Version : 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

# General Certificate of Secondary Education

# Mathematics 3301
*Specification A*

*Higher Tier Paper 2*

# Mark Scheme

## *2005 examination - June 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.

# AQA GCSE Mathematics Specifications A & B

## Notes for Examiners

In general if a response is fully correct then it is sufficient to tick the final answer and put the mark for that part in the margin. Parts not attempted or totally incorrect must have 0 for that part in the margin. Negative marks must not be used.

Errors **must** be underlined or ringed.

Responses that are partly correct will generally be awarded marks for method or partial working. In that case the following should appear in the margin to indicate what the mark(s) has been awarded for. These are detailed in the mark scheme.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **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. |
| **M dep** or **DM** | A method mark dependent on a previous method mark being awarded. |
| **B dep** or **DB** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **Ft** | Follow through marks. Marks awarded following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth. |

Within the script the following notations can be used to explain the decision further. These should appear next to the place in the script where the error or omission is made.

| | |
|---|---|
| **ft** or ✓ | Follow through marks. Wrong working should not be penalised more than once so that positive achievement later in the question can be recognised. |
| ✗ | An answer that does not follow through from previous working. |
| **MR** or **MC** | 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. |

**Fw** 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.

**Wnr** Work not replaced. Erased or crossed out work that is still legible can be marked.

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

^ Work incomplete or method missing.

**Allow** In general decisions should support the candidate. If an examiner feels that work is worthy of a mark then it can be allowed.

**BOD** Benefit of the doubt should only be given in cases where evidence is not secure. For example overwriting numbers. It should not be used to avoid making a decision. Examiners are expected to make decisions based on the scheme.

**seen** or ✓ Every page containing working should be annotated to show it has been considered.

**From page 23** ↘ Marks transferred from another part of the paper. Candidates often make a mistake in their original work and do the question on the back page or another page with some space. The part marks should be credited there **within the script** and the marks transferred to the margin by the printed question.

**Wrong method** Candidates sometimes obtain the correct answer via a completely wrong method. If an examiner is sure that this is the case then the Method mark should not be awarded and subsequently the accuracy mark cannot be awarded. This notation should also be used when candidates 'fiddle' algebra to demonstrate a given result.

**Pa** Premature approximation. Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise in the standardising meeting.

**Unusual responses**

Very occasionally situations may occur which are not covered by the above notations. In these rare cases examiners should write brief comments in the script to explain their decision, such as ignore, irrelevant etc.

**Blank answer spaces and blank pages**

**Blank answer spaces should be crossed through to show that they have been seen. Blank pages at the end of a paper should also be crossed through to indicate that they have been seen. Any working on these pages must be marked.**

## Diagrams

Diagrams that have working on them should be treated like normal responses and marked with same notations as above. If the diagram is written on but the correct response is within the answer space the work within the answer space should be marked and the diagram ticked to indicate that the examiner has seen it. Working on diagrams that contradicts work within the answer space is **not** to be considered as choice but as working.

**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 as directed at the standardising meeting.**

**Questions which ask candidates to show working**

**Instructions on marking will be given at the standardising meeting 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.**

**Probabililty**

**Answers should be written as fractions, decimals or percentages. If a candidate uses an incorrect notation such as "1 out of 4" for ¼ consistently through the paper, then penalise the first occurrence but allow any following answers. Ratio is not acceptable as incorrect notation.**

**Recording Marks**

Part marks for a question should be shown in the margin at the side of the work. The totals should be shown in the oval either at the end of each question or after each double page. These marks should be transferred to the appropriate box on the front of the paper. The grand total for the paper should also be shown in the appropriate box on the front of the paper. This total should agree with the total of the part marks within the paper.

Checkers at the board will first check that the part marks agree with the ringed totals, either at the end of each question or after each double page. They will then check that these marks have been transferred correctly and finally that the total on the front cover is correct. Papers that contain clerical errors may be returned to examiners.

# Paper 2H

| | | | |
|---|---|---|---|
| 1a | $8x - 4 + 3x + 18$ | M1 | Allow one error |
| | 11x + 14 | A1 | fw that does not contradict is not penalised but fw such as = 25*x* do not award A1 |

| | | | |
|---|---|---|---|
| 1b | $4x^2 - 2x^3$ | B2 | B1 each term fw such as $= 2x^5$ only give B1<br>**$4x^2 - 2x^2 = 2x^2$ is B1, $4x^2 - 2x^2 = 6x^4$ is B0** |

| | | | |
|---|---|---|---|
| 2a | $2n$ or $2n^{th}$ | B1 | oe. Accept 2 x *n*, *n* x 2 but not *n*2. Allow *x* for *n* but no other letter, unless they explain it |

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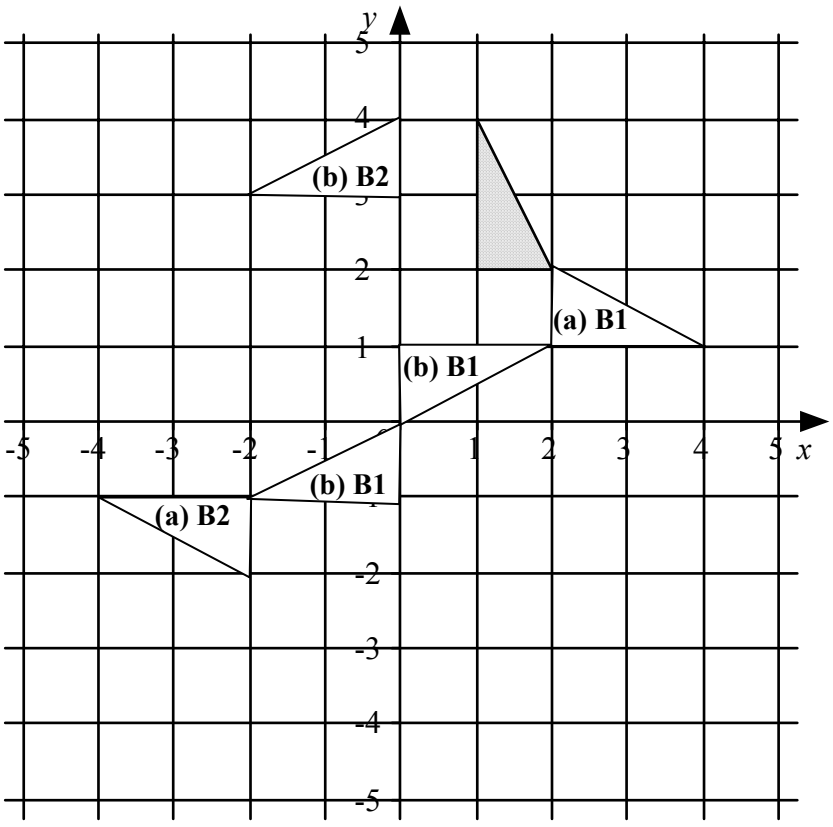
|---|---|---|---|
| 2b | $n + 1$ or $n^{th} + 1$ | B1 | oe |

| | | | |
|---|---|---|---|
| 3a | Correct position<br>(-2, -2), (-2, -1), (-4, -1) | B2 | B1 if reflected in $y = x$ |
| 3b | Correct position<br>(0, 3), (0, 4), (-2, 3) | B2 | B1 if rotated 90° clockwise about (0, 2)<br>B1 if rotated 90° anti-clockwise about (2, 0) |



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| 4a | 40 x 0.4 | M1 | |
| | 16 | A1 | |

| | | | |
|---|---|---|---|
| 4b | 30÷80 | M1 | |
| | Plot at (80, 0.375) | A1 | **Point on graph within $^1/_2$ square 2 marks** |

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| 4c | Yes (implied) plus reference to 20 (out of 80) or probability should be 0.25 or $^1/_4$ | B1 | |

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| 5 | 75% = 180 | M1 | Use of multiplier 0.75 B1 |
| | (1% =) 180 ÷ 75 (= 2.4) | A1 | 180 ÷ 0.75 M1 |
| | (100%) = 240 | A1 | |

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|---|---|---|---|
| 6 | **Use of multiplier 1.04** | B1 | eg 3000x1.04 = 3120 |
| | 3000 x $1.04^5$ | M1 | Must use a 'sensible multiplier' 1.4, 1.004 etc. for M1 |
| | 3649.96 | A1 | Accept £3650 if M1 awarded.<br>649.96 only B1, M1, A0 |

| | | | |
|---|---|---|---|
| 6 | **Adding 4% per annum for 5 years** | M1 | Must have £3120 as first answer and show working for all at least 4 years. |
| | At least 2 more years correct | A1 | Values are (£)3244.8(0), (£)3374.59(2), (£)3509.58 or (£)3509.57(568) |
| | 3649.96 or 3649.95 | A1 | ***Must be exact but accept £3650 if M1, A1 awarded.***<br>If values rounded to nearest penny values are 3120.00, 3244.80, 3374.59, 3509.57, 3649.95<br>649.96 only M1, A1, A0 |

| | | | |
|---|---|---|---|
| 7a | B, D, A | B3 | B1 each answer |
| 7b | Only in 1st and 3rd quadrants | B1 | B0 for straight line |
| | Correct curvature at (0, 0) | B1 | Gradient flattens at (0,0) SC1 any cubic |

| | | | |
|---|---|---|---|
| 8a | Plots at correct position | B2 | B1 for each plot to $^1/_2$ square accuracy |

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| 8b | 4 x their value from graph or table (say 100) | M1 | **Must** see evidence this is from graph or a nominal 'trend'. **NB do not accept if answer predicted from costs.**<br>NB graph is intentionally 'curved' but accept from a line of best fit or prediction from table of moving averages. |
| | 4 x 'their 100' – (94+98+101) | DM1 | NB Scale is easily mis-read |
| | 107 | A1ft | f.t. their values 99 gives 103, 101 gives 111, 102 gives 115, 103 gives 119. |

| | | | |
|---|---|---|---|
| 9 | Sight of digits 5925, 593, 59 or 6 | M1 | |
| | 5 925 000 000 or 5.925 x $10^9$ | A1 | oe from award of M |
| | Rounded to 5.93, 5.9 or 6 x $10^9$ | B1ft | f.t. their value if ≥ 4 s.f. if rounded to 3, 2 or 1 s.f..<br>NB If A0 awarded and final answer correctly rounded but not in standard form still give B1. |

NB in 10(a) (b) (c) alternative methods. For example:- Trig in (a). Pythag followed by cos rule in (b). Sine rule $\frac{\sin D}{13} = \frac{\sin 90}{33.8}$ in (c) must be complete method to get M2.

| | | | |
|---|---|---|---|
| 10a | $BC^2 = 19^2 – 9^2$ (=280) | M1 | $x^2 + 9^2 = 19^2$ |
| | BC = √280 | DM1 | For squaring, subtracting and evidence of square rooting. |
| | BC = 17 or 16.7(….) | A1 | 17 with no working B3 |

| | | | |
|---|---|---|---|
| 10b | **Sight of tangent** | M1 | |
| | tan $x = {}^{11}/_{24}$ or<br>Angle = $\tan^{-1}(11 \div 24)$ | DM1 | $\tan^{-1}(0.458..)$<br>M2 for any complete correct method.<br>Sin = 11/√697 or 11/26.4<br>Cos = 24/√697 or 24/26.4 |
| | 25 or 24.6(….) | A1 | 25 with no working B3<br>Radians 0.43, gradians 27.35<br>Penalise on first occurrence only. |

In 10(c) ft on wrong AC for method 1 and method 3.

| | |
|---|---|
| 10c | Method 1 (most likely). AC = 13 B1. Sight of sine M1. sin ADC =13 ÷ 33.8 DM1.<br>ADC = 22.6° A1 Radians 0.395, Gradians 25.133 |

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| 10c | Method 2 ADC = CAB B1. Sight of tan M1 tan CAB = 5 ÷ 12. DM1<br>CAB = ADC = 22.6° A1 |

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| 10c | Method 3 AC = 13 B1. ADC similar to ACB, or Pythagoras used to find DC = 31.2 M1<br>Use of cos rule or appropriate trig ratio with correct values M1. ADC = 22.6° A1 |

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| 10c | Method 4 Find angle A and thus C (67.4), or find C directly. M1, A1.<br><br>ADC = Angles in a quadrilateral ABCB = 360 – (90 + 90 + 153.4) M1, ADC = 22.6° A1 |

***Allow embedded answers unless contradicted on answer line, then award only M marks***

| | | | |
|---|---|---|---|
| 11a | $17 - x = 13.5$ | M1 | |
| | $17 - 13.5 = x$ | DM1 | |
| | 3.5 | A1ft | ft on first M awarded and only 1 error. |

| | | | |
|---|---|---|---|
| 11a | $^{17}/_{3} - {}^{x}/_{3} = 4.5$ | M1 | |
| | $x = 3 \times (5\,{}^{2}/_{3} - 4\,{}^{1}/_{2})$ | DM1 | oe |
| | 3.5 | A1ft | ft on first M awarded and only 1 error. |

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|---|---|---|---|
| 11b | $2y - 6 = 5 - 3y$ | M1 | No errors |
| | $2y + 3y = 5 + 6$ | M1 | Allow one error if first M1 awarded otherwise must be correct rearrangement. |
| | 2.2 | A1 | oe sc $y = {}^{8}/_{5}$ or 1.6 B2 from $2y - 3 = 5 - 3y$ only |

| | | | |
|---|---|---|---|
| 11c | $6z - 3 + 4z + 12 = 10z - 5 + 12z - 4$ | M1 | Allow one error |
| | $10z + 9 = 22z - 9$ | A1ft | ft if one error and terms on each side collected correctly |
| | 1.5 | A1ft | ft if M1, A0 awarded and no further errors made. |

| | | | |
|---|---|---|---|
| 12 | Breaks problem down into sum of lines and (semi-)circles | M1 | |
| | Length of lines 4.1+5.9+4.7+2.9 (= 17.6) | A1 | Sc 17.6 only B1 |
| | Use of $2\pi r \div 2$ | DM1 | or $\pi d \div 2$ but must use with numbers. |
| | Length of semi-circles $0.9\pi+0.6\pi+0.7\pi$ (= 6.9(11..)) | A1 | 2.8, 1.9, 2.2 |
| | Total = 24.5(…) | A1 ft | ft on 1 arithmetical or 'reading from scale' error and both M's awarded. |

4.1 = 2.9 + 0.6 + 0.6, 5.9 = 0.6 + 0.6 + 2.9 + 1.8, 4.7 = 2.9 + 1.8, 2.9 = 2.9

| | | | |
|---|---|---|---|
| 13 | $y = kx^2$ *or* $y \propto x^2$ | M1 | oe $5 = k \times 16$ |
| | $k = 0.3125$ | A1 | oe |
| | 20 | A1 | |

| | | | |
|---|---|---|---|
| 14 | Area semicircle – area circle | M1 | Accept $\pi \times 10^2 \div 2$ and/or $\pi \times 5^2$ for M1 |
| | $\pi 5^2 \div 2 - \pi(2.5)^2$ (= $12.5\pi - 6.25\pi$ = 39.27 - 19.63) | A1 | Accept fractions, decimals or in terms of $\pi$ |
| | 19.6(….) (=$6.25\pi$) | A1ft | ft on one error only, e.g.<br>Accept fractions, decimals or in terms of $\pi$.<br>Use of $\pi$ as 3.14 gives 19.625 A1<br>Common errors e.g.<br>$\pi \times 10^2 \div 2 - \pi \times 5^2 = 157.1 - 78.5 = 78.6$<br>= M1,A0,A0 ft.<br>$\pi \times 10^2 \div 2 - \pi \times 2.5^2 = 157.1 - 19.6 = 137.5$<br>= M1,A0,A1 ft<br>$\pi \times 5^2 \div 2 - \pi \times 5^2 = 39.3 - 78.5 = -39.3$<br>M1, A0, A0 (non –sensible answer) |

| | | | |
|---|---|---|---|
| 15 | Use of $\frac{4}{3}\pi \times 4^3 \div 2$ | M1 | Must use 4 or 8 as radius. |
| | (Volume hemisphere =) 133.9 to 134.1 (inclusive) | A1 | 133.97 if $\pi = 3.14$ used. |
| | (Volume paperweight =) 500+(their 134) (=634) | A1ft | If M1 awarded. |
| | $cm^3$ | B1 | This mark is independent |

| | | | |
|---|---|---|---|
| 16a | Continuation at least once more | M1 | e.g $5^3-4^3=61$,<br>$6^3-5^3=91$(allow this to be prime if stated) Correctly evaluated. |
| | Justification that the answer is not prime. | A1 | e.g. 91 = 7 x 13.<br>$8^3-7^3=169 = 13 \times 13$<br>Must show the factors.<br>NB $1^3 - 0^3 = 1$ (1 not prime) M1, A1 |

| | | | |
|---|---|---|---|
| 16b | $\boldsymbol{n^2 + 5n + 5n + 25 - (n^2 + 3n + 3n + 9)}$ | M1 | M1 for expanding and subtracting (allow 1 arithmetical error).<br>Condone 'invisible bracket' |
| | $\boldsymbol{n^2 + 10n + 25 - n^2 - 6n - 9}$ | A1 | A1 for all terms collected and correct signs or **clear** evidence of subtraction. |
| | $4n + 16 = 4(n + 4)$ | A1 | Factorisation must be shown. Expanding is A0. |

| | | | |
|---|---|---|---|
| 17 | Finds total of at least first 4 bars | M1 | 60, 40, 100, 40, (30, 50) |
| | Finds cumulative total at least as far as 200. | M1 | 60, 100, 200, (240, 270, 320).<br>NB these can occur in either part and cumulative totals implies bar totals. |
| | Median = 102 | A1 | Correct answer for either part scores 2 |
| | IQR = 35 | A1 | Sc No previous Ms awarded 85-120 or 120 – 85 seen allow M1. |

| | | | |
|---|---|---|---|
| 18 | $ax - ab = a^2 + bx$ | M1 | $x - b = a + \frac{bx}{a}$ Allow $ax + ab =$ |
| | $ax - bx = a^2 + ab$ | A1 | $x - \frac{bx}{a} = a + b$ |
| | $x(a - b) = a^2 + ab$ | DM1 | For factorising $x(1 - \frac{b}{a}) = a + b$<br>NB sc $x(a - b) = a^2 + b$ Allow M1 and A1 if $x = \frac{a^2 + b}{a - b}$ |
| | $x = \frac{a^2 + ab}{a - b}$ (= $\frac{a(a + b)}{a - b}$) | A1 ft | oe, e.g. $x = \frac{a + b}{1 - \frac{b}{a}}$<br>Follow through on factorisation if DM1 awarded.<br>Do not award if $x =$ not shown.<br>fw such as cancelling a's do not award last A1.<br>NB $x = \frac{a^2 + ab}{a + b} = \frac{a(a + b)}{a + b} = a$ is OK. |

| | | | |
|---|---|---|---|
| 19 | $4(3x - 1) - (2x + 1)$ | M1 | No errors – $2x + 1$ must be recovered. |
| | $(12x - 4 - 2x - 1 =) 10x - 5$ | A1 | NB if $-2x + 1$ used = $10x - 3$ |
| | $5(2x + 1)(3x - 1)$ | M1 | **oe 5 x denominator if quadratic. e.g $5(6x^2 - 1)$** |
| | $= 30x^2 + 5x - 5$ | A1 | |
| | $30x^2 - 5x = 0$ or $6x^2 - x = 0$ | DM1 | Dependent on second M.<br>Rearranging to form $ax^2 + bx + c = 0$ (no errors) |
| | $x = 0$ or $^1/_6$ (0.16(…)) | A1 | **No ft**<br><br>**Common error**<br>$4(3x - 1) - 2x + 1 = 5(2x + 1)(3x - 1)$ M0, M1<br>$10x - 3 = 30x^2 + 5x - 5$ A1<br>$30x^2 - 5x - 2 = 0$ M1<br>x = 0.35, -0.19 A0 |

| | | | |
|---|---|---|---|
| 20 | 99.5 | B1 | |
| | Their √(Their value '99.5' ÷ π) | M1 | Must use a 'lower' limit for volume 90, 95, 99, 99.9…5. |
| | 5.63(…), 5.628 etc…. | A1ft | ft of M1 awarded. 5.6277734<br>T&I must aim for 99.5 and be completely correct. |

| | | | |
|---|---|---|---|
| 21a | Linear scale factor is 2 | B1 | Allow numerical examples but must be complete $2^3 = 8$, $4^3 = 64$, 64 = 8 x 8, but the increase by a factor of 8 must be shown and not assumed B2 |
| | Volume scale factor is $lsf^3$ | B1 | Allow algebra $(2x)^3 = 8x^3$ |

| | | | |
|---|---|---|---|
| 21b | $(14.5 \div 8)^3$ or $1.8125^3$ | M1 | $\sqrt[3]{6} = 1.817$ $8^3$ x 6, $14.5^3 \div 6$ |
| | =5.95(4) | A1 | 8 x 1.817 ≈ 14.5 $\approx 14.5^3$ $\approx 8^3$ |
| | Volume increases by about 6 x so claim justified. | A1 | Allow 'Almost but not quite' |

| | | | |
|---|---|---|---|
| 22a | Line $y = 1$ drawn or points on curve | M1 | Accept $y = 1$ written in body of script. |
| | 0.8, -3.8 (± 0.1) | A1 | |

| | | | |
|---|---|---|---|
| 22b | Attempt to split equation into $x^2 + 3x - 2 = ax + b$ | M1 | Or $x^2 + 3x - 2 - (x^2 + 2x - 1)$<br>Or $x^2 + 3x - 2 + ax + b = x^2 + 2x - 1$ |
| | Line ($y = x - 1$) drawn | A1 | |
| | 0.4, -2.4 (± 0.1) | A1f.t. | f.t. on their line if M1 awarded.<br>e.g. $y = x + 1$(1, -3), $y = 1 - x$(0.6 (0.7), -4.6 (-4.7)), $y = -1 - x$ (0.2, -4.2) |