



**General Certificate of Education**

**Mathematics 6360**

**MS2B      Statistics 2**

**Mark Scheme**

*2007 examination - January series*

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

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## Key to mark scheme and abbreviations used in marking

|              |                                                                    |     |                            |
|--------------|--------------------------------------------------------------------|-----|----------------------------|
| 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                      | MC  | mis-copy                   |
| CAO          | correct answer only                                                | MR  | mis-read                   |
| CSO          | correct solution only                                              | RA  | required accuracy          |
| AWFW         | anything which falls within                                        | FW  | further work               |
| AWRT         | anything which rounds to                                           | ISW | ignore subsequent work     |
| ACF          | any correct form                                                   | FIW | from incorrect work        |
| AG           | answer given                                                       | BOD | given benefit of doubt     |
| SC           | special case                                                       | WR  | work replaced by candidate |
| OE           | or equivalent                                                      | FB  | formulae book              |
| A2,1         | 2 or 1 (or 0) accuracy marks                                       | NOS | not on scheme              |
| -x EE        | deduct x marks for each error                                      | G   | graph                      |
| NMS          | no method shown                                                    | C   | candidate                  |
| PI           | possibly implied                                                   | Sf  | significant figure(s)      |
| SCA          | substantially correct approach                                     | 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. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

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.**

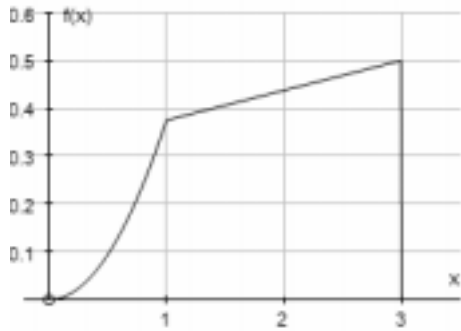
## MS2B

| Q       | Solution                                                                                                                                                                                                                                                     | Marks                                       | Total     | Comments                                                                                                 |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------|
| 1       | $\bar{x} = 39.5 \quad s = 4.84 \quad (s^2 = 23.4)$<br>$t_{\text{crit}} = 2.365$<br>95% CI for $\mu$<br>$= \bar{x} \pm t_{\text{crit}} \times \frac{s}{\sqrt{n}}$<br>$= 39.5 \pm 2.365 \times \frac{4.84}{\sqrt{8}}$<br>$= 39.5 \pm 4.05$<br>$= (35.5, 43.5)$ | B1B1<br>B1<br><br><br><br>M1<br><br><br>A1✓ | 5         | $\sigma = 4.53 \quad (\sigma^2 = 20.5)$<br><br><br><br><br>$39.5 \pm 2.365 \times \frac{4.53}{\sqrt{7}}$ |
|         | <b>Total</b>                                                                                                                                                                                                                                                 |                                             | <b>5</b>  |                                                                                                          |
| 2(a)(i) | $P(A = 4) = \frac{e^{-3.5} \times (3.5)^4}{4!} = 0.189$                                                                                                                                                                                                      | M1A1                                        | 2         |                                                                                                          |
| (ii)    | $P(B \leq 6) = 0.762$                                                                                                                                                                                                                                        | B1                                          | 1         |                                                                                                          |
| (iii)   | $T = A + B \sim \text{Po}(8.5)$<br>$P(T \text{ fewer than } 10) = P(T < 10)$<br>$= P(T \leq 9)$<br>$= 0.653$                                                                                                                                                 | M1<br>M1<br>A1                              | 3         | Use of Po (8.5)<br>$T \leq 9$ attempted<br>CAO                                                           |
| (b)     | $X \sim B(5, 0.653)$<br>$P(X \geq 4) = \binom{5}{4} (0.653)^4 (0.347)$<br>$+ (0.653)^5$<br>$= 0.31547 + 0.11873$<br>$= 0.434$                                                                                                                                | B1<br><br><br>M1<br><br>A1✓                 | 3         | $X \sim B(5, \text{their } p)$<br><br><br><br>On their $p$ from (a)(iii)                                 |
| (c)(i)  | $\bar{x} = 9.2$<br>$s^2 = 9.29$                                                                                                                                                                                                                              | B1<br>B1                                    | 2         | $\sigma^2 = 8.36$                                                                                        |
| (ii)    | Mean and variance have similar values which suggests that Poisson distribution may be appropriate                                                                                                                                                            | B1✓<br>B1✓                                  | 2         |                                                                                                          |
|         | <b>Total</b>                                                                                                                                                                                                                                                 |                                             | <b>13</b> |                                                                                                          |

**MS2B (cont)**

| <b>Q</b>      | <b>Solution</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Marks</b>                                               | <b>Total</b>                                      | <b>Comments</b>                                                                                                                                                                                                     |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3</b>      | $\bar{x} = 83.5$<br>$s^2 = \frac{1}{99}(15321) = 154.76$<br>$s = 12.44$<br>$H_0 : \mu = 85.9$<br>$H_1 : \mu \neq 85.9$<br>Under $H_0$ , $\bar{X} \sim N\left(85.9, \frac{(12.44^2)}{100}\right)$<br>$z_{\text{crit}} = \pm 1.96$<br>$z = \frac{83.5 - 85.9}{12.44/\sqrt{10}} = -1.929$<br>accept $H_0$ , reject the claim<br>Insufficient evidence to suggest that the mean has changed from 85.9 at the 5% level of significance. | B1<br><br>B1<br>B1<br><br>B1<br>M1<br>A1<br>A1✓<br><br>E1✓ | <br><br><br><br><br><br><br><br><br><br><br><br>8 | <br><br>$(154 < s^2 \leq 155)$<br>$(12.4 \leq s \leq 12.45)$<br><br>$z = 1.96 + 2$ tail test used<br>$\frac{(\text{their } \bar{x}) - 85.9}{(\text{their } s)/\sqrt{10}}$<br><br>AWFW -1.94 to 1.92<br>On their $z$ |
|               | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                            | <b>8</b>                                          |                                                                                                                                                                                                                     |
| <b>4(a)</b>   | $\sum p = 1$<br>$k = 1 - (0.01 + 0.05 + 0.14 + 0.30 + 0.12)$<br>$k = 0.38$                                                                                                                                                                                                                                                                                                                                                         | B1                                                         | 1                                                 |                                                                                                                                                                                                                     |
| <b>(b)(i)</b> | $E(X) = \sum_{\text{all } x} x P(X = x) = 4.35$                                                                                                                                                                                                                                                                                                                                                                                    | B1                                                         | 1                                                 | $\frac{87}{20}$                                                                                                                                                                                                     |
| <b>(ii)</b>   | $\text{Var}(X) = \sum_{\text{all } x} x^2 P(X = x) - \mu^2$<br>$= 20.09 - 18.9225$<br>$= 1.1675$                                                                                                                                                                                                                                                                                                                                   | M1<br>M1<br>A1                                             | <br><br>3                                         | $E(X^2)$ attempted<br>$\sum x^2 P(X = x) - \mu^2$<br>$\frac{467}{400}$ (AWFW 1.16 – 1.17)                                                                                                                           |
| <b>(c)(i)</b> | $E(Y) = 5E(X) + 2$<br>$= 5 \times 4.35 + 2$<br>$= 23.75$                                                                                                                                                                                                                                                                                                                                                                           | M1                                                         | 1                                                 | Their (b)(i) $\times 5 + 2$                                                                                                                                                                                         |
| <b>(ii)</b>   | $\text{Var}(Y) = 25\text{Var}(X)$<br>$= 29.1875$<br>Standard deviation = 5.40                                                                                                                                                                                                                                                                                                                                                      | M1<br><br>m1<br>A1                                         | <br><br>3                                         | Their (b)(ii) $\times 25$<br><br>$\sqrt{\quad}$<br>$(5.40 - 5.41)$                                                                                                                                                  |
|               | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                            | <b>9</b>                                          |                                                                                                                                                                                                                     |

**MS2B (cont)**

| <b>Q</b>     | <b>Solution</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Marks</b>                            | <b>Total</b> | <b>Comments</b>                                                                               |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------|-----------------------------------------------------------------------------------------------|
| <b>5(a)</b>  | $H_0 : \mu = 30$<br>$H_1 : \mu > 30$<br>$\bar{x} = 33.5$ and $s = 4.25$ ( $s^2 = 18.06$ )<br>Under $H_0$ $\bar{X} \sim N\left(30, \frac{(4.25^2)}{10}\right)$<br>$t = \frac{33.5 - 30}{4.25/\sqrt{10}} = 2.60$<br>$t_{\text{crit}} = 2.821$<br>do not reject $H_0$<br>Insufficient evidence at the 1% level of significance that Jasmine's teacher is underestimating the time that it takes to complete the homework assignments. | B1<br>B1B1<br><br>M1A1<br>B1<br><br>E1✓ | 7            | $\sigma = 4.03$ ( $\sigma^2 = 16.25$ )<br>↓<br>$\frac{33.5 - 30}{4.03/\sqrt{9}}$ (2.6 – 2.61) |
| <b>(b)</b>   | Times are Normally distributed                                                                                                                                                                                                                                                                                                                                                                                                     | B1                                      | 1            |                                                                                               |
| <b>Total</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         | <b>8</b>     |                                                                                               |
| <b>6(a)</b>  |                                                                                                                                                                                                                                                                                                                                                  | B1<br>B1<br>B1                          | 3            | for curve<br>for line<br>for axes                                                             |
| <b>(b)</b>   | $P(T \geq 1) = \frac{1}{2} \times \frac{7}{8} \times 2 = \frac{7}{8}$                                                                                                                                                                                                                                                                                                                                                              | M1A1                                    | 2            | OE                                                                                            |

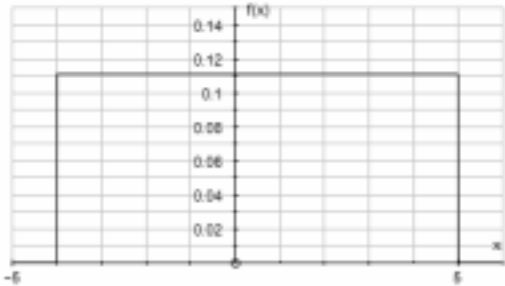
**MS2B (cont)**

| <b>Q</b>       | <b>Solution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Marks</b>                                                                                       | <b>Total</b> | <b>Comments</b>                                                                         |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------|
| <b>6(c)(i)</b> | <p>For <math>1 \leq t \leq 3</math></p> $\int_1^t \frac{1}{16}(t+5)dt = \left[ \frac{1}{32}t^2 + \frac{5}{16}t \right]_1^t$ $F(1) = \frac{1}{8}$ $F(t) = \frac{1}{8} + \frac{1}{32}t^2 + \frac{5}{16}t - \frac{11}{32}$ $F(t) = \frac{1}{32}(t^2 + 10t - 7)$ <p><b>Alternative:</b></p> $\int \frac{1}{16}(t+5)dt$ $= \frac{1}{16} \left( \frac{1}{2}t^2 + 5t + c \right)$ $F(1) = \frac{1}{8}$ $\Rightarrow c = -3.5$ $F(t) = \frac{1}{32}(t^2 + 10t - 7)$ | <p>M1A1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>(M1)<br/>(A1)</p> <p>(B1)</p> <p>(M1)</p> <p>(A1)</p> | <p>5</p>     | <p>Use of: <math>F(t) = F(1) + \int_1^t \frac{1}{16}(t+5)dt</math></p> <p><b>AG</b></p> |
| <b>(ii)</b>    | $\frac{1}{32}(m^2 + 10m - 7) = 0.5$ $m^2 + 10m - 23 = 0$ $m = \frac{-10 \pm \sqrt{192}}{2} = -5 \pm \sqrt{48}$ $= -5 \pm 4\sqrt{3}$ <p><math>(m &gt; 0)</math></p> $m = 4\sqrt{3} - 5 = 1.93$                                                                                                                                                                                                                                                               | <p>M1</p> <p>A1</p> <p>m1</p> <p>A1</p>                                                            | <p>4</p>     | <p>(or any valid method)</p> <p>(1.9282)</p>                                            |
|                | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                    | <b>14</b>    |                                                                                         |

**MS2B (cont)**

| Q    | Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Marks | Total       | Comments              |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------|-----------------------|-------|----|-------|-------|--------|----|-------|-------|--------|----|-------|-------|--------|--|--|--|--|----|-------|------|--------|----|-------|-------|--------|----|-------|------|--------|--|--|--|--|----|-------|------|--------|----|-------|-------|--------|----|-------|------|--------|--|--|--|--|----|-------|-------|--------|----|-------|-------|--------|----|-------|------|--------|----|--|-------|
| 7(a) | $H_0$ : No association between the performances at KS3 and GCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | B1    |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | <table><tr><td><math>O_i</math></td><td><math>E_i</math></td><td><math>O_i - E_i</math></td><td><math>X^2</math></td></tr><tr><td>60</td><td>63.55</td><td>-3.55</td><td>0.1983</td></tr><tr><td>55</td><td>44.64</td><td>10.36</td><td>2.4043</td></tr><tr><td>40</td><td>46.81</td><td>-6.81</td><td>0.9907</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>55</td><td>51.25</td><td>3.75</td><td>0.2744</td></tr><tr><td>32</td><td>36.00</td><td>-4.00</td><td>0.4444</td></tr><tr><td>38</td><td>37.75</td><td>0.25</td><td>0.0017</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>47</td><td>46.33</td><td>0.67</td><td>0.0097</td></tr><tr><td>31</td><td>32.54</td><td>-1.54</td><td>0.0733</td></tr><tr><td>35</td><td>34.13</td><td>0.87</td><td>0.0222</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>43</td><td>43.87</td><td>-0.87</td><td>0.0173</td></tr><tr><td>26</td><td>30.82</td><td>-4.82</td><td>0.7527</td></tr><tr><td>38</td><td>32.31</td><td>5.69</td><td>1.0005</td></tr></table> | $O_i$ | $E_i$       | $O_i - E_i$           | $X^2$ | 60 | 63.55 | -3.55 | 0.1983 | 55 | 44.64 | 10.36 | 2.4043 | 40 | 46.81 | -6.81 | 0.9907 |  |  |  |  | 55 | 51.25 | 3.75 | 0.2744 | 32 | 36.00 | -4.00 | 0.4444 | 38 | 37.75 | 0.25 | 0.0017 |  |  |  |  | 47 | 46.33 | 0.67 | 0.0097 | 31 | 32.54 | -1.54 | 0.0733 | 35 | 34.13 | 0.87 | 0.0222 |  |  |  |  | 43 | 43.87 | -0.87 | 0.0173 | 26 | 30.82 | -4.82 | 0.7527 | 38 | 32.31 | 5.69 | 1.0005 | M1 |  | $E_i$ |
|      | $O_i$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $E_i$ | $O_i - E_i$ | $X^2$                 |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 63.55 | -3.55       | 0.1983                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 55                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 44.64 | 10.36       | 2.4043                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 46.81 | -6.81       | 0.9907                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 55                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 51.25 | 3.75        | 0.2744                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 36.00 | -4.00       | 0.4444                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 38                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 37.75 | 0.25        | 0.0017                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 47                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 46.33 | 0.67        | 0.0097                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 32.54 | -1.54       | 0.0733                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 34.13 | 0.87        | 0.0222                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | 43                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 43.87 | -0.87       | 0.0173                |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
| 26   | 30.82                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | -4.82 | 0.7527      |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
| 38   | 32.31                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5.69  | 1.0005      |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | M1    |             | $O_i - E_i$           |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | M1    |             | $(O_i - E_i)^2 / E_i$ |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | M1    |             | $\Sigma$              |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | $X^2 = 6.1897$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A1    |             | AWFW 6.05 – 6.35      |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | $\nu = 3 \times 2 = 6 \Rightarrow \chi^2_{90\%} = 10.645$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | B1B1✓ |             | on their $\nu$        |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | Do not reject $H_0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | No evidence to suggest an association between KS3 results and GCE grades at 10% level of significance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | E1✓   | 9           |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
| (b)  | More of the students achieving level 7 at KS3 gain grade A's at GCE than expected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | E1    | 1           |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |             |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |
|      | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       | 10          |                       |       |    |       |       |        |    |       |       |        |    |       |       |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |      |        |    |       |       |        |    |       |      |        |  |  |  |  |    |       |       |        |    |       |       |        |    |       |      |        |    |  |       |

**MS2B (cont)**

| <b>Q</b>    | <b>Solution</b>                                                                           | <b>Marks</b> | <b>Total</b> | <b>Comments</b>                                                    |
|-------------|-------------------------------------------------------------------------------------------|--------------|--------------|--------------------------------------------------------------------|
| <b>8(a)</b> | $f(x) = \begin{cases} \frac{1}{9} & -4 \leq x \leq 5 \\ 0 & \text{otherwise} \end{cases}$ | M1<br>A1     | 2            |                                                                    |
| <b>(b)</b>  |          | B1<br><br>B1 | 2            | horizontal line from $-4$ to $5$<br><br>for drawn at $\frac{1}{9}$ |
| <b>(c)</b>  | $P(X > 2) = \frac{1}{9} \times 3$                                                         | M1           |              | $F(5) - F(2)$                                                      |
|             | $= \frac{1}{3}$                                                                           | A1           | 2            | $= 1 - \frac{2}{3}$<br>$= \frac{1}{3}$                             |
| <b>(d)</b>  | $\text{Mean} = \frac{1}{2}$                                                               | B1           |              |                                                                    |
|             | $\text{Variance} = \frac{1}{12} \times 81$                                                |              |              |                                                                    |
|             | $= 6.75$                                                                                  | B1           | 2            |                                                                    |
|             | <b>Total</b>                                                                              |              | <b>8</b>     |                                                                    |
|             | <b>TOTAL</b>                                                                              |              | <b>75</b>    |                                                                    |