# Mark Scheme (Results)

January 2018

Pearson Edexcel International GCSE
Mathematics B (4MB0)
Paper 02

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.
  Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

### Types of mark

- M marks: method marks
- A marks: accuracy marks
- B marks: unconditional accuracy marks (independent of M marks)

### Abbreviations

- cao – correct answer only
- ft – follow through
- isw – ignore subsequent working
- SC - special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- eeoo – each error or omission

**No working**

- If no working is shown then correct answers normally score full marks
- If no working is shown then incorrect (even though nearly correct) answers score no marks.

**With working**

- If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.
- If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.
- Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.
- If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.
- If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.
- If there is no answer on the answer line then check the working for an obvious answer.

**Ignoring subsequent work**

- It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.
- It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.
- Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

**Parts of questions**

- Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

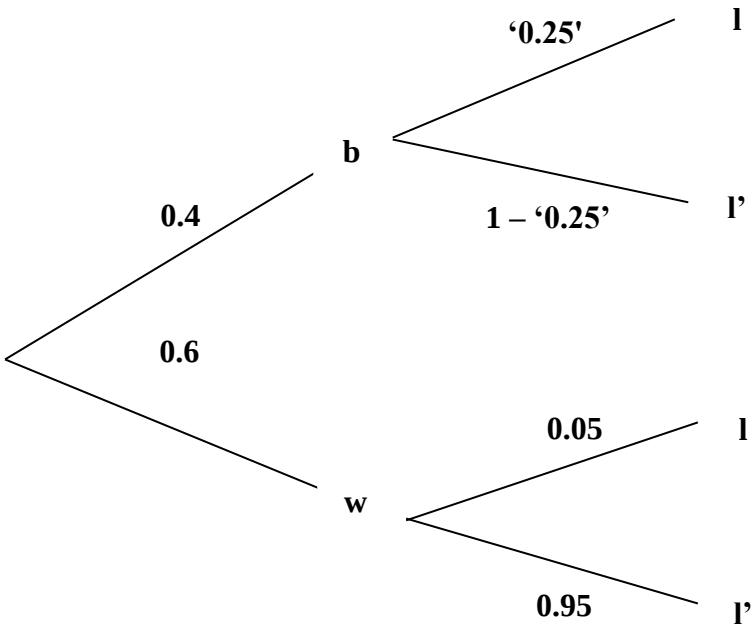
| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 1(a) (i) | $6.3\times50$ | 310 - 320 | 2 | B1 |
| (ii) | | 302º ± 2º | | B1 |
| (b) | Constructs perpendicular bisector of line *AC*<br><br>Draws circle (or two arcs crossing their perpendicular bisector) with radius 4.5 cm from centre *B* | | 2 | B1<br><br>B1 |
| (c) | | 016º - 018º | 1 | B1 |
| 2 (a) | $\text{f}(-1)=(-1)^3-(-1)^2+k(-1)-24=0\Rightarrow k=-26$ | $k=-26$ | 2 | M1A1 |
| (b) | $(x^3-x^2-26x-24)\div(x+1)=(x^2-2x-24)$<br><br>$(x^2-2x-24)=(x+4)(x-6)$<br><br>$(x^3-x^2-26x-24)$ | $(x+1)(x+4)(x-6)$ | 4 | M1A1 $(x^2-2x\pm k)$<br>[Compare coefficients $A=1, B=-2$]<br>M1<br><br>A1 |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 3 (a) | $\left[\text{S.A.} = 2\pi rh + 2\pi r^2\right]$<br>$252\pi = 2\times 6\times \pi \times h + 2\times 6^2 \times \pi$<br>$\Rightarrow 252 = 12h + 72 \Rightarrow 180 = 12h \Rightarrow h = 15$ | 15 | 3 | M1<br>M1A1 |
| (b) | $\text{V} = \pi \times 6^2 \times 15 = 540\pi$<br>$540\pi = \frac{4}{3}\times \pi \times r^3 \Rightarrow r^3 = 405 \Rightarrow 7.3986... \approx 7.4\ \left[\text{cm}\right]$ | 7.4 [cm] | 4 | M1A1<br>M1A1 |
| 4 (a) | $36\times 7.60 + \frac{4}{100}\times 4250$ | \$443.60 | 2 | M1A1 |
| (b) | $430.8 = 41\times 7.6 + \frac{4}{100}\times N$<br>$\Rightarrow N = 119.2\times 100 \div 4$ | \$2980 | 2 | M1A1 |
| (c) | $1.051\times 1.045^2 = 1.147718...$<br>$2123.28 \div \text{'}1.147718...\text{'} = 1850$ | \$1850 | 3 | M1<br>M1<br>A1 |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 5 (a) | $t=3 \Rightarrow s=(3)^3-9(3)^2+15\times 3+6=-3$ | $-3$ m | 2 | M1A1 (Allow 3 m) |
| (b) (i) | $v=\left(\frac{\mathrm{d}s}{\mathrm{d}t}\right)=3t^2-18t+15$<br>$v=0$<br>$3t^2-18t+15=0 \Rightarrow \left[t^2-6t+5\right]=(t-1)(t-5)=0$<br>$\Rightarrow t=\ldots,\ \ldots$ | $t=1,\ 5$ | 4 | M1A1<br>M1<br>A1 |
| (c) | $a=\left(\frac{\mathrm{d}v}{\mathrm{d}t}\right)=6t-18$<br>$t=4 \Rightarrow a=24-18$ | $a=6\ (m/s^2)$ | 3 | M1<br>M1<br>A1 |

<table>
<tr><th>Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr>
<td>6 (a)</td>
<td>Table
<table>
<tr><th>Weight ($x$ g)</th><th>Frequency</th><th>Class width</th><th>FD</th></tr>
<tr><td>$20 < x \leq 30$</td><td>16</td><td>10</td><td>1.6</td></tr>
<tr><td>$30 < x \leq 35$</td><td>28</td><td>5</td><td>5.6</td></tr>
<tr><td>$35 < x \leq 40$</td><td>32</td><td>5</td><td>6.4</td></tr>
<tr><td>$40 < x \leq 50$</td><td>14</td><td>10</td><td>1.4</td></tr>
<tr><td>$50 < x \leq 70$</td><td>10</td><td>20</td><td>0.5</td></tr>
</table>
Histogram<br><br>Coordinates at; (20, 1.6) (30, 5.6) (35, 6.4) (40, 1.4)<br><br>(50, 0.5) (70, 0.5)</td>
<td>(i) 10<br><br>(ii)</td>
<td>1<br><br>3</td>
<td>B1<br><br>B1 for calculating scale . FD of 1 = 5 small squares.<br><br>B1 one bar correct<br>B1 for all three correct</td>
</tr>
</table>

<table>
<tr><th>Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr>
<td>(b)</td>
<td>
<table>
<tr><th>Weight ($x$ g)</th><th>Frequency</th><th>Mid Points</th><th>Total</th></tr>
<tr><td>$20 < x \leq 30$</td><td>16</td><td>25</td><td>400</td></tr>
<tr><td>$30 < x \leq 35$</td><td>28</td><td>32.5</td><td>910</td></tr>
<tr><td>$35 < x \leq 40$</td><td>32</td><td>37.5</td><td>1200</td></tr>
<tr><td>$40 < x \leq 50$</td><td>14</td><td>45</td><td>630</td></tr>
<tr><td>$50 < x \leq 70$</td><td>10</td><td>60</td><td>600</td></tr>
<tr><td colspan="3">Total</td><td>3740</td></tr>
</table>
Estimate of Mean = $\frac{3740}{100} = 37.4$
</td>
<td>37.4</td>
<td>M1<br><br>M1<br><br><br><br>A1<br><br><br><br>A1<br>(4)</td>
<td>Uses correct midpoints<br><br>For attempting to use<br>$\sum \frac{\text{frequency} \times \text{'their' midpoints}}{100}$<br><br>For fully correct<br>$\sum \frac{\text{frequency} \times \text{midpoints}}{100}$<br><br>For 37.4</td>
</tr>
</table>

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 7(a) | $0.4\times \mathrm{P}(\text{he is late when he catches the bus}) = 0.1$<br>$\Rightarrow \mathrm{P}(\text{he is late when he catches the bus}) = \frac{0.1}{0.4} = 0.25$ | 0.25 | 2 | M1A1 |
| (b) |  | | 3 | B1 – any 2 values correct<br>B1 – any 3 values correct<br>B1 – all 5 values correct<br>ft their 0.25 |
| (c) | $0.6\times 0.95 + 0.4\times '0.75' = 0.87$ | 0.87 | 2 | M1A1ft |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 8(a) | | Rotation<br><br>90° clockwise<br><br>Centre (1,1) | 3 | B1 (More than one transformation Scores 0/3 marks)<br>B1<br><br>B1 |
| (b) | Vertices at<br>$(4, -3)$, $(4.5, -5)$ $(2.5, -4)$ | Correct diagram | 3 | M1 – for a similar shape in the second quadrant in the correct orientation<br>M1 – for an image in the correct orientation of the correct size<br>A1 cao |
| (c) | **METHOD 1**<br>$\begin{pmatrix} 0 & -2 \\ -2 & 1 \end{pmatrix}\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix}=\begin{pmatrix} -2 & 0 & 2 \\ 3 & 7 & 4 \end{pmatrix}$<br><br>$0\times a-2\times d=-2\Rightarrow d=1$<br>$0\times b-2\times e=0\Rightarrow e=0$<br>$0\times c-2\times f=2\Rightarrow f=-1$<br><br>$-2a+d=3\Rightarrow a=-1$<br>$-2b+e=7\Rightarrow b=-\frac{7}{2}$<br>$-2c+f=4\Rightarrow c=-\frac{5}{2}$ | $(-1, 1)$, $\left(-\frac{7}{2}, 0\right)$, $\left(-\frac{5}{2}, -1\right)$ | 4 | M1 - for attempting to pre-multiply the matrix for triangle *D* by **T**<br><br>A1 – for correct multiplication of matrix<br>(Co-ords in any order- but must be consistent)<br><br>M1 – solves the equations to find values for *a, b, c, d, e* and *f.*<br><br>A1 – for correct coordinates of triangle *D* |

| | | | | |
|---|---|---|---|---|
| | **METHOD 2**<br><br>Finds the inverse of **T**<br>$\begin{pmatrix} 0 & -2 \\ -2 & 1 \end{pmatrix}^{-1} = -\frac{1}{4}\begin{pmatrix} 1 & 2 \\ 2 & 0 \end{pmatrix}$<br>$-\frac{1}{4}\begin{pmatrix} 1 & 2 \\ 2 & 0 \end{pmatrix}\begin{pmatrix} -2 & 0 & 2 \\ 3 & 7 & 4 \end{pmatrix} = \begin{pmatrix} -1 & -\frac{7}{2} & \frac{-5}{2} \\ 1 & 0 & -1 \end{pmatrix}$ | $(-1, 1), \left(-\frac{7}{2}, 0\right), \left(-\frac{5}{2}, -1\right)$ | | M1 – for finding the correct determinant $(-4)$<br>A1 – for finding $\mathbf{T}^{-1}$<br><br>M1 – for multiplying $\mathbf{T}^{-1} \times$ coords of triangle *A*<br>A1 – for correct coordinates of triangle *D*<br><br>Accept $\begin{pmatrix} -1 & -3.5 & -2.5 \\ 1 & 0 & -1 \end{pmatrix}$ for A1 |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 9(a) | $AC = \sqrt{10^2 + 10^2} = 10\sqrt{2} \Rightarrow EO = 5\sqrt{2}$<br>$EO = \sqrt{15^2 - \left(5\sqrt{2}\right)^2} = \sqrt{175} = 5\sqrt{7}$ | * | 3 | M1<br>M1A1<br>Penalise incorrect rounding once only in this question |
| (b) | $\angle EMO = \tan^{-1}\left(\frac{5\sqrt{7}}{5}\right) = 69.2951... \approx 69.3^{\circ}$ | $69.3^{\circ}$ | 2 | M1A1 |
| (c) | $a^2 = b^2 + c^2 - 2bc\cos A \Rightarrow \cos A = \frac{b^2 + c^2 - a^2}{2bc}$<br>$\angle AEB = \cos^{-1}\left(\frac{15^2 + 15^2 - 10^2}{2 \times 15 \times 15}\right) = 38.942... \approx 38.9^{\circ}$ | $38.9^{\circ}$ | 3 | M1<br>M1A1 |
| (d) | Area of $\angle AEB = \frac{1}{2} \times 15 \times 15 \times \sin 38.942 = 70.710$<br>Area of base $= 10 \times 10 = 100$<br>Total surface area $= 4 \times 70.710 + 10 \times 10 = 382.8...$ [cm$^2$] | 383 [cm$^2$] | 4 | M1<br>B1<br>M1A1 |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| 10 (a)(i) | | $\overrightarrow{PB} = 3\mathbf{b} - 2\mathbf{a}$ | 3 | B1 |
| (ii) | $\overrightarrow{OQ} = \overrightarrow{OA} + \frac{2}{5}\overrightarrow{AB} \Rightarrow \overrightarrow{OQ} = \frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$ | $\overrightarrow{OQ} = \frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$ | | M1A1 |
| (b) | $\overrightarrow{OX} = \lambda\left(\frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}\right)$ and $\overrightarrow{PX} = \mu(-2\mathbf{a} + 3\mathbf{b})$ | $\overrightarrow{AX} = -4\mathbf{a} + \lambda\left(\frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}\right)$ | 4 | M1A1 |
| (i) | $\overrightarrow{AX} = -4\mathbf{a} + \lambda\left(\frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}\right)$ | | | M1A1 |
| (ii) | $\overrightarrow{AX} = -2\mathbf{a} + \mu(-2\mathbf{a} + 3\mathbf{b})$ | $\overrightarrow{AX} = -2\mathbf{a} + \mu(-2\mathbf{a} + 3\mathbf{b})$ | | |
| (c) | Equates components | | 3 | M1 |
| | $-4\mathbf{a} + \lambda\left(\frac{12}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}\right) = -2\mathbf{a} + \mu(-2\mathbf{a} + 3\mathbf{b})$ | | | M1A1 |
| | $\Rightarrow \frac{6}{5}\lambda = 3\mu$ and $\frac{12}{5}\lambda = 2 - 2\mu$ | | | |
| | Solves simultaneous equations | | | |
| | $\lambda = \frac{5}{8}$ $\mu = \frac{1}{4}$ | $\lambda = \frac{5}{8}$ $\mu = \frac{1}{4}$ | | |

| | | | | |
|---|---|---|---|---|
| (d) | $\frac{\Delta AOX}{\Delta AXQ}=\frac{5}{3}$<br><br>Area $\Delta AOX=\frac{5}{3}\times 10=\frac{50}{3}$<br><br>Area $\Delta OPX=\frac{1}{2}\times\Delta AOX=\frac{1}{2}\times\frac{50}{3}=\frac{25}{3}$ (units$^2$)<br>**ALT**<br>$\frac{\text{Area of } \triangle OPX}{\text{Area of } \triangle OAQ}=\frac{1\times 5}{2\times 8}=\frac{5}{16}$ and<br>$\frac{\text{Area of } \triangle AXQ}{\text{Area of } \triangle AOQ}=\frac{2\times 3}{2\times 8}=\frac{3}{8}$<br><br>As $\triangle AXQ=10$ it follows that<br>Area of $\triangle AOQ=\frac{80}{3}$<br>And Area of $\triangle OPX=\frac{5}{16}\times\frac{80}{3}=\frac{25}{3}$ | $\frac{25}{3}$ (units$^2$)<br><br>$\frac{25}{3}$ (units$^2$) | 3<br><br>{3} | M1<br>M1A1<br><br>{M1<br>M1<br>A1} |

| Question | Working | Answer | Mark | Notes |
|---|---|---|---|---|
| **11 (a)** | $24 = 2x^2 y \Rightarrow y = \frac{24}{2x^2} = \left(\frac{12}{x^2}\right)$ | $y = \frac{24}{2x^2} = \left(\frac{12}{x^2}\right)$ | 2 | M1A1 |
| **(b)** | $S = 4x^2 + 6xy$<br>$S = 4x^2 + 6x \times \frac{12}{x^2} \Rightarrow S = 4x^2 + \frac{72}{x}$ | $S = 4x^2 + \frac{72}{x}$ | 2 | M1A1 |
| **(c)** | $\left(S = 4x^2 + 72x^{-1}\right)$<br>$\frac{\mathrm{d}S}{\mathrm{d}x} = 8x - 72x^{-2}$<br>$8x - 72x^{-2} = 0 \Rightarrow 8x = \frac{72}{x^2}$<br>$x^3 = 9 \Rightarrow x = 2.08$ (cm) * | $x = 2.08$ (cm) | 4 | M1A1<br>M1A1 |
| **(d)** | $S = 4 \times 2.08^2 + \frac{72}{2.08} = 51.9209... = 51.9$ (3sf) | $S = 51.9$ (cm$^2$) | 1 | B1 |

| | | | | |
|---|---|---|---|---|
| **(e)** | | 60, 70 | 2 | B1B1 |
| **(f)** | Graph penalties (−1)<br>Straight line segments<br>Each point missed ($\pm\frac{1}{2}$ small square)<br>Each point not plotted<br>Tramlines<br>Very poor curve ie., line too thick | | 3 | B3 (Graph penalties) |
| **(g)** | Line drawn or two points marked consistent with line<br><br>Correct region defined $1.2 < x < 3.3$ ft their values from their line | $1.2 \pm 0.2$<br>$3.3 \pm 0.2$ | 2 | B1ft $1.2 < x$<br>B1ft $x < 3.3$ |

| $x$ | 3 | 3.5 |
|---|---|---|
| $4x^2$ | **36** | **49** |
| $\frac{72}{x}$ | **24** | **20.6** |
| $S$ | **60** | **70** |