.8785)  |
| <b>Note</b>  | 1 For calculation of individual terms or no method: award <b>B2</b> for 0.878 to 0.879 (AWFW); <b>B1</b> for 0.935 to 0.936 (AWFW)  |  |            |  |
| <b>(iii)</b> | $P(12 < X < 18)$<br>$\begin{matrix} (p_1) & (p_2) \\ = 0.8761 & \text{or } 0.9301 \end{matrix}$<br><b>MINUS</b> 0.3143 <b>or</b> 0.2053<br>$= \underline{0.561 \text{ to } 0.562}$  | M1<br>M1<br>A1                         | <b>(3)</b> | AWFW (0.5618)  |
| <b>Notes</b> | 1 For calculation of individual terms or no method: award <b>B3</b> for 0.561 to 0.562 (AWFW); <b>B2</b> for 0.670 to 0.671 (AWFW); <b>B2</b> for 0.615 to 0.616 (AWFW); <b>B2</b> for 0.724 to 0.725 (AWFW)<br>2 $(1 - p_2) - (1 - p_1) \Rightarrow$ M1 M1 A1 or M1 M1 or M1 |  |            |  |
| <b>(iv)</b>  | Mean of distribution = $40 \times 0.35 = \underline{14}$<br>$P(X=14)$<br>$= \binom{40}{14} 0.35^{14} 0.65^{26}$<br><b>or</b><br>$= 0.5721 - 0.4408$<br>$= \underline{0.131 \text{ to } 0.132}$  | B1<br>M1<br>A1                         | <b>(3)</b> | CAO; can be implied<br><br>Fully correct expression<br><br>Can be implied<br><br>Correct difference<br><br>AWFW (0.1313) |
|              |   |  | <b>9</b>   |  |
| <b>(b)</b>   | Selection is at <b>random</b><br>$P(Y < 30   B(50, 0.7))$<br>$= 1 - 0.9522$<br>$= \underline{0.047 \text{ to } 0.048}$<br>$= 1 - 0.9152 \text{ or } 0.084 \text{ to } 0.085$<br>$= 1 - 0.9749 \text{ or } 0.025 \text{ to } 0.026$<br>$= 0.952 \text{ to } 0.953$             | B1<br>M2<br>A1<br>(M2)<br>(M2)<br>(M1) | <b>4</b>   | Statement must include word “random”<br><br>AWFW (0.0478)  |
| <b>Note</b>  | 1 For direct use of $P(Y < 30   B(50, 0.7))$ using calculator or no method: award <b>(B1) B3</b> for 0.047 to 0.048 (AWFW); <b>(B1) B2</b> for 0.084 to 0.085 (AWFW); <b>(B1) B2</b> for 0.025 to 0.026 (AWFW); <b>(B1) M1</b> for 0.952 to 0.953                             |  |            |  |
|              |   |  |            |  |
|              |   | <b>Total</b>                           | <b>13</b>  |  |



