AQA

GCSE

# Methods in Mathematics (Linked Pair)

Higher Tier Unit 1 Algebra and Probability
Mark scheme

9365
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Version 1.0 Final

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

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

Further copies of this mark scheme are available from aqa.org.uk

## Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **M dep** | A method mark dependent on a previous method mark being awarded. |
| **A** | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| **B** | Marks awarded independent of method. |
| **B dep** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **Q** | Marks awarded for quality of written communication. |
| **ft** | Follow through marks. Marks awarded for correct working following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded for a common misinterpretation which has some mathematical worth. |
| **oe** | Or equivalent. Accept answers that are equivalent.<br>eg accept 0.5 as well as $\frac{1}{2}$ |
| **[*a*, *b*]** | Accept values between *a* and *b* inclusive. |
| **25.3 …** | Allow answers which begin 25.3 e.g. 25.3, 25.31, 25.378. |
| **Use of brackets** | It is not necessary to see the bracketed work to award the marks. |

Examiners should consistently apply the following principles

**Diagrams**

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

**Responses which appear to come from incorrect methods**

Whenever there is doubt as to whether a candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

**Questions which ask candidates to show working**

Instructions on marking will be given but usually marks are not awarded to candidates who show no working.

**Questions which do not ask candidates to show working**

As a general principle, a correct response is awarded full marks.

**Misread or miscopy**

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

**Further work**

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

**Choice**

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

**Work not replaced**

Erased or crossed out work that is still legible should be marked.

**Work replaced**

Erased or crossed out work that has been replaced is not awarded marks.

**Premature approximation**

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **1 (a)** | $x^2 + 5x$ or $5x + x^2$ | B1 | |
| | **Additional Guidance** | | |
| | Do not ignore further working | | |
| | Examples: | | |
| | $x^2$ 5$x$ | | B0 |
| | $x^2 + 5$ | | B0 |
| | $x2 + 5x$ | | B0 |
| | $x^2 + 5x = 5x^3$ | | B0 |
| **1 (b)** | $3(y - 4)$ | B1 | |
| | **Additional Guidance** | | |
| | Do not ignore further working | | |
| | Examples: | | |
| | $3 \times (y - 4)$ | | B1 |
| | $(y - 4)3$ | | B1 |
| | $3 \times y - 4$ (brackets missing) | | B0 |
| | $(y - 4)^3$ (3 is a power) | | B0 |
| | $3(y \quad 4)$ (no minus sign) | | B0 |
| **1 (c)** | $w(w^2 - 1)$ | B1 | |
| **2** | ($x$ =) 3 × 12 or 36<br>or<br>($y$ =) 15 ÷ 3 or 5 | M1 | |
| | 41 | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 3 | $3n - 10$ | B2 | oe $3 \times n - 10$ or $n \times 3 - 10$<br>B1 $3n$ or $3 \times n$ or $n \times 3$ or $n3 - 10$ or $an - 10$, where $a$ is a positive integer other than 3<br>or $n^b - 10$, where $b$ is a positive integer other than 1<br>or a different letter used in an otherwise correct answer |

| Additional Guidance | |
|---|---|
| $3n$ as a term in any expression | B1 |
| $n - 10$ or $4n - 10$ | B1 |
| $n + 3n - 10$ | B1 |
| $n + 4n - 10$ | B0 |
| $3(n - 10)$ | B0 |
| Ignore '$n =$' before or '$= n$' after the expression | |

| | | | |
|---|---|---|---|
| 4 (a) | **Alternative method 1** | | |
| | 413 – 350 or 63 | M1 | |
| | Their 63 ÷ 350 (× 100)<br>or 0.18 (× 100) | M1dep | |
| | 18 | A1 | |
| | **Alternative method 2** | | |
| | 413 ÷ 350 or 1.18 | M1 | |
| | Their 1.18 × 100 or 118<br>or their 1.18 – 1 (× 100)<br>or 0.18 (× 100) | M1dep | |
| | 18 | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 4 (b) | **Alternative method 1** | | |
| | 0.95 seen | M1 | oe |
| | $0.95^{13}$ | M1 | oe |
| | 0.51… and explanation that this is more than 50% | Q1 | Strand ii<br>Correct working and explanation |
| | **Alternative method 2** | | |
| | Any amount × 0.95 | M1 | oe |
| | Any amount × $0.95^{13}$ | M1 | oe |
| | Correct value for their amount × $0.95^{13}$ and explanation that this is more than 50% | Q1 | Strand ii<br>Correct working and explanation |
| | **Additional Guidance** | | |
| | If they work year by year in Alt 2 scheme allow rounding or truncation to the nearest penny on each calculation. M2 can be awarded for correct multiplication by 0.95 thirteen times, even if values are incorrect.<br>The table shows the minimum and maximum acceptable values for each year, with the amounts rounded to 2 dp. A student truncating each time will not be able to access the Q mark, as their amount will fall under 50% | | |

| Year | Min | 2 dp | Max |
|---|---|---|---|
| 1 | 0.95 | 0.95 | 0.95 |
| 2 | 0.90 | 0.90 | 0.903 |
| 3 | 0.85 | 0.86 | 0.86 |
| 4 | 0.80 | 0.82 | 0.82 |
| 5 | 0.76 | 0.78 | 0.78 |
| 6 | 0.72 | 0.74 | 0.741 |
| 7 | 0.68 | 0.70 | 0.704 |
| 8 | 0.64 | 0.67 | 0.67 |
| 9 | 0.60 | 0.64 | 0.64 |
| 10 | 0.57 | 0.61 | 0.61 |
| 11 | 0.54 | 0.58 | 0.58 |
| 12 | 0.51 | 0.55 | 0.55 |
| 13 | 0.48 | 0.52 | 0.523 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | 0.8 on 'Success' and 0.2 on 'Failure' for first experiment | B1 | oe fraction, decimal or percentage |
| | 0.1 on 'Success' and 0.9 on 'Failure' on one pair of branches for second experiment | B1 | oe fraction, decimal or percentage |
| | Second pair of branches for second experiment matches first pair, with total for each pair being 1 | B1ft | 0.1<br>0.8 0.9 is correct answer for B3<br>0.2 0.1<br>0.9<br>SC2 experiments transposed as<br>0.8<br>0.1 0.2<br>0.9 0.8<br>0.2 |
| | **Additional Guidance** | | |
| | 0.8 = $\frac{8}{10}$ or $\frac{4}{5}$ or 80%<br>0.2 = $\frac{2}{10}$ or $\frac{1}{5}$ or 20%<br>0.1 = $\frac{1}{10}$ or 10%<br>0.9 = $\frac{9}{10}$ or 90% | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6 | **Alternative method 1** | | |
| | $14x + 2y = 10$<br>or<br>$70x – 14y = 140$ and $70x + 10y = 50$ | M1 | oe<br>Equates coefficients<br>Allow one multiplication error |
| | $24x = 30$<br>or<br>$24y = –90$ or $–24y = 90$ | M1 | oe<br>Correctly uses addition or subtraction with their equations to eliminate one unknown<br>Allow one addition or subtraction error |
| | $x = 1.25$<br>or<br>$y = –3.75$ | A1 | oe mixed number or fraction |
| | $x = 1.25$ and $y = –3.75$ | A1 | oe mixed numbers or fractions<br>SC1 correct solution without algebraic working |
| | **Alternative method 2** | | |
| | Rearranges an equation to make one of the variables the subject and substitutes into the other equation | M1 | |
| | Substitutes correctly and collects like terms | M1 | Allow one error in collection of terms |
| | $x = 1.25$<br>or<br>$y = –3.75$ | A1 | oe mixed number or fraction |
| | $x = 1.25$ and $y = –3.75$ | A1 | oe mixed numbers or fractions<br>SC1 correct solution without algebraic working |
| | **Additional Guidance** | | |
| | If their equations do not have one pair of equal coefficients they cannot access the second M1<br>Allow a graphical method for full marks | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7 | **Alternative method 1** | | |
| | (100 – 65)(%) or 35(%) | M1 | oe |
| | (65 – their 35)(%) related to 12<br>or 30(%) related to 12 | M1 | |
| | 12 ÷ their 30 × their 35<br>or 12 ÷ their 30 × 100 or 40 | M1 | oe<br>40 is the total number of members |
| | 14 | A1 | SC3 26 |
| | **Alternative method 2** | | |
| | (65 – 50)(%) or 15(%) | M1 | |
| | Their 15(%) related to 6 | M1 | |
| | 6 ÷ their 15 × (100 – 65)<br>or 6 ÷ their 15 × 35<br>or 6 ÷ their 15 × 100 or 40 | M1 | 40 is the total number of members |
| | 14 | A1 | SC3 26 |
| | **Alternative method 3** | | |
| | 65 and (100 – 65) or 65 and 35 | M1 | |
| | 13 and 7 | M1 | |
| | 26 and 14 | M1 | |
| | 14 | A1 | SC3 26 |
| | **Alternative method 4** | | |
| | Any trial of two numbers with a difference of 12 or of 65% and 35% of an assumed total | M1 | eg 13 and 1 and [93, 93]%<br>or 60 → 39 girls and 21 boys |
| | A better trial | M1dep | eg 14 and 2 and [87, 88]% |
| | A better trial | M1dep | eg 15 and 3 and [83, 84]% |
| | 14 | A1 | SC3 26 |

| Q | Answer | Mark | Comments |
|---|---|---|---|

| Q | Additional Guidance | |
|---|---|---|
| 7 | Percentage signs might be missing from students' work<br>65 – 45 = 20 (45 taken to be 45%, the (incorrect) percentage of boys)<br>20 = 12 (read as 20% = 12)<br>10 = 6 (read as 10% = 6)<br>5 = 3<br>Boys = 12 + 12 + 3 = 27 | M0<br>M1<br><br><br>M1A0 |

| | | | |
|---|---|---|---|
| 8 | + 1 | B1 | In each case allow other terms in $x$, $x^2$, etc, if the coordinates fit the equation<br>eg, for the first B1, $y = 2x + x - 2$ |
| | –2 | B1 | |
| | –1 | B1 | |
| | 58 | B1 | |
| | **Additional Guidance** | | |
| | Do not allow $3^2 + 7^2$ or 9 + 49 for fourth B1 | | B0 |

| | | | |
|---|---|---|---|
| 9 | $(\frac{6}{6}$ and$)$ $\frac{5}{6}$ and $\frac{1}{6}$ seen or used | M1 | oe with no other probabilities used in their calculations |
| | $\frac{5}{36}$ or $0.13\dot{8}$ or 0.139 or 0.14<br>or $13.\dot{8}\%$ or 13.9% or 14% | A1 | oe fraction, decimal or percentage $\frac{20}{216}$<br>SC1 $\frac{25}{216}$ or 0.1157… or 0.116 or 0.12<br>or 11.57…% or 11.6% or 12% |
| | **Additional Guidance** | | |
| | The SC1 is for inclusion of the first roll with a probability of $\frac{5}{6}$ | | |

| | | | |
|---|---|---|---|
| 10 | ($y$ =) $-2x + 1$ or gradient of given line is –2 | B1 | |
| | Gradient of required line is<br>–1 ÷ their –2 or 0.5 | M1 | oe implied by $y = 0.5x$ …. |
| | $y = 0.5x - 3$ | A1 | oe $x - 2y = 6$ |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11 | $\frac{3}{10}$ and $\frac{4}{8}$<br>or<br>$\frac{1}{10}$ and $\frac{2}{8}$ | M1 | oe fraction, decimal or percentage<br>Must be linked as a pair or pairs |
| | $\frac{3}{10} \times \frac{4}{8}$ or $\frac{12}{80}$<br>or<br>$\frac{1}{10} \times \frac{2}{8}$ or $\frac{2}{80}$ | M1 | oe fraction, decimal or percentage<br>If seen on a tree diagram, the multiplication may be implied by a final value |
| | $(\frac{3}{10} \times \frac{4}{8}) + (\frac{1}{10} \times \frac{2}{8})$ | M1 | oe $\frac{12}{80} + \frac{2}{80}$ |
| | $\frac{14}{80}$ | A1 | oe fraction, decimal or percentage<br>$\frac{7}{40}$ or 0.175 or 17.5% |
| | **Additional Guidance** | | |
| | $\frac{3}{10} = 0.3 = 30\%$<br><br>$\frac{4}{8} = \frac{2}{4} = \frac{1}{2} = 0.5 = 50\%$<br><br>$\frac{1}{10} = 0.1 = 10\%$<br><br>$\frac{2}{8} = \frac{1}{4} = 0.25 = 25\%$<br><br>$\frac{12}{80} = \frac{6}{40} = \frac{3}{20} = 0.15 = 15\%$<br><br>$\frac{2}{80} = \frac{1}{40} = 0.025 = 2.5\%$ | | |

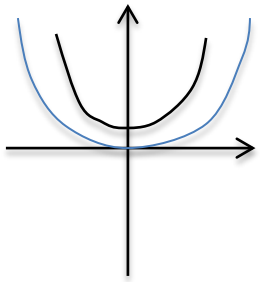
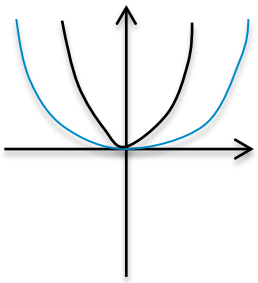
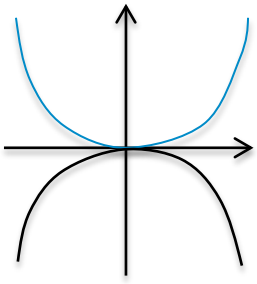
| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12 | **Alternative method 1** | | |
| | $(P =) \dfrac{45}{(\sqrt[3]{R})^2}$ | M1 | |
| | $(P =) \dfrac{45}{9/R}$ or $(P =) 45 \times \dfrac{R}{9}$ or $(P =) \dfrac{45R}{9}$ | M1 | |
| | $P = 5R$ or $k = 5$ | A1 | |
| | **Alternative method 2** | | |
| | Identifies values for $P$, $Q$ and $R$ which fit both equations | M1 | eg $P = 5$, $Q = 3$, $R = 1$ |
| | Shows correct working to calculate the value of $k$ | M1 | |
| | $P = 5R$ or $k = 5$ | A1 | |
| | **Additional Guidance** | | |
| | Condone $(P =) \dfrac{45}{3/R}$ or $(P =) \dfrac{45R}{3}$ or $P = 15R$ or $k = 15$ for the second mark if from otherwise correct working. This will come from the student forgetting to square 3 | | M1M1A0 |
| 13 | $\dfrac{5 \times 4}{8}$ or $\dfrac{20}{8}$ or $2\dfrac{4}{8}$ or 2.5 | M1 | oe |
| | $2\dfrac{1}{2}$ | A1 | |
| | **Additional Guidance** | | |
| | $\dfrac{10}{4}$ or $\dfrac{5}{2}$ | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **14** | $2a = b + 3$ or $-2a = -b - 3$ or $\frac{b}{2} = a - \frac{3}{2}$ or $\frac{b}{2} = \frac{2a-3}{2}$ | M1 | |
| | $a = \frac{b+3}{2}$ or $a = \frac{-b-3}{-2}$ or $a = \frac{b}{2} + \frac{3}{2}$ or $a = \frac{1}{2}(b + 3)$ | A1 | SC1 $\frac{b+3}{2}$ or $\frac{-b-3}{-2}$ or $\frac{b}{2} + \frac{3}{2}$ or $\frac{1}{2}(b + 3)$ |
| | **Additional Guidance** | | |
| | $a = (b + 3) \div 2$ | | M1 A1 |
| | $a = b + 3 \div 2$ | | M1 A0 |
| | In all cases, $3 + b$ is equivalent to $b + 3$ | | |
| **15 (a)** | $\frac{116}{230}$ | B1 | oe fraction, decimal or percentage $\frac{58}{115}$ |
| | **Additional Guidance** | | |
| | Decimal or percentage answers are unlikely, but must be to at least 3 sf: 0.504…. or 50.4….% | | |
| **15 (b)** | $\frac{31}{230}$ | B1 | oe fraction, decimal or percentage |
| | **Additional Guidance** | | |
| | Decimal or percentage answers are unlikely, but must be to at least 2 sf: 0.13…. or 13….% | | |
| **15 (c)** | $\frac{31}{58}$ | B1 | oe fraction, decimal or percentage |
| | **Additional Guidance** | | |
| | Decimal or percentage answers are unlikely, but must be to at least 2 sf: 0.53…. or 53….% | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16 | **Alternative method 1** | | |
| | $3x + 12 = 28.5$ | M1 | |
| | $3x = 28.5 - 12$ or $3x = 16.5$ | M1 | |
| | $(x =)$ 5.5 | A1ft | ft M1M0 with one error |
| | $(A =)$ 28.5 and $(B =)$ 29.5 and Yes | Q1ft | Strand (iii)<br>Correct decision for their values, which must be correct for their value of $x$ |
| | **Alternative method 2** | | |
| | 28.5 – 12 or 16.5 | M1 | |
| | Their 16.5 ÷ 3 | M1 | |
| | $(x =)$ 5.5 | A1ft | ft M1M0 or M0M1 with one error |
| | $(A =)$ 28.5 and $(B =)$ 29.5 and Yes | Q1ft | Strand (iii)<br>Correct decision for their values, which must be correct for their value of $x$ |
| | **Alternative method 3** | | |
| | $5x + 1 = 3x + 12$ | M1 | |
| | $5x - 3x = 12 - 1$ or $2x = 11$ | M1 | |
| | $(x =)$ 5.5 | A1ft | ft M1M0 with one error |
| | $(A =)$ 28.5 and $(B =)$ 29.5 and Yes<br>or $(C =)$ 28.5 and $(B =)$ 29.5 and Yes | Q1 | Strand (iii) |
| | **Additional Guidance** | | |
| | Their error could be adding 12 instead of subtracting. | | |
| | On alt 2, if they start with an incorrect value for $x$, they can achieve the Q1ft for only working out that $A$ is not 28.5 and saying 'No' | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **17 (a)** | **Alternative method 1** | | |
| | (P(A)=) 2 × 0.12 or 0.24 | M1 | oe |
| | (P(D) =) 1 – (their 0.24 + 0.12 + 0.28) or 1 – 0.64 or 0.36 | M1 | oe |
| | 1 – (0.24 + 0.12 + 0.28) = 0.36<br>**and**<br>0.12 × 3 = 0.36 | Q1 | oe<br>Strand ii<br>All working correct |
| | **Alternative method 2** | | |
| | (P(D)=) 3 × 0.12 or 0.36 | M1 | oe |
| | (P(A) =) 1 – (0.12 + 0.28 + their 0.36) or 1 – 0.76 or 0.24 | M1 | oe |
| | 1 – (0.12 + 0.28 + 0.36) = 0.24<br>**and**<br>0.12 × 2 = 0.24 | Q1 | oe<br>Strand ii<br>All working correct |
| **17 (b)** | 0.28 × 200 | M1 | oe |
| | 56 | A1 | Allow $\frac{56}{200}$ |
| | 62 | A1ft | ft their 56 + 6 if M1 scored |
| **18** | $36 \times 10^{12}$ or 36 000 000 000 000 | M1 | Allow one calculation error in 4 × 9 or 5 + 7 |
| | $3.6 \times 10^{13}$ | A1 | SC1 $3.6 \times 10^{n}$ where $n$ is an integer |
| **19** | Divides 1 by 11, showing at least 0.09 | M1 | |
| | $0.\dot{0}\dot{9}$ | Q1 | Strand (i) Correct notation |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **20** | $x(x + 3)$ or $x^2 + 3x$ | M1 | For this mark only, condone $x + x(x + 3)$ or $x + x^2 + 3x$ |
| | Their $x(x + 3) + x + 4$ | M1 | |
| | $x^2 + 3x + x + 4$ or $x^2 + 4x + 4$ | M1 | For this mark only, this can come from expanding $(x + 2)^2$ |
| | $x^2 + 4x + 4 = (x + 2)^2$ | A1 | |
| | **Additional Guidance** | | |
| | There are no marks for purely numerical answers. | | |
| **21** | $\frac{2}{5}a = \frac{3}{4}b$<br>or<br>0.75 ÷ 0.4 or 1.875<br>or<br>0.4 ÷ 0.75 or $0.5\dot{3}$<br>or<br>0.75 : 0.4 | M1 | oe eg $4a = 7.5b$ or $40a = 75b$ |
| | $8a = 15b$<br>or<br>$a = (0.75 \times 2.5)b$ or $a = 1.875b$<br>or<br>$b = (0.4 \times 1.\dot{3})a$ or $b = 0.5\dot{3}b$<br>or<br>75 : 40 | M1 | oe<br><br>oe ratio with at least one integer value |
| | 15 : 8 | A1 | SC2 8 : 15 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **22** | $(n^{\frac{1}{3}} =) \ \frac{1}{2}$<br>or<br>$16^{\frac{-3}{4}}$ (= $n$) or $\frac{1}{16^{\frac{3}{4}}}$ (= $n$) | M1 | |
| | $\frac{1}{8}$ | A1 | |
| **23 (a)** |  | B1 | Curve must be all above given graph and at least roughly parallel |
| **23 (b)** |  | B1 | Curve must be between given graph and the $y$ axis and pass through (0, 0) |
| **23 (c)** |  | B1 | Curve must be an attempt at reflection and pass through (0, 0) |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **24** | ($w^2$ =) 6 | B1 | |
| | (2$xy$ =) $2\sqrt{36}$ or $2 \times 2\sqrt{3} \times \sqrt{3}$ or $2 \times 6$ or $4 \times 3$ | M1 | Implied by ($w^2$ + 2$xy$ =) $3\sqrt{36}$ |
| | (2$xy$ =) 12 or ($v^2$ =) 6 + 12 or 18 | A1 | 12 implies M1A1, 18 implies B1M1A1 |
| | $3\sqrt{2}$ or $a = 3$ | A1 | Correct answer scores full marks, with or without 6 seen |
| **25** | (2, 2, 2) | B1 | |
| | (6, 6, –6) and (6, –6, 6) and (–6, 6, 6) | B2 | B1 for any one |
| | **Additional Guidance** | | |
| | Accept coordinates marked on the system | | |