

# Mark Scheme (Results)

## November 2024

### Pearson Edexcel International GCSE In Mathematics A (4MA1) Paper 1H

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## General Marking Guidance

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

## 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  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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.

| **International GCSE Maths** | | | | |
|---|---|---|---|---|
| **Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.** | | | | |
| **Q** | **Working** | **Answer** | **Mark** | **Notes** |
| **1** (a) | | $10 < p \leqslant 15$ | 1 | B1 allow $10 \leqslant p \leqslant 15$ or $10 < p < 15$ or $10 \leqslant p < 15$ or 10 – 15 |
| (b) | 12.5 × 18 + 17.5 × 16 + 22.5 × 14 + 27.5 × 8 + 32.5 × 4 (= 1170)<br><br>or<br><br>225 + 280 + 315 + 220 + 130 (= 1170)<br><br>[lower bound products are: 180, 240, 280, 200, 120]<br>[upper bound products are: 270, 320, 350, 240, 140]<br><br>Sum of lower bound products = 1020<br>Sum of upper bound products = 1320<br><br>Sum of products using 11, 16, 21, 26 and 31 = 1080<br>Sum of products using 12, 17, 22, 27 and 32 = 1140<br>Sum of products using 13, 18, 23, 28 and 33 = 1200<br>Sum of products using 14, 19, 24, 29 and 34 = 1260 | | 4 | M2 for at least **4** correct products added (need not be evaluated) **or**<br><br>If not M2 then award:<br><br>M1 for consistent use of value within interval (including end points) for at least **4** products which must be added<br><br>or<br><br>correct midpoints used for at least **4** products and not added |
| | "1170" ÷ 60 | | | M1 dep on at least M1<br><br>Allow division by their $\Sigma f$ provided addition or total under column seen |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | 19.5 | | A1 oe |
| | | | | **Total 5 marks** |

| | | | | |
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| **2** | | Fully correct angle bisector with all relevant arcs | 2 | B2 for a fully correct angle bisector with all arcs shown (the line and the arcs can intersect on or within the overlay guidelines)<br><br>(B1 for all arcs and no angle bisector drawn<br>or<br>for a correct angle bisector within or on guidelines but no arcs or insufficient arcs)<br><br>NB Overlay is available |
| | | | | **Total 2 marks** |

| | | | | | |
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| **3** | (a) | | $p^{15}$ | 1 | B1 cao |
| | (b) | $8n^2+6n+n^2-4n$ | | 2 | M1 for expanding with at least 3 correct terms (must see for example, $8n^2$ and not just $2n \times 4n$)(can assume that no sign in front of a number is a + if terms written in a list or table) |
| | | | $9n^2+2n$ | | A1 oe $2n+9n^2$ or $n(9n+2)$ or $n(2+9n)$ |
| | (c) | eg<br>$2x+5=12-3x$ or<br>$\frac{2}{3}x+\frac{5}{3}=4-x$ oe | | 3 | M1 for removal of fraction **and** multiplying out RHS correctly by 3<br>**or**<br>separating fraction (LHS) in an equation |
| | | eg<br>$2x+3x=12-5$ or $5x=7$ or<br>$5-12=-3x-2x$ or $-7=-5x$ or<br>$\frac{2}{3}x+x=4-\frac{5}{3}$ oe or $\frac{5}{3}x=\frac{7}{3}$ oe | | | M1 ft (dep on 4 terms) correctly rearranging their 4 term equation for terms in $x$ on one side of equation and number terms on the other |
| | | *Working required* | $\frac{7}{5}$ | | A1 oe eg 1.4 or $1\frac{2}{5}$ dep on M2 |
| | | | | | **Total 6 marks** |

| | | | | | |
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| **4** | (a) | | 2 3 5 7 | 1 | B1<br>All numbers must be present with no repeats and no other numbers.<br><br>Numbers can be in any order<br><br>Allow commas, colons, etc, between the numbers |
| | (b) | | 3 7 | 1 | B1<br>Both numbers must be present with no repeats and no other numbers.<br><br>Numbers can be in any order<br><br>Allow commas, colons, etc, between the numbers |
| | (c) | | 2 4 5 6 8 | 1 | B1<br>All numbers must be present with no repeats and no other numbers.<br><br>Numbers can be in any order<br><br>Allow commas, colons, etc, between the numbers |
| | | | | | **Total 3 marks** |

| | | | | |
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| **5** | $\pi \times 70^2 \times 18$ oe or<br>$\pi \times 0.7^2 \times 0.18$ oe | | 4 | M1 for use of $\pi r^2 h$ |
| | $88200\pi$ or 277 088(.472)) or<br>$0.0882\pi$ or $\frac{441}{5000}\pi$ or 0.277(088472) | | | A1<br>Allow 276 948 – 277 200 or<br>Allow 0.276 948 – 0.277 200 |
| | "277 088(.472)" ÷ 1000 (= 277.088…) or<br>$88200\pi \div 1000$ (= $88.2\pi$ or $\frac{441}{5}\pi$)<br>"0.277(088472)" × 1000 (= 277.088…) or<br>$88200\pi \div 1000$ (= $88.2\pi$ or $\frac{441}{5}\pi$) | | | M1<br><br>Allow a value for their volume which contains ***π***, **70** and **18** to be divided by 1000<br><br>Allow a value for their volume which contains ***π***, 0**.7** and **0.18** to be multiplied by 1000 |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | 277 | | A1 awrt 277 |
| | | | | **Total 4 marks** |

| | | | | |
|---|---|---|---|---|
| **6** | B1 for<br>$2^2 \times 5^2$ oe or $2 \times 2 \times 5 \times 5$ oe or<br>$2^2 \times 7$ oe or $2 \times 2 \times 7$ oe or<br>$5^2 \times 7$ oe or $5 \times 5 \times 7$ oe or<br>$2^2 \times 5 \times 7$ oe or $2 \times 2 \times 5 \times 7$ oe or<br>$2 \times 5^2 \times 7$ oe or $2 \times 5 \times 5 \times 7$ oe or<br>$2^2 \times 5^2 \times 7 \times 11$ or $2 \times 2 \times 5 \times 5 \times 7 \times 11$ oe or 700 or<br>$2^p \times 5^q \times 7^r$ where two of $p$ or $q$ or $r$ are correct | $2^2 \times 5^2 \times 7$ | 2 | B2 Allow $2 \times 2 \times 5 \times 5 \times 7$<br>Answers must be a product of prime factors<br><br>Can be in any order (allow $2^2 . 5^2 . 7$)<br><br>Do not allow 1 in the final answer<br><br>$2 \times 2 \times 5 \times 5 \times 7$ in working space and 700 on answer line award B2<br>$2^2 \times 5^2 \times 7$ in working space and 700 on answer line award B2<br><br>(B1 for $2^p \times 5^q \times 7^r$ where two of $p$ or $q$ or $r$ are correct<br>**or**<br>one mistake in their product<br>(see working on the left for examples)<br>**or**<br>for 700) |
| | | | | **Total 2 marks** |

| | | | | |
|---|---|---|---|---|
| **7** | 475 × 0.16 (= 76) oe **or**<br>475 × (1 – 0.16) (= 399) oe | | 4 | M1 (working for shop A) |
| | 1 – 0.15 (= 0.85) **or** $x$ – 0.15$x$ = 408 **or**<br>100(%) – 15(%) (= 85(%)) **or**<br>$\frac{408}{85}$ (= 4.8) oe | | | M1 (working for shop B) |
| | 408 ÷ "0.85" (= 480) **or**<br>408 ÷ "85" × 100 (= 480) **or**<br>408 × 100 ÷ "85" (= 480) oe **or**<br>"4.8" × 100 (= 480) **or**<br>$\frac{408}{85}\times 15\left(=72\right)$ | | | M1 (working for shop B) |
| | *Working required* | **A**<br>**and**<br>72 and 76 seen | | A1 dep on M2 for **A** with correct working (72 and 76 seen) |
| | | | | **Total 4 marks** |

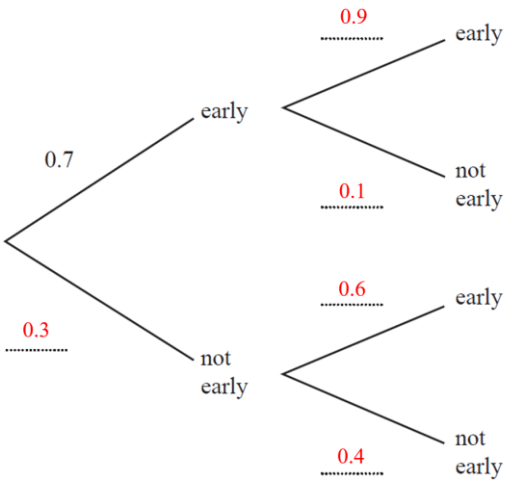
| | | | | | |
|---|---|---|---|---|---|
| **8** | (a)(i) | $(x\pm8)(x\pm3)$ or<br>$x(x-3)+8(x-3)$ or<br>$x(x+8)-3(x+8)$ | | 2 | M1 for $(x\pm8)(x\pm3)$ or<br>$(x+a)(x+b)$ where $ab = -24$ or<br>$a + b = 5$ and, $a$ and $b$ are integers |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | $(x+8)(x-3)$ | | A1 for $(x+8)(x-3)$<br>Allow any letter for $x$<br><br>Must be in the form $(x+a)(x+b)$ where $a$ and $b$ are integers |
| | (ii) | | –8 and 3 | 1 | B1 must ft from their answer in (a)(i)<br>ft from their incorrect factors in the form $(x + a)(x + b)$<br>Award B0 for –8 and 3 if no marks scored in (a)(i) |
| | (b) | $3y-7y>-10-5$ or<br>$5+10>7y-3y$ | | 3 | M1 allow use of = or condone incorrect inequality sign |
| | | $-4y>-15$ or $15>4y$ or $y=\frac{15}{4}$ oe or | | | M1 allow use of = or condone incorrect inequality sign |
| | | *Working required* | $y<\frac{15}{4}$ | | A1 dep on M1<br>oe eg $y < 3.75$ or $\frac{15}{4} > y$ or $3.75 > y$<br>Must have correct sign on answer line<br><br>NB Sight of correct answer in working space and just $(y=)\frac{15}{4}$ oe on answer line gains M2 only |
| | | | | | **Total 6 marks** |

| | | | | | |
|---|---|---|---|---|---|
| **9** | (a) | | 0.000 084 | 1 | B1 cao |
| | (b) | $52 \times 10^{145}$ or $5.2 \times 10^{n}$ or<br>$p \times 10^{146}$ where $1 \leq p < 10$ | | 2 | M1 |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | $5.2 \times 10^{146}$ | | A1 |
| | | | | | **Total 3 marks** |

| | | | | |
|---|---|---|---|---|
| **10** | eg $51^2 = (DE)^2 + 24^2$ oe **or** $2601 = (DE)^2 + 576$ oe<br>**or** $(DE^2 =) 51^2 - 24^2$ (= 2025) oe **or** $(DE^2 =) 2601 - 576$ (= 2025) oe **or**<br>$\cos(DFE) = \frac{24}{51}$ **or** $\sin(DEF) = \frac{24}{51}$ | | 5 | M1 for applying Pythagoras theorem correctly |
| | $(DE =)\sqrt{51^2 - 24^2}$ (= $\sqrt{2025}$ = 45) **or** $(DE =)\sqrt{2601 - 576}$ (= $\sqrt{2025}$ = 45)<br>**or** $(DFE =)\cos^{-1}\left(\frac{24}{51}\right)(= 61.9...)$ **or** $(DEF =)\sin^{-1}\left(\frac{24}{51}\right)(= 28.0...)$ | | | M1 for square rooting |
| | $\frac{\textit{their } DE}{7.5}(= 6)$ oe **or** $\frac{7.5}{\textit{their } DE}\left(= \frac{1}{6}\right)$ **or** $\frac{x}{24} = \frac{7.5}{\textit{their } DE}$ oe<br>**or** tan"*their* 61.9..." $= \frac{7.5}{(x)}$ **or** tan"*their* 28.0..." $= \frac{(x)}{7.5}$ **or**<br>$\frac{(x)}{\sin(\textit{their } 28.0)} = \frac{7.5}{\sin(\textit{their } 61.9)}$<br>NB Their *ED* or their 61.9 or their 28.0 must be clearly identified<br>Their 61.9.. or their 28.0.. cannot be used as lengths of the triangle<br>Their 45 cannot be used as an angle of the triangle | | | M1 for a correct method to find the scale factor<br>Allow correct use of sine rule/cosine rule/Pythagoras theorem<br>Allow 0.17 or better for $\frac{1}{6}$<br>**Special case** Allow $(DE =)\sqrt{51^2 + 24^2}$ $(= \sqrt{3177} = 3\sqrt{353} = 56.3...)$ for "45" for this mark |
| | 24 ÷ "6" oe **or** $24 \times "\frac{1}{6}"$ **or** 24 × "1.67" **or** $(x =)\frac{7.5}{\textit{their } ED} \times 24$<br>**or** $(x =)\frac{7.5}{\tan"\textit{their } 61.9..."}$ oe **or** $(x =) 7.5 \times \tan"\textit{their } 28.0..."$ oe<br>**or** $(x =)\frac{7.5}{\sin(\textit{their } 61.9)} \times \sin(\textit{their } 28.0)$ oe<br>**or** $51 \times "\frac{1}{6}"(= 8.5)$ **and** $(x =)\sqrt{8.5^2 - 7.5^2}\left(= \sqrt{16}\right)$ | | | M1 dep on previous M1 for a correct method to find *x* or for finding *BC* **and** using Pythagoras theorem to find *x*<br>Allow $24 \times "\frac{7.5}{56(.3...)}"$ **or** $24 \div "\frac{56(.3...)}{7.5}"$<br>for scale factor for this mark |
| | *Working required* | 4 | | A1 dep on M2<br>The value of 4 must come from correct figures |
| | | | | **Total 5 marks** |

<table>
<tr>
<td>11 (a)</td>
<td>
<table>
<tr><td>x</td><td>0.5</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>y</td><td>5</td><td>4</td><td>5</td><td>6.7</td><td>8.5</td><td>10.4</td><td>12.3</td></tr>
</table>
</td>
<td>Four correct values</td>
<td>2</td>
<td>B2 oe<br><br>(B1 for 2 or 3 correct values of y)<br><br>May be awarded if plotted correctly on the graph</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td>Correct graph</td>
<td>2</td>
<td>M1 ft their table dep on B1for at least 6 points plotted correctly (within or on the circles on the overlay)</td>
</tr>
<tr>
<td></td>
<td>Correct answer scores full marks (unless from obvious incorrect working)</td>
<td></td>
<td></td>
<td>A1 for correct curve between $x = 0.5$ and $x = 6$<br><br>Note: If a fully correct graph is shown, but an incomplete table is shown in (a), then award the marks for (a)<br><br>Ignore curve drawn for $x < 0.5$ and $x > 6$</td>
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<td>Total 4 marks</td>
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</table>

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| **12** | eg<br>$\tan 47 = \frac{(BD)}{4250}$ **or** $\tan 24 = \frac{4250}{(BC)}$ **or** $\tan(47+"19") = \frac{(BC)}{4250}$ **or** $\frac{(BD)}{\sin 47} = \frac{4250}{\sin 43}$<br>**or** $(AD =)\frac{4250}{\cos 47}(= 6231.686...)$ **or** $(AD =)\frac{4250}{\sin 43}(= 6231.686...)$<br>**or** $(AC =)\frac{4250}{\sin 24}(= 10\,449.021...)$ **or** $(AC =)\frac{4250}{\cos 66}(= 10\,449.021...)$ | | 4 | M1 |
| | eg<br>$(BD =)4250\tan 47(= 4557.567...)$ **or** $(BC =)\frac{4250}{\tan 24}(= 9545.656...)$<br>**or** $(BD =)\frac{4250}{\sin 43}\times\sin 47(= 4557.567...)$ **or** $\frac{(DC)}{\sin"19"} = \frac{"10449....."}{\sin"137"}$<br>**or** $\frac{(DC)}{\sin"19"} = \frac{"6231.686"}{\sin 24}$ **or** $(BC =)4250\times\tan(47+"19")(= 9545.656...)$<br>**or** $(DC^2 =)"6231"^2 + "10\,449"^2 - 2\times"6231"\times"10\,449"\times\cos 19$ | | | M1 |
| | eg<br>"9545.656" – "4557.567" (= 4988.089)<br>**or** $(DC =)\frac{"6231.686"}{\sin 24}\times\sin 19$ **or** $(DC =)\frac{"10449....."}{\sin"137"}\times\sin"19"$<br>**or** $(DC =)\sqrt{"6231"^2 + "10\,449"^2 - 2\times"6231"\times"10\,449"\times\cos 19}$ | | | M1 for a complete method |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | 4988 | | A1 allow in the range 4932 – 4990 |
| | | | | |

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| **13** | (a) |  | Correct probabilities | 2 | B2 for all 3 correct pairs of probabilities on the correct branches<br><br>If not B2 then award B1 for one correct pair of probabilities on a correct branch<br><br>Allow equivalent fractions<br><br>0.7 and 0.3 counts as a pair |
| | (b) | 0.7 × "0.9" oe | | 2 | M1ft (probabilities < 1) for a complete method involving one product |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | 0.63 | | A1 ft oe eg $\frac{63}{100}$ or 63% |
| | | | | | **Total 4 marks** |

| | | | | | | |
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| **14** | $B = \frac{k}{d^2}$ oe | $Bk = \frac{1}{d^2}$ oe | | 3 | M1<br>(NB Not for $B = \frac{1}{d^2}$)<br>Constant of proportionality must be a symbol such as *k*<br>Allow *D* or *b* | M2 for<br>$0.25 = \frac{k}{12^2}$ oe or<br>$0.25 \times k = \frac{1}{12^2}$ oe or |
| | $0.25 = \frac{k}{12^2}$ oe or<br>$0.25 = \frac{k}{144}$ oe or<br>$k = 36$ | $0.25 \times k = \frac{1}{12^2}$ oe or<br>$0.25 \times k = \frac{1}{144}$ oe or<br>$k = \frac{1}{36}$ | | | M1 for substitution of *B* and *d* into a **correct** formula | |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | | $B = \frac{36}{d^2}$ | | A1 e.g $B = 36 \times \frac{1}{d^2}$ or $B = 36 \times d^{-2}$<br><br>Award 3 marks if answer is $B = \frac{k}{d^2}$ on the answer line and $k = 36$ clearly given in the body of working of the script<br><br>M2A0 for $Bd^2 = 36$ or $d = \frac{6}{\sqrt{B}}$ or $d^2 = \frac{36}{B}$ | |
| | | | | | | **Total 3 marks** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **15** | $3x(2x-1)=6x^2-3x$ or<br>$3x(5x+4)=15x^2+12x$ or<br>$(2x-1)(5x+4)=10x^2+8x-5x-4$<br>$(10x^2+3x-4)$ | | 3 | M1 | An expansion with only one error.<br><br>Do not award this mark for $6x^2 - 3x + 15x^2 + 12x$ | M2 for 3 (out of a maximum of 4) of $30x^3+24x^2-15x^2-12x$ |
| | $(6x^2-3x)(5x+4)=30x^3+24x^2-15x^2-12x$<br>$(15x^2+12x)(2x-1)=30x^3-15x^2+24x^2-12x$<br>$3x(10x^2+8x-5x-4)=30x^3+24x^2-15x^2-12x$<br>$3x(10x^2+3x-4)=30x^3+9x^2-12x$ | | | M1 | ft dep on M1<br><br>allow one further error | (M1 for 2 correct out of a maximum of 4) |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | $30x^3+9x^2-12x$ | | A1 | cao (terms may be in any order but must be simplified) dep on M1<br>accept $a = 30$, $b = 9$, $c = -12$<br><br>ISW correct factorisation<br>eg<br>$3(10x^3+3x^2-4x)$<br>Do not ISW incorrect simplification | |
| | | | | | | **Total 3 marks** |

| | | | | |
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| **16** | $120 = \frac{1}{2} \times a \times b \times \sin 50$ oe or $\frac{120 \times 2}{\sin 50}$ oe<br>or<br>$120 = \frac{1}{2} \times 2x \sin 25 \times x \cos 25$ oe or $\frac{120 \times 2}{2 \times \sin 25 \times \cos 25}$ oe<br>or<br>313(.2977494) | | 4 | M1 for a **correct** equation for $a \times b$ or $r^2$ (allow any letters for $a$ or $b$)<br>or<br>for a **correct** expression for $a \times b$ or $r^2$<br>or<br>for 313(.2977494) |
| | $(radius =) \sqrt{\frac{120 \times 2}{\sin 50}}$ (= 17.7(0021891)) oe or<br>$(radius =) \sqrt{\frac{120 \times 2}{2 \times \sin 25 \times \cos 25}}$ (= 17.7(0021891)) oe or<br>$(radius =) \sqrt{313(.2977494)}$ (= 17.7(0021891)) | | | M1 for a **correct** rearrangement to find the radius<br>or<br>for square rooting 313(.2977494)<br>or<br>for 17.7(0021891)) |
| | (area of $OAPB =) \pi \times "17.7"^2 \times \frac{50}{360}$ oe | | | M1 |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | 137 | | A1 awrt 137 |
| | | | | **Total 4 marks** |

| | | | | | |
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| **17** | (a) | | $5\sqrt{27}$ | 1 | B1 Allow $n = 5$<br>Do not accept 5 by itself |
| | (b) | $\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ or $\frac{5-\sqrt{2}}{\sqrt{2}-1}\times\frac{-\sqrt{2}-1}{-\sqrt{2}-1}$ | | 3 | M1 for rationalising the denominator by multiplying numerator and denominator by $\sqrt{2}+1$ or $-\sqrt{2}-1$ |
| | | eg<br>$\frac{5\sqrt{2}+5-2-\sqrt{2}}{2-1}$ oe or $\frac{5\sqrt{2}+5-2-\sqrt{2}}{\sqrt{4}+\sqrt{2}-\sqrt{2}-1}$ oe or $5\sqrt{2}+5-2-\sqrt{2}$ | | | M1 (numerator must be expanded to 4 terms, denominator may be 4 terms which need to be all correct)<br><br>Accept 1 in the denominator without working |
| | | *Working required* | $3+4\sqrt{2}$ | | A1 or for stating $a = 3$ and $b = 4$<br>dep on M2 |
| | | | | | **Total 4 marks** |

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|---|---|---|---|---|
| **18** | eg two from<br>1.5 × 10 (= 15) or 0.8 × 15 (= 12) or 4 × 5 (= 20) or 2.5 × 30 (= 75) or 4.6 × 5 (= 23) or<br>eg two from<br>15 or 12 or 20 or 75 or 23<br>**or**<br>eg two from<br>150 or 120 or 200 or 750 or 230 or<br>eg two from<br>6 or 4.8 or 8 or 30 or 9.2 | | 4 | M1 for at least two correct frequencies<br><br>**or**<br><br>for counting squares or blocks |
| | eg<br>1.5 × 10 + 0.8 × 15 + 4 × 5 + 2.5 × 30 + 4.6 × 5 (= 145) or<br>15 + 12 + 20 + 75 + 23 (= 145)<br>**or**<br>150 + 120 + 200 + 750 + 230 (= 1450)<br>6 + 4.8 + 8 + 30 + 9.2 (= 58)<br>**or**<br>$\frac{1}{3}\times"12"+"20"+"75"(=99)$<br>4 + 20 + 75 (= 99) | | | M1 for a method to find the number of students in each time interval with an intention to add<br>Allow one error<br>**or**<br>for a method to find the total number of squares or blocks oe with an intention to add<br>Allow one error<br>**or**<br>for a correct method to find the frequency between 20 and 60 minutes eg 4 + 20 + 75<br>M2 for a value of 99 for 20 – 60 minute interval |
| | eg<br>$\frac{0.8\times5+"20"+"75"}{"15"+"12"+"20"+"75"+"23"}$ or $\frac{\frac{1}{3}\times"12"+"20"+"75"}{"145"}$<br>**or**<br>$\frac{\frac{1}{3}\times"120"+"200"+"750"}{"1450"}$ or $\frac{\frac{1}{3}\times"4.8"+"8"+"30"}{"58"}\left(=\frac{39.6}{58}\right)$ | | | M1 for a complete method<br><br>Allow the one error in the previous M mark to follow through |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | $\frac{99}{145}$ | | A1 oe but must be a fraction |
| | | | | **Total 4 marks** |

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| **19** | $\frac{30}{2}\left[2a+(30-1)d\right]=4395$ or $30a + 435d = 4395$ or $2a+29d=293$ | | 5 | M1 for using $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$ |
| | $a+(10-1)d+a+(20-1)d=284$ or $a+9d+a+19d=284$ or $2a+28d=284$ or $a+14d=142$ | | | M1 for using $U_n=a+(n-1)d$ correctly to form an equation |
| | eg<br>$2a+29d=293$<br>– $2a+28d=284$<br>($d = 9$) | eg<br>$28a+406d=4102$<br>– $29a+406d=4118$<br>((–) $a$ = (–) 16) | | M1 dep on M2 for a correct method to eliminate $a$ or $d$:<br><br>coefficients of $a$ or $d$ the same **and** correct operator to eliminate selected variable (condone any one arithmetic error)<br><br>**or**<br><br>writing $a$ or $d$ in terms of the other variable and correctly substituting. |
| | $\frac{45}{2}\left[2(16)+(45-1)9\right]$ | | | M1 dep on previous M1 for using $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$ correctly with $a = 16$ and $d = 9$ |
| | *Working required* | 9630 | | A1 dep on M2 |
| | | | | **Total 5 marks** |

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| **20** | $4\times 2x^3$ or $8x^3$ or $\pm 64$ | | 4 | M1 for differentiating one term correctly |
| | $8x^3 - 64 = 0$ oe | | | M1 dep on M1<br>The equation must be in the form $ax^3 - 64 = 0$ oe where $a \neq 0$ or $8x^3 + b = 0$ oe where $b \neq 0$<br>where *a* and *b* are constants |
| | $x = \sqrt[3]{\frac{64}{8}} (= 2)$ | | | M1 dep on previous M1 for solving for *x*.<br>The equation must be in the form $ax^3 - 64 = 0$ oe where $a \neq 0$ or $8x^3 + b = 0$ oe where $b \neq 0$<br>where *a* and *b* are constants |
| | *Working required* | $y = -96$ | | A1 oe eg $y + 96 = 0$ or $y = 0x - 96$ or $-y = 96$<br><br>dep on M3 must be an equation in terms of *y*<br><br>Do not accept –96 or (2, –96) |
| | | | | **Total 4 marks** |

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| **21** | 28.35 or 28.45 or 16.5 or 17.5 or 87.5 or 92.5 | | 3 | B1<br>Accept<br>$28.44\dot{9}$ for 28.45<br>$17.4\dot{9}$ for 17.5 |
| | $(T =)\dfrac{28.45^2 + 17.5^2}{87.5}$ (= 12.75031429) | | | M1 for substituting the correct bounds into the formula for $T$<br>$(T =)\dfrac{UB_x^{\,2} + UB_y^{\,2}}{LB_w}$ where<br>$28.4 < UB_x \leq 28.45$<br>$17 < UB_x \leq 17.5$<br>$87.5 \leq LB_w < 90$ |
| | *Working required* | 12.8 | | A1 awrt 12.8 dep on M1<br>Answer must come from correct figures (28.45, 17.5 and 87.5) |
| | | | | **Total 3 marks** |

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| **22** | $\frac{1}{2}\times\frac{4}{3}\times\pi\times12^3\left(=1152\pi=3619.(114)\right)$ oe or<br>$\frac{1}{2}\times\frac{4}{3}\times\pi\times9^3\left(=486\pi=1526.(814)\right)$ oe or<br>$\frac{4}{3}\times\pi\times12^3\left(=2304\pi=7238(.229)\right)$ oe or<br>$\frac{4}{3}\times\pi\times9^3\left(=972\pi=3053(.628)\right)$ oe | | 3 | M1 for finding the volume of a sphere or a hemisphere |
| | $\frac{1}{2}\times\frac{4}{3}\times\pi\times12^3-\frac{1}{2}\times\frac{4}{3}\times\pi\times9^3$ oe or $"1152\pi"-"486\pi"\left(=666\pi\right)$ oe or<br>$\frac{\frac{4}{3}\times\pi\times12^3-\frac{4}{3}\times\pi\times9^3}{2}$ oe or $\frac{"2304\pi"-"972\pi"}{2}\left(=\frac{1332\pi}{2}=666\pi\right)$ oe | | | M1 |
| | *Correct answer scores full marks (unless from obvious incorrect working)* | 2092 | | A1 2091 – awrt 2093 |
| | | | | **Total 3 marks** |

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| **23** | $\left(\frac{dy}{dx} =\right) 2x-8$ or $(x-4)^2$….. or $\left(x =\right)\frac{-1+9}{2}$ | | 5 | M1 for using differentiation **or** completing the square **or** by symmetry |
| | $x = 4$ or (4, –25) or (4, …) or $\frac{p+q}{2} = 4$ oe | | | M1 |
| | $q = -3$ **or** $p = 11$ | | | A1 |
| | $(k =)(-3)^2 - 8(-3) - 9$ **or**<br>$(k =)(11)^2 - 8(11) - 9$ | | | M1 |
| | *Working required* | 24 | | A1 dep on M2 |
| | | | | **Total 5 marks** |

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|---|---|---|---|---|
| **23** | $p^2 - 8p - 9 = k$ **and** $q^2 - 8q - 9 = k$ or<br>$(p - 9)(p + 1) = k$ **and** $(q - 9)(q + 1) = k$ | | 5 | M1 |
| **ALT 1** | $(q+14)^2 - 8(q+14) - 9 = q^2 - 8q - 9$ **or**<br>$(p-14)^2 - 8(p-14) - 9 = p^2 - 8p - 9$ **or**<br>$(q + 14 - 9)(q + 14 + 1) = (q - 9)(q + 1)$ **or**<br>$(p - 9)(p + 1) = (p - 14 - 9)(p - 14 + 1)$ oe | | | M1 for a correct equation in one variable |
| | $q = -3$ **or** $p = 11$ | | | A1 |
| | $(k =)(-3)^2 - 8(-3) - 9$ **or**<br>$(k =)(11)^2 - 8(11) - 9$ | | | M1 |
| | *Working required* | 24 | | A1 dep on M2 |
| | | | | **Total 5 marks** |

| | | | | |
|---|---|---|---|---|
| **23** | $(q+14)^2-8(q+14)-9(=k)$ **or** $(p-14)^2-8(p-14)-9(=k)$ | | 5 | M1 |
| **ALT 2** | $(q+14)^2-8(q+14)-9=q^2-8q-9$ **or**<br>$(p-14)^2-8(p-14)-9=p^2-8p-9$ | | | M1 for a correct equation in one variable |
| | $q=-3$ **or** $p=11$ | | | A1 |
| | $(k=)(-3)^2-8(-3)-9$ **or**<br>$(k=)(11)^2-8(11)-9$ | | | M1 |
| | *Working required* | 24 | | A1 dep on M2 |
| | | | | **Total 5 marks** |

| | | | | |
|---|---|---|---|---|
| **23** | $y=(x-4)^2-16-9$ oe or $k=(x-4)^2-25$ oe or<br>$x^2-8x-9-k=0$ | | 5 | M1 |
| **ALT 3** | $(x=)4\pm\sqrt{k+25}$ or<br>$(x=)\dfrac{--8\pm\sqrt{(-8)^2-(4\times1\times(-9-k))}}{2\times1}$ oe or $(x=)\dfrac{8\pm\sqrt{100+4k}}{2}$ oe | | | M1 |
| | $4+\sqrt{k+25}-\left(4-\sqrt{k+25}\right)=14$ oe or<br>$\dfrac{8+\sqrt{100+4k}}{2}-\left(\dfrac{8-\sqrt{100+4k}}{2}\right)=14$ oe | | | A1 for a correct equation in one variable |
| | $25+k=\left(\dfrac{14}{2}\right)^2$ oe | | | M1 |
| | *Working required* | 24 | | A1 dep on M2 |
| | | | | **Total 5 marks** |

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|---|---|---|---|---|---|
| **24** | (i) | | $-10\mathbf{a}+2\mathbf{b}$ | 1 | B1 or $2\mathbf{b}-10\mathbf{a}$<br>Must be simplified |
| | (ii) | | $\frac{15}{2}\mathbf{a}+\frac{5}{2}\mathbf{b}$ | 1 | B1 oe eg $7\frac{1}{2}\mathbf{a}+2\frac{1}{2}\mathbf{b}$ or<br>$7.5\mathbf{a}+2.5\mathbf{b}$<br>Must be simplified |
| | (iii) | eg<br>$\left(\overrightarrow{OR}="k"\overrightarrow{OP}=\right)"k"\left("\frac{15}{2}\mathbf{a}+\frac{5}{2}\mathbf{b}"\right)$ oe | | 4 | M1 ft from part (ii) for $\overrightarrow{OR}$<br>$\overrightarrow{OP}$ must be in terms of **a** and **b** (lower case) |
| | | eg<br>$\left(\overrightarrow{OR}=\overrightarrow{OA}+\overrightarrow{AR}=\right)10\mathbf{a}+"\lambda"\left("-10\mathbf{a}+2\mathbf{b}"\right)\left(=\left(10-10"\lambda"\right)\mathbf{a}+2"\lambda"\mathbf{b}\right)$<br>oe<br>or<br>$\left(\overrightarrow{OR}=\overrightarrow{OQ}+\overrightarrow{QR}=\right)2\mathbf{b}-"\mu"\left("-10\mathbf{a}+2\mathbf{b}"\right)\left(=10"\mu"\mathbf{a}+\left(2-2"\mu"\right)\mathbf{b}\right)$<br>oe | | | M1 ft from part (i) for another path for $\overrightarrow{OR}$<br>$\overrightarrow{AQ}$ must be in terms of **a** and **b** (lower case) |
| | | eg<br>$\frac{15}{2}"k"=10-10"\lambda"$ oe **and** $\frac{5}{2}"k"=2"\lambda"$ oe or $"\lambda"=\frac{5}{8}$ oe or<br>$\frac{5}{2}"k"=2-2"\mu"$ **and** $\frac{15}{2}"k"=10"\mu"$ oe or "*k*" = 0.5 oe | | | M1 for **correct** equations<br>(not followed through equations) |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | $\frac{15}{4}\mathbf{a}+\frac{5}{4}\mathbf{b}$ | | A1 oe eg $3\frac{3}{4}\mathbf{a}+1\frac{1}{4}\mathbf{b}$ or<br>$3.75\mathbf{a}+1.25\mathbf{b}$ |
| | | | | | **Total 6 marks** |

| | | | | | | |
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| **25** | | $(y=)\,2(x^2-12x)+7$ **or**<br>$(y=)\,2\left(x^2-12x+\frac{7}{2}\right)$ **or**<br>$\frac{y-7}{2}=x^2-12x$ | $(x=)\,2(y^2-12y)+7$ **or**<br>$(x=)\,2\left(y^2-12y+\frac{7}{2}\right)$ **or**<br>$\frac{x-7}{2}=y^2-12y$ | | | M1 for a correct first step in order to complete the square<br><br>For each method mark the function must be correct |
| | | eg<br>$(y=)\,2\left((x-6)^2-6^2\right)+7$<br>**or**<br>$(y=)\,2\left((x-6)^2-6^2+\frac{7}{2}\right)$<br>**or**<br>$(y=)\,2(x-6)^2-65$ oe<br>**or**<br>$\frac{y-7}{2}=(x-6)^2-6^2$ oe | eg<br>$(x=)\,2\left((y-6)^2-6^2\right)+7$<br>**or**<br>$(x=)\,2\left((y-6)^2-6^2+\frac{7}{2}\right)$<br>**or**<br>$(x=)\,2(y-6)^2-65$ oe<br>**or**<br>$\frac{x-7}{2}=(y-6)^2-6^2$ oe | | | M1 dep on M1 |
| | | $(x-6)^2=\frac{y+65}{2}$ oe **or**<br>$(x-6)^2=\frac{y-7}{2}+6^2$ oe | $(y-6)^2=\frac{x+65}{2}$ oe **or**<br>$(y-6)^2=\frac{x-7}{2}+6^2$ oe | | | M1 |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | | $6+\sqrt{\frac{x+65}{2}}$ | 4 | A1 oe eg $6+\sqrt{\frac{x-7}{2}+36}$<br>Must be in terms of $x$<br>M3A0 for $6\pm\sqrt{\frac{x+65}{2}}$ or $6\pm\sqrt{\frac{y+65}{2}}$<br>or $6+\sqrt{\frac{y+65}{2}}$ |
| | | | | | | **Total 4 marks** |
| **Note: Allow candidates to swap *x* and *y* when finding the inverse** | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **25 ALT** | | $2x^2-24x+7-y(=0)$ | | | M1 for a correct first step |
| | | $(x=)\dfrac{24\pm\sqrt{576-8(7-y)}}{4}$ or $(x=)\dfrac{24+\sqrt{576-8(7-y)}}{4}$ | $2\left((x-6)^2-6^2\right)+7-y(=0)$ or $2\left((x-6)^2-6^2+\dfrac{7}{2}\right)-y(=0)$ | | M1 dep on M1 |
| | | $(x=)6\pm\sqrt{\dfrac{y+65}{2}}$ | $(x-6)^2=\dfrac{y+65}{2}$ | | M1 |
| | | *Correct answer scores full marks (unless from obvious incorrect working)* | $6+\sqrt{\dfrac{x+65}{2}}$ | 4 | A1 oe eg $6+\sqrt{\dfrac{x-7}{2}+36}$<br>Must be in terms of $x$<br>M3A0 for $6\pm\sqrt{\dfrac{x+65}{2}}$ or $6\pm\sqrt{\dfrac{y+65}{2}}$ or $6+\sqrt{\dfrac{y+65}{2}}$ |
| | | | | | **Total 4 marks** |
| **Note: Allow candidates to swap *x* and *y* when finding the inverse** | | | | | |

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