Version 1.0

**General Certificate of Secondary Education**
**June 2013**

# Linear Mathematics 4365H

# (Specification 4365)

# Paper 1 Higher Tier 43651H

# Final

***Mark Scheme***

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 events which all examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised 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 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.



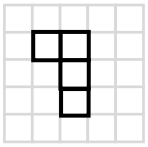
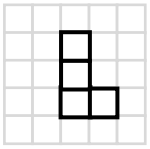
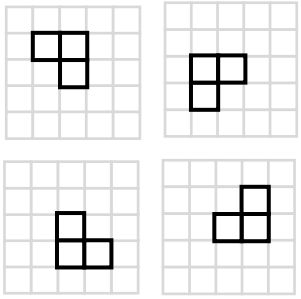
Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

## 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. |
| **[*a*, *b*)** | Accept values between *a* and *b* with *a* included but *b* not included |
| **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. |
| **Nms** | No method shown |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1 |  **A** | B1 | Only outline needed. Can be anywhere on grid<br>Internal lines not necessary (may be dashed).<br>Shape may be shaded (even in chequer-board fashion) |
| |  **B** | B1 | Only outline needed. Can be anywhere on grid<br>Internal lines not necessary (may be dashed).<br>Shape may be shaded (even in chequer-board fashion) |
| |  **C** | B1 | Any orientation (as shown)<br>Only outline needed. Can be anywhere on grid<br>Internal lines not necessary (may be dashed).<br>Shape may be shaded (even in chequer-board fashion) |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2** | $\frac{40 \times 200}{80}$ | M1 | M1 for any two shown in the appropriate calculation<br>M1 for 41 ≈ 40 **and** 198 ≈ 200 **and** 77 ≈ 80 clearly stated if not used in a calculation |
| | 100 | A1 | Correct answer only seen is M1, A1 but must use correct approximations if working is seen |
| **3** | Substitutes 10 into **at least two** expressions and evaluates correctly or $n$ = 10 substituted into **all five** expressions ie. $\frac{1}{10}$, 10 – 1, 10 + 1, $10^2$ and $\sqrt{10}$ | M1 | $\frac{1}{10}$ (oe) , 9, 11, 100, [3, 4] |
| | Evaluates all 5 expressions correctly ($\sqrt{10}$ can be left as $\sqrt{10}$) **or**<br>$\frac{1}{10}$, $\sqrt{10}$, 10 – 1, 10 + 1, $10^2$<br>written in either order | A1 | If $\sqrt{10}$ evaluated and not in range [3, 4] then this is A0<br>If 10 substituted but not evaluated only the expressions order or reverse order will get A1 |
| | $n$ – 1 **or** 9 **or** 10 – 1 | A1ft | Do not ft if 3 expressions evaluated incorrectly<br>ft on M1, A0 if $\sqrt{10}$ given a value **and** 5 expressions evaluated, with **at least 3 correct**.<br>**or** ft on M1, A0 if $\sqrt{10}$ not evaluated, with **at least three** correct out of $\frac{1}{10}$, 9, 11 or 100, but the median given implies that $\sqrt{10}$ used in the correct place if the numbers were arranged in order<br>Median may be given as a value, an expression in $n$ or an unevaluated expression using 10 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4(a)** | Even | B1 | |
| **4(b)** | Odd | B1 | |
| **4(c)** | Either | B1 | |
| **5(a)** | Correct straight (if not drawn with a ruler then intention to be straight) line graph from (0, –1) to (4, 7) with 1mm<br>(½ square) tolerance<br>Allow a dashed line | B3 | B2 correct line but not from (0, –1) to<br>(4, 7) for at least a continuous $x$ distance of 2.<br>B2 all integer points (any others must also be correct) between 0 and 4 plotted but line not drawn<br>B2 correct but more than ½ square from tolerance<br>**Only one of these may be awarded.**<br>B1 straight line graph through (0, –1) of any length even if crooked later but not $x = 0$ or $y = -1$<br>B1 Single straight line graph with gradient 2 of any length<br>B1 two correct points calculated (eg in table) or plotted<br>Any line that is not straight is B0 although the B1 for two points calculated or plotted may still be gained |
| **5(b)** | 1.5 | B1 | Correct (eg from algebra) or ft their graph if $y = 2$ drawn to the graph and then a vertical line to $x$-axis |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **6(a)** | Histogram or frequency polygon with mid-points of bars and vertices of polygon at (5, 36), (15, 34), (25, 18) and (35, 12) | B2 | B1 one error<br>Ignore lines before (5, 36) and after (35, 12) if polygon drawn |
| **6(b)** | $6 \times (18 + 12)$<br>**NB** table can be seen if necessary. | M1 | oe $\frac{30}{100} \times 600$ |
| | 180 | A1 | SC1 30% stated as answer<br>SC1 for 420 as answer |
| **7** | $2 \times 4 + 3 \times 3 + 5 \times 1$<br>**or** $8 + 9 + 5$ | M1 | 22 has to come from correct working |
| | (30 – their 22) ÷ 4 | M1Dep | Their $22 + 4a = 30$ |
| | 2 | A1 | First M must be scored |
| **7**<br>**Alt 1** | Guess a value for $a$ and correctly works out $\sum xf$ | M1 | |
| | Guesses a second value nearer to the correct answer and correctly works out $\sum xf$ | M1Dep | |
| | 2 | A1 | First M must be scored |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **8(a)** | $3(x - 5)$ | B1 | |
| **8(b)** | $5y + 20t - 10$ | B2 | B1 for 2 correct terms.<br>Penalise any incorrect further working.<br>Eg<br>$5y + 20t - 10 = 25yt - 10$ is B1<br>$5y + 20t - 1 = 25yt - 1$ is B0 (error in expansion and incorrect further work)<br>$5y + 20t - 10 = 5(y + 4t - 2)$ given as answer is B1 as shows a misunderstanding of expanding brackets. |
| **8(c)** | $3w + 6 = 2w - 1$ | M1 | $w + 2 = \frac{2}{3}w - \frac{1}{3}$ |
| | $3w - 2w = -1 - 6$ | M1 | This mark is for rearranging their expansion correctly to get $w$ terms one side and number terms on the other.<br>$w - \frac{2}{3}w = -\frac{1}{3} - 2$ (oe) |
| | $-7$ | A1ft | ft on one error |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **9** | (550 – 250) ÷ 3 | M1 | J + W = 250 **or** J + 4W = 550 |
| | 100 | A1 | 3W = 300 or W = 100 |
| | 250 – their 100 | M1Dep | 100 + J = 250 or 400 + J = 550 |
| | 150 | A1 | |
| **9 Alt 1** | $\frac{4}{5} - \frac{1}{5}$ $(= \frac{3}{5})$ | M1 | |
| | Their $\frac{3}{5}$ = 300 or $\frac{1}{5}$ = 100 | A1 | |
| | 250 – their 100 | M1Dep | |
| | 150 | A1 | |
| **9 Alt 2** | 550 marked by top division **and** 250 marked by bottom division on **same** diagram | M1 | |
| | 300 indicated as difference **on diagram** or 350 and 450 written by intermediate divisions | A1 | 100 marked between any two divisions is M1, A1 |
| | 150 marked at bottom | M1Dep | |
| | 150 stated as answer | A1 | |
| **9 Alt 3** | Guesses a value for weight of jug, subtracts from 250, multiplies answer by 4 and adds to their value | M1 | |
| | Correct calculations | A1 | |
| | Guesses a second value for weight of jug nearer to 150 and **correctly** calculates all values | M1Dep | |
| | 150 | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **10** | $y \leq 5$ or $5 \geq y$ | B1 | Any order.<br>Penalise first use of > or < only.<br>Penalise first use of >= or => or =< or <= only.<br>Accept $2 < y \leq 5$ or $2 \leq y \leq 5$ |
| | $x \geq 2$ or $2 \leq x$ | B1 | Accept $2 \leq x < 5$ or $2 \leq x \leq 5$ |
| | $y \geq x$ or $x \leq y$ | B1 | oe<br>Sc1 $y = 5$ **and** $x = 2$ **and** $y = x$<br>or Sc1 $y \geq 5$ **and** $x \leq 2$ **and** $y \leq x$ |
| **11** | 3 + 4 + 5 (= 12) | B1 | 3 and 4 must be used |
| | 48 ÷ their 12 (= 4) | M1 | 'Their 12' means their addition of 3 + 4 + 5 or their total if they think that a pentagon does not have 5 sides |
| | 20 | A1ft | ft on B0<br>Accept 12 : 16 : 20 |
| **12** | $2a + 2c = 5a - 5b$<br>**or** $2a + 2c = 5(a - b)$<br>$2c = 5a - 2a - 5b$<br>or $2c = 5(a - b) - 2a$ | M2 | M1 if **one** expansion, sign or rearrangement error on any line<br>$-2c$ = is OK if rest correct |
| | $c = \frac{3a - 5b}{2}$<br>or equivalent expression | A1ft | ft on one error<br>Must have $c$ = on answer line<br>If question simplified by an incorrect expansion $2a + c$ to give $c$ = … (see exemplar below) then they must simplify their answer<br>Do not award if incorrect further work |
| **12 Alt** | $a + c = 2.5(a - b)$<br>$c = 2.5(a - b) - a$ | M2 | M1 if **one** expansion, sign or rearrangement error on any line |
| | $c = 2.5(a - b) - a$<br>or equivalent expression | A1 ft | ft on one error<br>Must have $c$ = on answer line<br>Do not award if incorrect further work |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **13(a)** | 20 | B1 | |
| **13(b)** | 9 | B1 | |
| **13(c)** | 11 and 3 seen | M1 | Could be written on diagram |
| | 8 | A1 | |
| **13(d)** | Comment on average and the implication, eg waiting times decreased after new window as median lower | B1 | ft their medians if valid conclusion reached |
| | Comment on range or inter-quartile range and the implication, eg Spread of waiting times decreased after new window as range decreased **or** Not much effect on waiting times as IQR about the same | B1 | ft their values if a valid conclusion reached |
| **14(a)** | 35 | B1 | |
| ***14(b)** | 100 | B1 | |
| | Angle at centre twice angle on circumference | Q1 | Must use words 'centre' and 'circumference' (or 'perimeter')<br>Allow poor spelling even though both words given<br>oe (strand) (i) |
| **15(a)** | $6x^2 + 4x + 15x + 10$ | M1 | Allow one sign or arithmetic error. Must see 4 terms including term in $x^2$, 2 terms in $x$ and a constant term |
| | $6x^2 + 19x + 10$ | A1 | **NB** Answer only<br>$6x^2 + 19x + b$ implies M1<br>$ax^2 + 19x + 10$ implies M1<br>Do not award if incorrect further work |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **15(b)** | $9x^4y^8$ | B2 | B1 for two of 9, $x^4$ or $y^8$<br>B1 maximum for any use of $\times$ signs<br>B0 for any addition eg $9 + x^4 + y^8$<br>Deduct one mark for incorrect further work |
| ***16** | Any side chosen for square and squared, eg $10^2 = 100$ | M2 | M2 is for both square and circle areas attempted with correct numerical values (eg if 10 chosen for side of square, then 5 must be used as radius of circle, or if 4 chosen as radius then 8 used as side of square)<br>M1 if both square and circle area attempted with one incorrect numerical value (eg if 10 chosen for side of square, then 10 used as radius of circle, or if 4 chosen as radius then 4 used as side of square) |
| | Half the side squared and multiplied by $\pi$, eg $\pi \times 25$<br>$\pi$ must be [3.1, 3.142] or $\frac{22}{7}$ | | |
| | Work out 75% of their square and a correct calculation of the circle area, **or** works out what percentage the circle area is of the square area | A1 | This can be awarded even if only M1 awarded.<br>Allow $\pi$ used if a clear comparison, eg $\pi \times 25 > 3 \times 25$ |
| | A method mark gained and correct conclusion based on 75% of their square with their circle | Q1 | Strand (ii).<br>Do not award if their circle area > square area, eg 78.5 > 25 |
| ***16 Alt** | $2r$ length of side of square giving $4r^2$ as area | M2 | M2 is for both square and circle area attempted with correct numerical values (eg if $r$ chosen for side of square, then $\frac{r}{2}$ must be used as radius of circle, or if $r$ chosen as radius then $2r$ used as side of square)<br>M1 if both square and circle area attempted with one incorrect numerical value (eg if $x$ chosen for side of square, then $x$ used as radius of circle, or if $x$ chosen as radius then $x$ used as side of square) |
| | $r$ as radius of circle giving $\pi r^2$ as area of circle | | |
| | 75% of their square (= $3r^2$) and correct expression for area of circle with their chosen radius | A1 | |
| | A method mark gained and correct conclusion based on 75% of their square with their circle. eg $\pi > 3$ | Q1 | Strand (ii). Do not award if their circle area > square area, eg $\pi r^2 > r^2$ |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **17** | $\frac{n(n-1)+n(n+1)}{2}$ | B1 | This mark is for combining fractions **or** if fractions dealt with separately, for combining $n^2$ terms correctly<br>$\frac{n^2-n+n^2+n}{4}$ is B0 as incorrect combining of fractions |
| | $\frac{n^2-n+n^2+n}{2}=\frac{2n^2}{2}$ | B1 | This mark is for eliminating $-n$ and $n$ either by showing by crossing or writing on same line and writing next line without them<br>$\frac{n^2}{2}-\frac{n}{2}+\frac{n^2}{2}+\frac{n}{2}$ |
| | $\frac{2n^2}{2}=n^2$ | B1 | This mark is for cancelling 2 top and bottom<br>$\frac{n^2}{2}+\frac{n^2}{2}=n^2$ |
| **17 Alt** | $\frac{n}{2}((n-1)+(n+1))$ | B1 | This mark is for factorising out a common factor.<br>$\frac{n}{4}(n-1+n+1)$ is B0 as incorrect factorisation |
| | $\frac{n}{2}(2n)$ | B1 | This mark is for combining terms inside bracket correctly |
| | $n^2$ | B1 | $1n^2$ is OK |
| **18** | $(x^2+2x-3)-(x^2+x-3)$ | M1 | Or attempt to 'balance' equations |
| | $y=x$ | A1 | |
| | – 2.3 and 1.3 | A1 ft | ft if M awarded and their line drawn |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **19(a)** | $3 \times 3 = 9$ **and** $\sqrt{3} \times \sqrt{3} = 3$<br>**or** $3^{\frac{1}{2}} \times 3^{\frac{1}{2}} = 3$ | B1 | $\sqrt{3} \times \sqrt{3}$ is essential seen or implied<br>Accept $(3^{1.5})^2 = 3^3 = 27$ oe |
| **19(b)** | $(3\sqrt{3})^2 - (3\sqrt{2})^2$ (= 27 – 18)<br>**or** $(3\sqrt{2})^2 + AD^2 = (3\sqrt{3})^2$ | M1 | Invisible brackets must be recovered for M1 |
| | $\sqrt{9}$ or 3 | A1 | |
| | $3\sqrt{2} + \sqrt{2}$ (= $4\sqrt{2}$) | M1Dep | Dep on M1, not on A1 as well |
| | 0.5 × their base × their 3 | M1Dep | |
| | $6\sqrt{2}$ | A1 | |
| **19(b)**<br>**Alt 1** | $(3\sqrt{3})^2 - (3\sqrt{2})^2$ (= 27 – 18) | M1 | Invisible brackets must be recovered for M1 |
| | $\sqrt{9}$ or 3 | A1 | |
| | Area *ABD* = 0.5 × their 3 × $3\sqrt{2}$ **and** area *ADC* = 0.5 × their 3 × $\sqrt{2}$ | M1Dep | Dep on M1, not on A1 as well |
| | Area *ABD* = 0.5 × their 3 × $3\sqrt{2}$ **+** area *ADC* = 0.5 × their 3 × $\sqrt{2}$ | M1Dep | Sum of two correct areas for their AD |
| | $6\sqrt{2}$ | A1 | |
| **19(b)**<br>**Alt 2** | $(3\sqrt{3})^2 - (3\sqrt{2})^2$ (= 27 – 18) | M1 | Invisible brackets must be recovered for M1 |
| | $\sqrt{9}$ or 3 | A1 | |
| | $3\sqrt{2} + \sqrt{2}$ (= $4\sqrt{2}$) | M1Dep | Dep on M1, not on A1 as well |
| | Sin *ABD* = their 3 ÷ $3\sqrt{3}$ **and** Area = 0.5 × $3\sqrt{3}$ × Their $4\sqrt{2}$ × their $\frac{1}{\sqrt{3}}$ | M1Dep | |
| | $6\sqrt{2}$ | A1 | |