GCSE
Methods in Mathematics (Linked Pair Pilot)

93652H
Unit 2: Higher Tier
Mark Scheme

9365
June 2014

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.
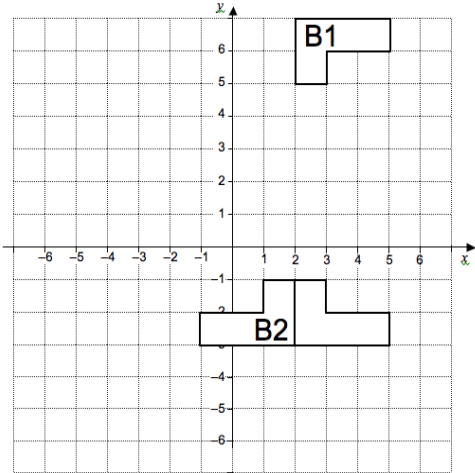
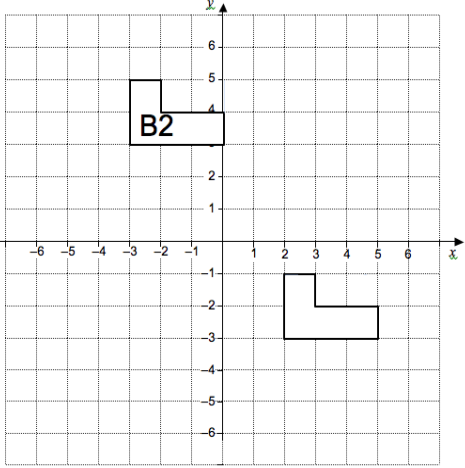|	
M	Method marks are awarded for a correct method which could lead to a correct answer.
M dep	A method mark dependent on a previous method mark being awarded.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks 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. 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.

M2 Higher Tier

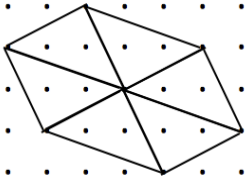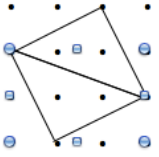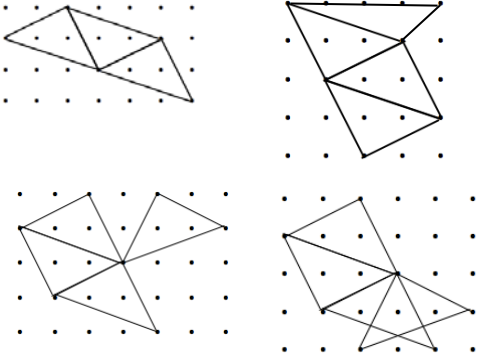| Q	Answer	Mark	Comments
1	**Alternative method 1**		
	23 ÷ 40 (×100)	M1	
	57.5	A1	
	42.5	A1ft	ft 100 – their 57.5 Accept 42 or 43 with working seen.
	Alternative method 2		
	17	B1	
	Their (40 – 23) ÷ 40 (×100)	M1	
	42.5	A1ft	ft their 17 ÷ 40 × 100 Accept 42 or 43 with working seen.
	Alternative method 3		
	Any correct statement that equates a number as a percentage of 40 (but not 40 = 100%) eg 4 = 10%, 20 = 50%	M1	
	A correct set of equivalences that add to 23 or 17, eg 10 = 25%, 7 = 17.5% 20 = 50%, 3 = 7.5%	M1dep	
	42.5	A1	Accept 42 or 43 with working seen.
	Alternative method 4		
	40 + 40 + 20 (= 100) or 40 × 2.5	M1	100 ÷ 40 = 2.5
	23 + 23 + 11.5 or 23 × 2.5 or 17 + 17 + 8.5 or 17 × 2.5	M1	These statements imply the first M1
	42.5	A1	Accept 42 or 43 with working seen.

Q	Answer	Mark	Comments
2	Odd ticked	B1	
	Odd $\times$ odd = odd or a^2 = odd Even $\times$ even = even or b^2 = even Odd plus even = odd	Q1	Strand (ii). Clear explanation. This is not dependent on the correct box being ticked.

Q	Answer	Mark	Comments
3 (GM)	Rhombus ✔ ✘ ✔ ✘ ✔	B2	B1 for 4 correct, 1 wrong B0 for 2 or more wrong
	Kite ✔ ✔ ✘ ✔ ✘	B2	B1 for 4 correct, 1 wrong B0 for 2 or more wrong

Q	Answer	Mark	Comments
4(a)	2.17158…	B1	
4(b)	2.2	B1ft	ft their answer to (a)

Q	Answer	Mark	Comments
5(a) (GM)	6 outside of circles **and** 3 in the intersection	B1	Ignore any numbers written by x and $2x$

Q	Answer	Mark	Comments
5(b)	$2x + 3 + x + 6 = 30$	M1	oe $2x + 3 + x = 24$
	7	A1	
	Sets up an equation using x, $2x$ (or $3x$) and at least one of 3, 6 and/or 30 and solves correctly or sets up a correct equation and solves incorrectly. eg $3x + 3 = 30$, $x = 9$ $2x + 3 + x - 3 + 3 = 33$, $x = 10$	Q1	Strand (iii). NB the 3 or 6 could be implied, eg $3x = 27$, $x = 9$

Q	Answer	Mark	Comments
6	x coordinate = 2	B1	(2, 4) marked on diagram.
	Base = 7 – – 3 (=10)	B1	10 marked on diagram as base or stated as base in script. This mark is for showing that the base is 10 and **not** for 7 – – 3 = 10 if used to find the x coordinate.
	Height = 20 ÷ their 10 × 2 (= 4)	M1	4 marked on diagram as height **NB** height shown or stated as 4 is 2 marks (assume base of 10)
	y coordinate = 8	A1ft	ft their height if M awarded and no other errors. Accept **NB** 8 stated as y coordinate is B1, M1, A1 (ie last 3 marks) unless contradictory or wrong working.

Q	Answer	Mark	Comments
7(a)		B2	B1 for line $x = 2$ shown B1 for reflection in $y = 2$ B1 for any reflection in a line of form $x = a$ where a is less than 2.

Q	Answer	Mark	Comments
7(b)		B2	B1 for any translation of form $\begin{pmatrix} p \\ 6 \end{pmatrix}$ or $\begin{pmatrix} -5 \\ q \end{pmatrix}$ B1 for correct shape with top left corner at $(-5, 6)$

8	**Alternative method 1**		
	$360 \div 5$ or 72 **or** $360 \div 8$ or 45	M1	This scheme is based on using the exterior angles. They must be clearly stated as exterior angles or shown on diagram
	72 **and** 45	A1	
	27	A1ft	ft the difference of their exterior angles SC1 answer of 27 with interior and exterior angles confused
	Alternative method 2		
	$540 \div 5$ or 108 or $1080 \div 8$ or 135	M1	This scheme is based on using the interior angles. They must be clearly stated as interior angles or shown on diagram
	108 **and** 135	A1	
	27	A1ft	ft the difference of their interior angles SC1 answer of 27 with interior and exterior angles confused
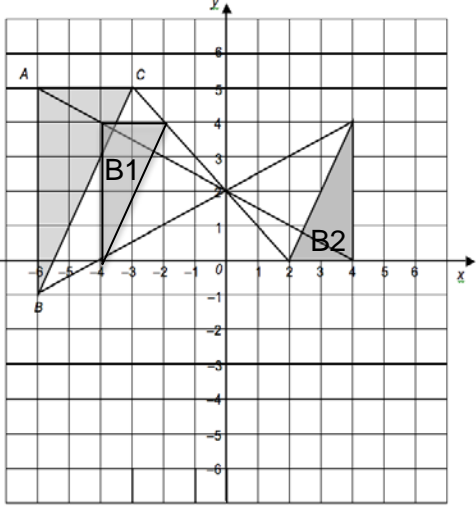
Q	Answer	Mark	Comments
9(a) **(GM)**	C A B	B2	B1 1 correct B1 2 correct if one letter repeated B0 if all rows same letter
9(b) **(A)**	$y = \dfrac{1}{2}x - 2$	B1	

10	Minimum	B2	If answer grid blank, mark practice grid. Enough shapes (≥ 6) to fully surround a point or to show a shape that will obviously tessellate, such as a square or a rectangle. B1 for any triangles that are in the correct combination to tessellate B1 for a B2 answer but with an incorrect triangle, or any spurious triangle that negates the tessellation or any overlapping triangle eg

11(a)	2 × 25 or 5 × 10	M1	oe eg 50 ÷ 2 = 25 **or** branches on a prime factor tree **or** any indication eg (2, 25) of a 'product' that equals 50 **or** 2, 5, 5 **or** 2, 5 and 5 shown as the last numbers of a prime factor tree (allow 1s)
	2 × 5 × 5	A1	$2^{(1)} \times 5^2$
11(b)	List of multiples of 40 and 50 to at least 80, 120 and 100, 150	M1	Venn diagram (ft their prime factors for 50 in (a))
	$2^3 \times 5^2$ or 200	A1	oe SC1 any multiple of 200

Q	Answer	Mark	Comments
12	$6n + 1$	B2	oe B1 for $6n$ or $6 \times n$ or $n \times 6$. Do not accept $n6$ but $n6 + 1$ is B1 Accept other letters

Q	Answer	Mark	Comments
13(a)	**Alternative method 1**		
	$x + 10 = 5x$, or $x = 5x - 10$ or $5x + 10 = x$ or $5x = x - 10$ or $x = 5(x - 2)$	M1	oe
	$4x = 10$ or $10 = 4x$	A1	
	2.5	A1ft	ft if one error Answer only or from T&I is 1 mark
	Alternative method 2		
	$x - \dfrac{x}{5} = 2$ or $x + \dfrac{x}{5} = -2$ or $\dfrac{x}{5} - x = 2$	M1	oe
	$\dfrac{4x}{5} = 2$	A1	
	2.5	A1	ft if one sign or arithmetic error Answer only or from T&I is 1 mark

Q	Answer	Mark	Comments
13(b)	**Alternative method 1**		
	3(2*y* – 3) + 4(*y* – 4) or 6*y* – 9 + 4*y* – 16	M1	Ignore denominators even if wrong $\dfrac{6y - 9}{12} + \dfrac{4y - 16}{12}$ If expanded straight away allow one sign or arithmetic error **NB** 3(2*y* – 3) + 4(*y* – 4) = 12 is M2
	10*y* – 25	A1	**NB** this may be implied, eg 6*y* – 9 + 4*y* – 16 = 1, 10*y* = 26
	Their 10*y* – 25 = 12	M1	
	3.7	A1ft	ft on one error and both Ms.
	Alternative method 2		
	$\dfrac{y}{2} - \dfrac{3}{4} + \dfrac{y}{3} - \dfrac{4}{3}$	M1	
	$\dfrac{5y}{6} - \dfrac{25}{12}$	A1	
	$\dfrac{5y}{6} = \dfrac{37}{12}$	M1	This is for their $\dfrac{5y}{6} - \dfrac{25}{12} = 1$ correctly rearranged to get letter terms on one side and number terms on the other.
	3.7	A1ft	ft on one error and both Ms.

Q	Answer	Mark	Comments
14(a)	**Alternative method 1**		
	$2.1 \div 7 = \dfrac{3}{10} = 0.3$ $7 \div 2.1 = \dfrac{10}{3} = 3.3\ldots$	M1	$2.1 \div 4.9 = \dfrac{3}{7} = 0.428\ldots$ $4.9 \div 2.1 = \dfrac{7}{3} = 2.33..$
	$8.5 \times 0.3 = 2.55$ $2.55 \div 8.5 = \dfrac{3}{10} = 0.3$ $8.5 \div 3.3\ldots = 2.55$ $8.5 \div 2.55 = \dfrac{10}{3} = 3.3\ldots$	A1	$5.95 \times \dfrac{3}{7} = 2.55$ $2.55 \div 5.95 = \dfrac{3}{7} = 0.428\ldots$ $5.95 \div \dfrac{7}{3} = 2.55$ $5.95 \div 2.55 = \dfrac{7}{3} = 2.33$ **NB** $4.9 + 1.5 + 2.1 - 5.95 = 2.55$ is M0 **and** $5.95 - 2.1 - 1.5 = 2.55$ is M0 **NB** Result can be assumed to show equality of ratios
	Alternative method 2		
	$4.9 \div 5.95 = \dfrac{14}{17} = 0.823\ldots$	M1	$5.95 \div 4.9 = \dfrac{17}{14} = 1.214..$
	$2.1 \div \dfrac{14}{17} = 2.55$ $2.1 \div 2.55 = \dfrac{14}{17} = 0.823\ldots$	A1	$2.1 \times \dfrac{17}{14} = 2.55$ $2.55 \div 2.1 = \dfrac{17}{14} = 1.214\ldots$

Q	Answer	Mark	Comments
14(a)	**Alternative method 3**		
	$\dfrac{XE}{5.95} = \dfrac{2.1}{4.9}$	M1	oe $\dfrac{5.95}{XE} = \dfrac{4.9}{2.1}$
	$(XE =) \dfrac{2.1}{4.9} \times 5.95$ $(= 2.55)$	A1	

Q	Answer	Mark	Comments
14(b)	$CY \times 1.5 = 2.1 \times 4.9$	M1	10.29 is M0 unless used.
	$(CY =) \dfrac{2.1 \times 4.9}{1.5}$ $(= 6.86)$	A1	$2.1 \times 4.9 = 10.29$ followed by $6.86 \times 1.5 = 10.29$ is M1, A1 **NB** Result can be assumed to show equality of products

Q	Answer	Mark	Comments
15	Use of sine with 15 and 28 (even if nonsense)	M1	$\dfrac{x}{\sin 90} = \dfrac{15}{\sin 28}$
	$(x =)$ 15 ÷ sin 28 or 15 ÷ 28 sin or sin 28 = 15/x	M1Dep	This is for a correct use of sin 28, 15 (and x)
	[31.9, 32]	A1	If answer in range then award full marks if working using sine seen. 32 must have working. If answer not in range, award part marks as above. **NB** If adjacent found by tan, [28, 28.21] and then Pythagoras or inverse cosine used must be a complete method for M2.

Q	Answer	Mark	Comments
16(a) **(GM)**	$1.\dot{6}$ or 1.66 or 1.67 or $1\frac{2}{3}$ or $\frac{15}{9}$ or $\frac{5}{3}$	B1	Allow any indication of recurrence, eg $1.6^{\overline{r}}$ 1.66, but not $1.6…$, Allow equivalent answers eg $1\frac{6}{9}$ **NB** 1.6 is B0 Ignore any incorrect rounding **after** a correct answer seen, eg answer of 1.7 after 1.666… seen Do not accept ratio, eg 3 : 5 or 5 : 3 but $1 : \frac{5}{3}$ is OK as one of the acceptable answers can be seen.
16(b) **(GM)**	54	B1	
16(c) **(GM)**	18	B1ft	**NB** 18 is 1 mark even if scale factor wrong in (a) ft 30 ÷ their (a) if correct and given to at least 2dp. Ignore incorrect rounding after correct answer seen, eg 18.8 after 18.75 seen with 1.6 in (a)
17		B2	B1 for any correctly sized and orientated triangle anywhere. B1 for 2 vertices correct. B1 for three rays from corners that pass through (0, 2) and go as far as $x = 1$ B1 for enlargement of $\frac{2}{3}$

Q	Answer	Mark	Comments
18(a) **(GM)**	35	B1	
18(b)	40	B1	
	Opposite angles of cyclic quad (add up to) 180°	Q1	oe Strand (i) No need to mention 180 if angle given as 40 Accept 'supplementary' to mean adds to 180.
18(c)	$x = 55$ $y = 110$ $z = 125$	B3	If answer line blank mark diagram or script. B2 any two correct B2 $y = 110$ and $x + z = 180$ B2 $z = 125$ and $y = 2x$ B1 any one correct B1 values less than 180 such that $y = 2x$ or $x + z = 180$

Q	Answer	Mark	Comments
19	$OR = OP$ (= 6cm or sides of same square) **or** show 6 on OR on diagram	B1	Must give reason if OR not marked as 6
	$OC = OA$ (= 8cm or sides of same square) **or** show 8 on OA on diagram	B1	Must give reason if OA not marked as 8
	$\angle ROC = \angle AOP = 30$ with $90 - 60$ or $120 - 90$ stated or 60 shown as $\angle AOR$	B1	
	Congruent as SAS. Might be stated in words such as two sides and included angle. May use cosine rule to calculate third side. Must be correct and give correct value 4.1… then SSS can be given as reason or in words 'all three sides same'.	B1	If no reasons given penalise first omission but allow thereafter.

Q	Answer	Mark	Comments
20	**Alternative method 1**		
	$$\dfrac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-4)}}{2(2)}$$	M1	Allow one error from Wrong sign for b –25 for $(-5)^2$ if evaluated –32 for $-4ac$ if evaluated but M0 for wrong formula, including lack of ±. **or** Dividing by 2 not $2a$ **or** dividing only square root by $2a$, but can be recovered.
	$$\dfrac{5 \pm \sqrt{57}}{4}$$	A1	
	3.14 and –0.64 or 3.137458609 and –0.637458609 rounded to any accuracy > 2dp	A1	ft on (rounded to any accuracy > 2dp) wrong sign for b giving –3.14 and 0.64 –25 for $(-5)^2$ giving 1.91 and 0.59 SC1 answers only
	Alternative method 2		
	$2(x - \dfrac{5}{4})^2 - \dfrac{57}{8}$ or $(x - \dfrac{5}{4})^2 - \dfrac{57}{16}$	M1	
	$= \dfrac{5}{4} \pm \sqrt{(\dfrac{57}{16})}$	A1	
	3.14 and –0.64 or 3.137458609 and –0.637458609 rounded to any accuracy > 2dp	A1	

Q	Answer	Mark	Comments
21	$(BC^2 =) \ 6^2 + 11^2 - 2 \times 6 \times 11 \times \cos 85$	M1	
	$= [145.49, 146]$	A1	
	(diameter =) $[12, 12.1]$	A1	**NB** diameter = 1.47 is M1
	(perimeter semi-circle =) $[18.9, 19]$	M1Dep	ft their diameter.
	Perimeter = $[35.9, 36]$	A1ft	ft their diameter. eg $[19.3, 19.5]$ using 1.47 SC2 for $[36.6, 37]$

Q	Answer	Mark	Comments
22	**Alternative method 1**		
	$\dfrac{8}{9}$ seen	M1	If $\dfrac{1}{9}$ 'subtracted' on a day-by-day method correct fractions or decimals (at least 3dp) must be seen for at least 4 days.
	$\left(\dfrac{8}{9}\right)^6$	M1Dep	
	$0.49\ldots$	A1	oe eg $1 \div 2.07$
	Alternative method 2		
	Value for V chosen and $V \times 0.888^6$	M1	If $\dfrac{1}{9}$ 'subtracted' on a day by day method correct fractions or decimals (at least 3dp) must be seen for at least 4 days.
	Correct calculation for their V	M1Dep	
	Original V divided by their value and answer show to be 0.49… or less than ½ of their value	A1	oe

Q	Answer	Mark	Comments
23	**Alternative method 1**		
	Volume original = $\frac{1}{3} \times \pi \times 8^2 \times 18$ (= 384π or [1190.4, 1206.6])	M1	
	Volume removed = $\frac{1}{3} \times \pi \times 2^2 \times$ 4.5 (= 6π or [18.6, 18.855])	M1	$\frac{1}{3} \times \pi \times (8^2 \times 18 - 2^2 \times 4.5)$ is M2
	378π or [1170, 1190])	A1	
	Alternative method 2		
	Volume original = $\frac{1}{3} \times \pi \times 8^2 \times 18$ (= 384π or [1190.4, 1206.6])	M1	
	Linear scale factor ¼ so volume scale factor $\frac{1}{64}$ so $\frac{63}{64}$	M1	
	378π or [1170, 1190])	A1	