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General Certificate of Secondary Education
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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.

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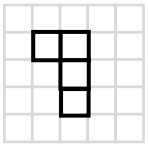
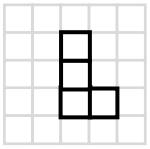
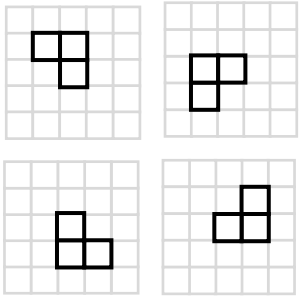
Glossary for Mark Schemes

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. 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 Internal lines not necessary (may be dashed). Shape may be shaded (even in chequer-board fashion)
	 **B**	B1	Only outline needed. Can be anywhere on grid Internal lines not necessary (may be dashed). Shape may be shaded (even in chequer-board fashion)
	 **C**	B1	Any orientation (as shown) Only outline needed. Can be anywhere on grid Internal lines not necessary (may be dashed). 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 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** $\frac{1}{10}$, $\sqrt{10}$, 10 – 1, 10 + 1, 10^2 written in either order	A1	If $\sqrt{10}$ evaluated and not in range [3, 4] then this is A0 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 ft on M1, A0 if $\sqrt{10}$ given a value **and** 5 expressions evaluated, with **at least 3 correct**. **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 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 (½ square) tolerance Allow a dashed line	B3	B2 correct line but not from (0, –1) to (4, 7) for at least a continuous x distance of 2. B2 all integer points (any others must also be correct) between 0 and 4 plotted but line not drawn B2 correct but more than ½ square from tolerance **Only one of these may be awarded.** B1 straight line graph through (0, –1) of any length even if crooked later but not $x = 0$ or $y = -1$ B1 Single straight line graph with gradient 2 of any length B1 two correct points calculated (eg in table) or plotted 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 Ignore lines before (5, 36) and after (35, 12) if polygon drawn
6(b)	$6 \times (18 + 12)$ **NB** table can be seen if necessary.	M1	oe $\frac{30}{100} \times 600$
	180	A1	SC1 30% stated as answer SC1 for 420 as answer
7	$2 \times 4 + 3 \times 3 + 5 \times 1$ **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 **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. Penalise any incorrect further working. Eg $5y + 20t - 10 = 25yt - 10$ is B1 $5y + 20t - 1 = 25yt - 1$ is B0 (error in expansion and incorrect further work) $5y + 20t - 10 = 5(y + 4t - 2)$ 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. $w - \frac{2}{3}w = -\frac{1}{3} - 2$ (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. Penalise first use of > or < only. Penalise first use of >= or => or =< or <= only. 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 Sc1 $y = 5$ **and** $x = 2$ **and** $y = x$ 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 Accept 12 : 16 : 20
12	$2a + 2c = 5a - 5b$ **or** $2a + 2c = 5(a - b)$ $2c = 5a - 2a - 5b$ or $2c = 5(a - b) - 2a$	M2	M1 if **one** expansion, sign or rearrangement error on any line $-2c$ = is OK if rest correct
	$c = \frac{3a - 5b}{2}$ or equivalent expression	A1ft	ft on one error Must have c = on answer line If question simplified by an incorrect expansion $2a + c$ to give c = … (see exemplar below) then they must simplify their answer Do not award if incorrect further work
12 Alt	$a + c = 2.5(a - b)$ $c = 2.5(a - b) - a$	M2	M1 if **one** expansion, sign or rearrangement error on any line
	$c = 2.5(a - b) - a$ or equivalent expression	A1 ft	ft on one error Must have c = on answer line 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') Allow poor spelling even though both words given 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 $6x^2 + 19x + b$ implies M1 $ax^2 + 19x + 10$ implies M1 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 B1 maximum for any use of $\times$ signs B0 for any addition eg $9 + x^4 + y^8$ 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) 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 π, eg $\pi \times 25$ π 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. Allow π 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). 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) 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 πr^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 $\frac{n^2-n+n^2+n}{4}$ 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 $\frac{n^2}{2}-\frac{n}{2}+\frac{n^2}{2}+\frac{n}{2}$
	$\frac{2n^2}{2}=n^2$	B1	This mark is for cancelling 2 top and bottom $\frac{n^2}{2}+\frac{n^2}{2}=n^2$
17 Alt	$\frac{n}{2}((n-1)+(n+1))$	B1	This mark is for factorising out a common factor. $\frac{n}{4}(n-1+n+1)$ 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** $\sqrt{3} \times \sqrt{3} = 3$ **or** $3^{\frac{1}{2}} \times 3^{\frac{1}{2}} = 3$	B1	$\sqrt{3} \times \sqrt{3}$ is essential seen or implied Accept $(3^{1.5})^2 = 3^3 = 27$ oe
19(b)	$(3\sqrt{3})^2 - (3\sqrt{2})^2$ (= 27 – 18) **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) **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) **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	