



**General Certificate of Secondary Education  
June 2013**

**Methods in Mathematics (Pilot)                      9365**

**Unit 2 Higher Tier 93652H**

**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.

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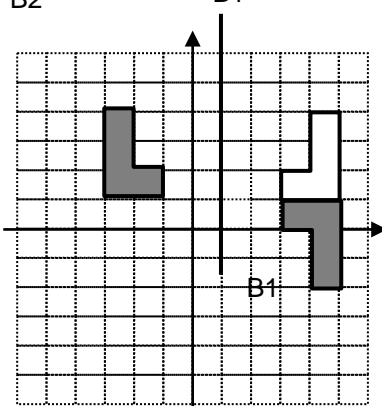
## Glossary for Mark Schemes

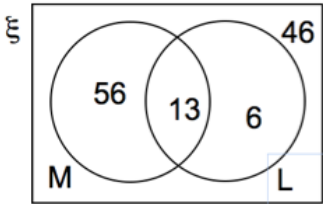
GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

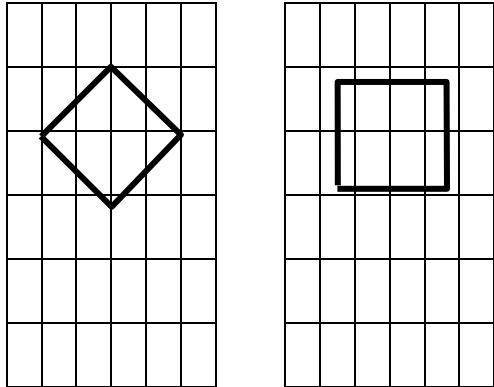
<b>M</b>	Method marks are awarded for a correct method which could lead to a correct answer.
<b>M dep</b>	A method mark dependent on a previous method mark being awarded.
<b>A</b>	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can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

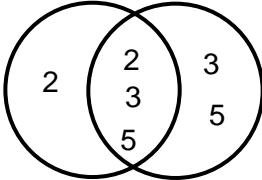
## M2 Higher Tier

Q	Answer	Mark	Comments
1	Sight of 0.945	B1	
	$390 \times 0.945$	M1	
	368.55	A1	Allow incorrect rounding after correct answer seen or 368 or 369 with working SC1 for 411.45
1	<b>Alternative</b>		
	$390 \times 5.5 \div 100 (= 21.45)$	M1	oe
	$390 - \text{their } 21.45$	M1	
	368.55	A1	Allow incorrect rounding after correct answer seen or 368 or 369 with working SC1 for 411.45
1	<b>Alternative</b>		
	(10% = 39), 5% = 19.5, (1% = 3.9), 0.5% = 1.95		oe
	$390 - \text{Their } (5\% + 0.5\%)$		
	368.55		Allow incorrect rounding after correct answer seen or 368 or 369 with working SC1 for 411.45
2	$CBA = 68$ stated or seen on diagram.	B1	If 68 not shown or stated as $CBA$ but used in an appropriate calculation then allow B1.
	$180 - (2 \times \text{their } 68)$ or $112 - \text{their } 68$	M1	$CAB = 68$ on diagram
	44	A1	Ft their 68 if M1 awarded.
3(a)	Kite	B1	Any order
	Square	B1	Allow arrowhead as replacement for either
3(b)	Parallelogram	B1	Any order
	Rectangle	B1	

Q	Answer	Mark	Comments
3(c)	All sides equal Opposite angles equal Opposite sides equal Opposite sides parallel Two lines of symmetry Two sets of equal angles (Implies two separate sets) (Internal) angles add up to $360^\circ$ 2 pairs equal angles (Implies two separate sets) 2 pairs parallel lines (no need to say opposite) Diagonals bisect Diagonals different length Adjacent (Allied) angles add up to $180^\circ$ (supplementary). Two acute angles Two obtuse angles Exterior angles add up to (or total) 360 No right angle	B1	Accept any valid property except the two given or 4 sides or 4 angles.  Accept more than one property as long as they are all correct or irrelevant.
4(a)	B2 B1 	B2	B1 Reflect P in $y = 1$ B1 Any reflection in $x = a$ where $a$ is one of 2.5, 2, 1.5, 0.5, 0, $-0.5$
4(b)	Reflect(ion)(ed)	B1	Any combined transformation is zero marks
	$y = x$	B1	SC1 if reflection or $y = x$ not stated then give SC for $y = x$ drawn on diagram

Q	Answer	Mark	Comments
5(a)	7.5	B1	oe. If no answer on answer line, accept answer in output oval. If contradictory answers on answer line and in output oval, answer line takes precedence
5(b)	12	B1	oe. If no answer on answer line, accept answer in input oval. If contradictory answers on answer line and in input oval, answer line takes precedence
5(c)	Any values that work eg $x \times 2 - 9$ , $x \times 3 - 18$ , $x \times 1 - 0$	B1	If FD blank accept a clear two operation calculation shown in working, eg $9 \times 3 - 18$ or $\times 1 - 0$ . If answer on working lines and in FD accept the better answer. Accept more than one answer on working lines (with blank FD) as long as they are all correct.
*6	Works out values for length and width that give a perimeter of 32 or an area of 48.	M1	$xy = 48$ or $x + y = 16$ (oe)
	Width = 4cm length = 12cm	A1	$x^2 - 16x + 48 = 0$ (oe) Must be a quadratic = 0
	56 or 40	A1	
	M awarded and perimeter calculated using $4 \times$ their length + $2 \times$ their width or $4 \times$ their width + $2 \times$ their length	Q1	Strand (iii). Working must be clear and a complete method. eg $64 - 8 = 56$ is Q0 if 4 not identified as short side. If working is haphazard even if 4, 12 and 56 or 40 seen then award Q0
7(a)	120	B1	
7(b)	 <p>A Venn diagram with two overlapping circles, M and L. Circle M contains the number 56, circle L contains the number 6, and their intersection contains the number 13. The total number of elements in the universal set is 46.</p>	B2	B1 For 2 or 3 correct entries

Q	Answer	Mark	Comments
8(a)	$\pi \times 4.5^2$	M1	
	[63.58, 63.63]	A1	Accept 63 or 64 after M1 awarded.
	63.6	B1 ft	ft their answer if $\geq 4$ sf and M1 awarded. eg $\pi \times 4.5^2 = 199.85 \approx 200$ . Incorrect further work after an answer of [63.5, 63.63] then do not award B1.
8(b)	$2\pi r = 93$ or $\pi d = 93$	M1	
	$r = 93 \div 2\pi$	M1 Dep	$d = 93 \div \pi$ and $d \div 2$
	[14.79, 14.81] $93 \div (2 \times 3.14) = 14 \frac{127}{157}$ on some calculator displays. _____ $\pi = \frac{22}{7}$ gives $14 \frac{35}{44}$ . Check if fractional answers are in range	A1	15 with working Non-contradictory further work such as working out the area can be ignored. T&I is MO unless answer given in range.
9		B2	B1 for any square centred on cross(M). B1 if $\sqrt{8}$ or 2.8... seen. B1 any rectangle centred on M with area $8 \text{ cm}^2$ B1 any square area $8 \text{ cm}^2$ not centred on M. If 'diamond' drawn $\frac{1}{2}$ square accuracy.
10(a)	$5x - 15 - 3x + 3$ or $5x - 15 - 3x - - 3$	M1	3 correct terms for M1 (can be seen separately) NB $5x - 15 = \pm 3x \pm 3$ or allow M1 only, even if correct answer or ft answer subsequently seen.
	$5x - 15 - 3x + 3$	A1	Completely correct for A1
	$2x - 12$ or $2(x - 6)$	A1 ft	ft if M1 awarded and no further errors. Deduct a mark if incorrect further work

Q	Answer	Mark	Comments
10(b)	$8(x + 2) + 2(2x + 1)$ (with one denominator of 16 or no denominator) If expanded straightaway 3 terms must be correct.	M1	$4(x + 2) + 2x + 1$ (with one denominator of 8 or no denominator) If expanded straightaway 3 terms must be correct.
	12x + 18	A1	$6x + 9$ or any multiple eg $24x + 36$ <b>NB</b> $12x + 18, 6x + 9$ etc.. is M1, A1 as they often eliminate the denominators in two operations and leave incompatible denominators in their calculations.
	Their $12x + 18 = 0$ (must be a linear equation)	M1Dep	Their $6x + 9 = 0$ (must be a linear equation)
	-1.5	A1 ft	ft on both Ms and one error.
10(b)	<b>Alternative</b>		
	$\frac{x}{2} + 1 + \frac{2x}{8} + \frac{1}{8}$	M1	oe 3 correct fractions for M1
	$\frac{3x}{4} + 1\frac{1}{8}$	A1	oe $\frac{3x}{4} + \frac{9}{8}$ or $0.75x + 1.125$
	Their $\frac{3x}{4} + 1\frac{1}{8} = 0$	M1	
	-1.5	A1ft	ft on both Ms and one error.
11(a)	30 or $2 \times 3 \times 5$	B1	Venn Diagram (2 circles) with correct values.  or Lists of multiples of 60 or 450 eg 120, 180, 240, ... 450, 900, ....
11(b)	60 and 450 seen	B2	Sc1. No working or irrelevant working and answer of 1800



Q	Answer	Mark	Comments
12	25% increase = 1.25	B1	oe.
	20% decrease = 0.8	B1	oe
	$1.25 \div 0.8 (= 1.5625) (\times 100)$	M1	oe, eg $125 \div 80 (\times 100)$
	56.25 or 56	A1	Digits 15625 or 156 is 3 marks, A0  SC2 $1.25 \div 1.2 = 1.04\dots$ (or equivalent, eg $125 \div 120 = 1.04166\dots$ )
12	<b>Alternative</b>		
	Values chosen for X and Y and F calculated correctly (Call this P)	M2	If values are decimals then must be given to 1 dp.  Allow M1 if one of $X + 25\%$ or $Y - 20\%$ calculated incorrectly.
	X increased by 25% <b>and</b> Y decreased by 20% <b>and</b> $X \div Y$ calculated correctly (call this Q)		
	$Q \div P (\times 100)$	M1Dep	oe Dependent on at least M1.
56.25 or 56	A1	Digits 15625 or 156 is 3 marks, A0	
12	<b>Alternative</b>		
	$x \times 1.25 (= p)$	M1	x any quantity 25% increase in x
	$y \times 0.8 (= q)$	M1	y any quantity 20% decrease in y
	Their $p \div$ their $q$	M1	
	56.25 or 56	A1	
13	$162 \times 2 (=324)$	M1	
	Their $324 \div 4 (= 81)$	M1dep	NB 81 seen with incorrect working such as $162 \div 2$ is M0.
	82	A1	

Q	Answer	Mark	Comments
13	<b>Alternative 1</b>		
	$2n$ identified from table or working	B1	
	$2n - 2$	B1dep	oe
	82	B1	82 with no working or no incorrect working is 3 marks.
13	<b>Alternative 2</b>		
	Table of values or similar showing pattern $1 \Rightarrow 2$ , pattern $\Rightarrow 4$ , pattern $3 \Rightarrow 6$ etc	M1	
	(pattern ) 81 ( $\Rightarrow 162$ )	M1dep	oe
	82	B1	82 with no working or no incorrect working is 3 marks.
13	<b>Alternative 3</b>		
	Table of values or similar showing side $2 \Rightarrow 2$ , side $3 \Rightarrow 4$ , side $4 \Rightarrow 6$ etc	M1	
	Side $n \Rightarrow 2n - 2$	A1	oe
	82	A1	
13	<b>Alternative 4</b>		
	Table of values or similar showing shaded $2 \Rightarrow$ side 2, shaded $4 \Rightarrow$ side 3, shaded $6 \Rightarrow$ side 4 etc	M1	
	Shaded $2n \Rightarrow$ side $n + 1$	A1	oe
	82	A1	
13	<b>Alternative 5</b>		
	$n = S \div 2 + 1$	M1	oe Formula connecting shaded squares (S) and sides $n$ .
	$162 \div 2 = 81$	M1Dep	oe
	82	A1	

Q	Answer	Mark	Comments
13	<b>Alternative 6</b>		
	Table of values	M1	oe Formula connecting shaded squares (S) and sides $n$ .
	$162 \div 2 = 81$	M1Dep	oe
	82	A1	
14(a)	$\pm 73^2 \pm 48^2$ (5329 $\pm$ 2304) (7633 or 3025)	M1	$x^2 + 48^2 = 73^2$
	$73^2 - 48^2$ or $5329 - 2304$ or $x^2 + 48^2 = 73^2$ or $x^2 + 2304 = 5329$ <b>and</b> $\sqrt{3025}$ or $55 \times 55 = 3025$ or $55^2 = 3025$	Q1	Strand (ii). Must show subtraction and square root
	55	A1	55 with no working is M1, Q0, A1
14(b)	Sight of cos with 32 and 42 used together (equation or expression can be nonsense)	M1	
	$\cos x = 32 \div 42$ or $\cos^{-1}(32 \div 42)$ or $\cos x = 0.76..$ or $\cos^{-1}(0.76...)$ or $\cos^{-1} = 32 \div 42$	M1Dep	oe
	[40.3, 40.4]	A1	40 with working Correct answer is 3 marks no matter what they do before. Ms are for partial working if answer incorrect.

Q	Answer	Mark	Comments
15(a)	$x^2 - 9x - x + 9$	B1	Must show all 4 terms
15(b)	$(x - 9)(x - 1) - (x - 1) (= 0)$	M1	$x^2 - 11x + 10 (= 0)$
	$(x - 10)(x - 1)$	M1	
	10 and 1	A1	10 and 1 is full marks with or without accurate working.
15(b)	<b>Alternative 1</b>		
	$(x - 5.5)^2 - 5.5^2 + 10$	M1	
	$x = 5.5 \pm \sqrt{20.25}$	M1	
	10 and 1	A1	
15(b)	<b>Alternative 2</b>		
	$\frac{11 \pm \sqrt{11^2 - 4 \times 1 \times 10}}{2}$	M1	
	$\frac{11 \pm \sqrt{81}}{2}$	M1	
	10 and 1	A1	
15(b)	<b>Alternative 3</b>		
	$(x - 9)(\cancel{x - 1}) = \cancel{x - 1}$ or $x - 9 = 1$	M1	
	10	A1	
	1	A1	
15(b)	<b>Alternative 4</b>		
	$(x) = 1$	B1	ie Any answer of 1 is B1 despite other working even if from T&I
	$x - 9 = 1$	M1	
	10	A1	

Q	Answer	Mark	Comments
16	$10 \times 18 (= 180)$	M1	$(9 + x) \times 9 = 10 \times 18$
	$180 \div 9 (= 20)$	M1Dep	$9 + x = 20$
	11	A1	
17	(cos Q = ) $(15^2 + 13^2 - 19^2) \div (2 \times 13 \times 15)$	M1	$19^2 = 13^2 + 15^2 - 2 \times 13 \times 15 \times \cos Q$ $361 = 394 - 390 \cos Q$ $361 = 4 \cos Q$
	0.0846...	A1	
	[85, 85.2]	A1	85 with no working is M0
18	$(2x + 3)(2x - 3)$	B1	
	$(2x \pm a)(x \pm b)$	M1	$ab = \pm 3$
	$(2x + 3)(x - 1)$	A1	
	$\frac{2x - 3}{x - 1}$	A1ft	ft if B1 and M1 awarded and terms cancelled. Do not award if incorrect further work.
19	Area of any 2 of the following triangles or parallelograms found (ignore lack of units)  $DPC = AQB = 36 \text{ cm}^2$ $AXP = QYC = 16 \text{ cm}^2$ $APD = QCB = 24 \text{ cm}^2$ $DQX = BPY = 4 \text{ cm}^2$ $AXD = BYC = 8 \text{ cm}^2$ $PBC = ADQ = 12 \text{ cm}^2$ $DQBP = 24 \text{ cm}^2$ $AQCP = 48 \text{ cm}^2$	M2	Award M2 only if areas clearly identified either by labelling or writing on diagram.  <b>NB</b> Only one from each line can count. M1 for any one area clearly identified either by labelling or writing on diagram.  They may also 'double up' triangles and give a total of the two congruent triangles. eg $AXP + QYC = 32 \text{ cm}^2$ this is M1 for 1 pair and M2 for two pairs (do not accept $DPC + AQB = 72 \text{ cm}^2$ as this is the total area).
	Any suitable correct addition or subtraction of triangles or parallelograms	M1	
	Shaded = $72 - 56$	A1	Their total must be 56

Q	Answer	Mark	Comments
19	<b>Alternative 1</b>		
	$QY = \frac{2}{3} \sqrt{6^2 + 8^2} = 6 \frac{2}{3}$	M1	QY must be labelled or shown on diagram as 6.6' for example.
	Angle $PDQ = \tan^{-1}(6 \div 8) (=36.86\dots)$	M1	
	('height' of parallelogram) $= 4 \times \sin PDQ (= 2.4)$	M1	
	$2.4 \times 6 \frac{2}{3}$	A1	
19	<b>Alternative 2</b>		
	$AQ = \sqrt{6^2 + 4^2} (= 2\sqrt{13} \text{ or } 7.211)$ <b>and</b> $XQ = AQ \div 3 (2.4037\dots)$	M1	
	$QY = \frac{2}{3} \sqrt{6^2 + 8^2} = 6 \frac{2}{3}$	M1	
20(a)	Opposite sides parallel (same direction) and equal (same length) <b>or</b> opposite sides are equal vectors.	Q1	Strand (i). Must mention that opposite sides are parallel and equal <b>or</b> equal vectors
20(b)	<b>b – c or –c + b</b>	B1	
20(c)	$LP = \frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{c} - \mathbf{a})$	B2	$LP =$ must be stated or $LP = LA + AP$ B1 for $\frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{c} - \mathbf{a})$
20(c)	<b>Alternative 1</b>		
	$\frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{c} - \mathbf{a}) = \mathbf{a} + \frac{1}{2}\mathbf{c} - \frac{1}{2}\mathbf{a}$	B2	B1 for $\frac{1}{2}\mathbf{a} + \frac{1}{2}(\mathbf{c} - \mathbf{a})$
20(c)	<b>Alternative 2</b>		
	$(LP) = -\frac{1}{2}\mathbf{a} + \mathbf{b} + (\mathbf{c} - \mathbf{b}) + \frac{1}{2}(\mathbf{a} - \mathbf{c})$	M1	This is $LP = LO + OB + BC + CP$
	$-\frac{1}{2}\mathbf{a} + \mathbf{b} + \mathbf{c} - \mathbf{b} + \frac{1}{2}\mathbf{a} - \frac{1}{2}\mathbf{c}$	A1	

Q	Answer	Mark	Comments
20(c)	<b>Alternative 3</b>		
	$(LP =) -\frac{1}{2}\mathbf{a} + \mathbf{c} + \frac{1}{2}(\mathbf{a} - \mathbf{c})$	M1	This is $LP = LO + OC + CP$
	$-\frac{1}{2}\mathbf{a} + \mathbf{c} + \frac{1}{2}\mathbf{a} - \frac{1}{2}\mathbf{c}$	A1	
20(c)	<b>Alternative 4</b>		
	OC = $\mathbf{c}$ and $L$ and $P$ are midpoints.	M1	Using midpoint theorem. This may be expressed differently but if evidence that mid-point theorem used then award M1
	$LP = \frac{1}{2}OC$	A1	This is for accurately describing the results using the mid-point theorem.
20(c)	<b>Alternative 5</b>		
	Written explanation such as (Journey of) $L$ to $A$ to $P$ is half (the journey of) $O$ to $A$ to $C$ so $LP$ is half $OC$ .	B2	B1 if intention seen but explanation not complete or slight error
20(d)	$MN = \frac{1}{2}\mathbf{b} + \frac{1}{2}(\mathbf{c} - \mathbf{b})$	M1	
	$LP = MN = \frac{1}{2}\mathbf{c}$ ..... $LMNP$ is a parallelogram (as opposite sides are the same vector).	A1	By choosing $MN$ it is opposite $LP$ so no need to say opposite sides but a 'conclusion' must be stated or implied.
20(d)	<b>Alternative 1</b>		
	$LM = -\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$	M1	
	$LM = PN = -\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ ..... $LMNP$ is a parallelogram (as opposite sides are the same vector).	A1	By choosing $LM$ and $PN$ no need to say opposite sides but a 'conclusion' must be stated or implied.

Q	Answer	Mark	Comments
20(d)	<b>Alternative 2</b>		
	$LP$ parallel to $OC$ and $\frac{1}{2}OC$ (midpoint theorem)	M1	
	$MN$ parallel to $OC$ and $\frac{1}{2}OC$ (midpoint theorem) so $LMNP$ is a parallelogram as opposite sides parallel and the same length.	A1	