AQA Qualifications

GCSE

Methods in Mathematics (Linked Pair Pilot)

93652H
Unit 2: Higher Tier
Mark Scheme

9365
November 2013

Version 1.0 Final Mark Scheme

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.

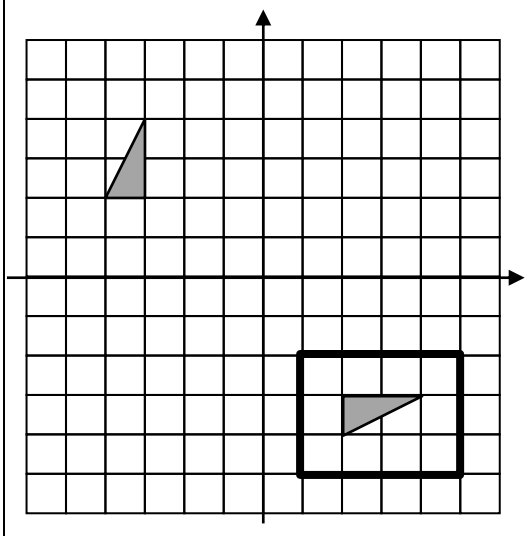
M	Method marks are awarded for a correct method which could lead to a correct answer.
M dep	A method mark dependent on a previous method mark being awarded.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks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

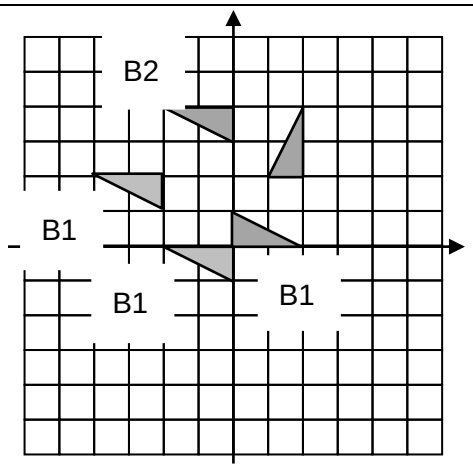
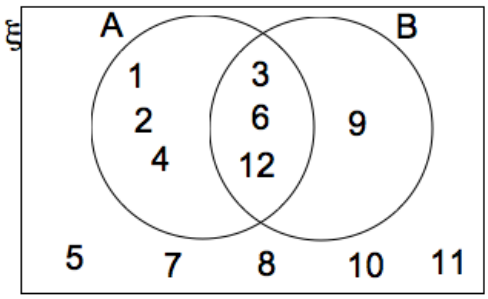
M2 Higher Tier

Q	Answer	Mark	Comments
1(a)	29.067…..	B1	29.06782609
1(b)	30	B1ft	Ft their answer to (a) if given to at least 2 sf.
2	2 and 23, 3 and 23, 5 and 23, 7 and 19, 11 and 17	B2	B1 for total between 24 and 30 with one prime plus an odd (non-prime) eg 2 + 25 = 27, 2 + 27 = 29, 3 + 25 = 28, 5 + 21 = 26, 7 + 21 = 28, 11 + 15 = 26, 13 + 15 = 28, 9 + 17 = 26, 9 + 19 = 28 B1 for 13 + 13 = 26 B1 for total of 24 or 30 using 2 primes (5 + 19 = 24,11 + 19 = 30, 11 + 13 = 24, 7 + 23 = 30, 7 + 17 = 24, 13 + 17 = 30) B1 for list of primes with at most one error for every 5 correct primes B1 for two sums of two primes seen
3	Any rectangle centred on M with an area of 12 cm^2 Allow ± 1 mm for any drawn not on grid lines, eg 3 × 4	B2	B1 any rectangle centred on M B1 any rectangle area 12 not centred on M B1 for square centred on M with side approximately 3.5 B1 for 4 corners that clearly show a **rectangle** of area 12 (allow this mark for badly drawn rectangles, ie if more than 1 mm away from straight)

Q	Answer	Mark	Comments
4	Area of one square = x^2 or area $\frac{1}{2}$ square = $\frac{1}{2}x^2$ or area $\frac{1}{4}$ square = $\frac{1}{4}x^2$ **NB** these may be written on diagram or stated in script	B1	eg $16 \times x^2 = 16x^2$ 11 whole squares = $11x^2$
	11 whole squares shown on diagram or stated.	B1	
	$\frac{1}{2}$ (x^2) seen on diagram or stated for large triangle **or** $\frac{1}{4}$ (x^2) seen on diagram or stated for small triangle	B1	
	Clear method showing that all individual squares and triangles sum to 16 , eg $11(x^2) + 8\times \frac{1}{2}(x^2) + 4\times \frac{1}{4}(x^2)$ $(=16x^2)$	Q1	Strand (ii) Not enough to show 16 squares on diagram, some clear statement must be made.
4 **Alt 1**	$x^2 + x^2$ = diagonal^2	M1	
	Diagonal = $x\sqrt{2}$	M1	
	$4\ x\sqrt{2}\ \times\ \ 2\ x\sqrt{2}$	A1	
	Clear method showing diagonal calculated using Pythagoras and lengths of sides calculated in terms of the diagonal, then multiplied and total 16.	Q1	Strand (ii)

Q	Answer	Mark	Comments
5	Volume of water = 30 × 20 × 7.5 or 30 × 20 × 10 × 0.75 (= 4500)	B1	
	30 × 0.75 (= 22.5) **or** 20 × 0.75 (= 15)	M1	
	Using the value of height to show that 10 ×20 × 22.5 = 4500 or 10 × 30 × 15 = 4500	M1	
	Full method showing depth is three-quarters for **both** faces	Q1	Strand (ii)
5 Alt 1	Volume of water = 30 × 20 × 7.5 or 30 × 20 × 10 × 0.75 (= 4500)	B1	
	4500 ÷ (20 × 10) (= 22.5) or 4500 ÷ (30 × 10) (= 15)	M1	
	Using the value of height to show that 22.5 ÷ 30 = 0.75 (oe) or 15 ÷ 20 = 0.75 (oe)	M1	
	Full method showing depth is three-quarters for **both** faces	Q1	Strand (ii)
5 Alt 2	Volume of water = 30 × 20 × 7.5 (= 4500)	B1	Clear explanation that volume of water is 0.75 of total volume.
	Volume of water = (30 × 20 × 7.5) ÷ (30 × 20 × 10) = 0.75	B1	
	Clear explanation using the proportion of water and the volume of prism formula, must mention constant cross-sectional area	Q2	Strand (ii)

Q	Answer	Mark	Comments
6	$12y - 4$ (= 28) or $3y - 1 = 7$	M1	
	Correctly rearranging their **expanded** or **divided** equation to get letters on one side, numbers on the other.	M1	$12y = 32$ $3y = 8$. $32 \div 12$ is M2
	$2\frac{2}{3}$	A1ft	oe ft on M1, M0 or M0, M1 SC1 for 29/12 (2.42 or 2.416..)
7	$3x - 5 = x$	M1	
	$x = 2.5$	A1	
	13	A1ft	If M1 awarded ft 4 × their x + 3. or 2 × their x + 8. or 6 × their x – 2.
8(a)		B2	B1 for congruent triangle, with correct orientation, wholly within a rectangle bounded by $y = -2$, $y = -5$, $x = 1$ and $x = 5$ B1 for a congruent triangle wholly within the same rectangle with two vertices on coordinates (2, –3) or (2, –4) or (4, –3)

Q	Answer	Mark	Comments
8(b)		B2	B1 for 90° rotation clockwise about (0, 2) B1 for 90° rotation anti-clockwise about (2, 0) B1 for 90° rotation anti-clockwise about (0, 0)
9(a)		B2	B1 for at least one correct region
9(b)	Lists of multiples for either 12 or 9	M1	
	36	A1	Sc1 any multiple of 36 > 36
9(b) **Alt 1**	Appropriate lists for either of the two largest numbers in set B	M1	
	LCM from their list	A1	Sc1 any multiple of their LCM > LCM.

Q	Answer	Mark	Comments
10(a)	*a* and *p* **or** *b* and *q* **or** *c* and *r* **or** *d* and *s*	B1	
	a and *d* **or** *c* and *b* **or** *r* and *q* **or** *p* and *s*	B1	
	c and *p* or *d* and *q*	B1	
10(b)	360 ÷ 45	M1	6 × 180 = 1080 **and** 1080 ÷ 8 = 135 **and** 135 stated or shown as interior angle
	8	A1	Allow octagon if working seen
11(a)	–7, –4, –1, 2, 5	B2	B1 for 4 correct **or** –10, –7, –4, –1, 2
11(b)	$-8n + 98$	B2	oe B1 for $-8n$
11(c)	Shows for any rectangles that the area is height × height + 1 or width × width – 1 eg 2 × 1, 3 × 2 , 6 × 5 etc	B1	Can draw a square and rectangle on diagram
	Shows that the sides are n and $n + 1$	B1	eg a diagram showing n and $n + 1$ as sides of a rectangle. Shows the area of the square is n^2 and the rectangle is n
	Full method showing area is $n \times (n + 1)$	Q1	Strand (ii)
11(c) Alt 1	Differencing to get second difference 2	M1	
	Obtaining 'linear' part after subtracting n^2 is 1, 2, 3, 4, …	M1	
	Full method showing area is $n \times (n + 1)$	Q1	Strand (ii)

Q	Answer	Mark	Comments
11(c) Alt 2	Table of differencing to get second difference 2	M1	
	Working table backwards correctly to get the 'zeroth term'	M1	oe Difference between 1st and 2nd term is $3a + b$ and first term is $a + b + c$
	Identifying $c = 0$, $a = 1$ and $b = 1$ in $ax^2 + bx + c$ to give $n^2 + n$	Q1	Strand (ii)
12(a)	22^2 and 38^2 seen added or subtracted.	M1	1928 is M1
	√their($22^2 + 38^2$)	M1Dep	oe
	[43.9, 44]	A1	44 with working, SC1 31 or 30.98…
12(b)	Sight of sin used	M1	
	19 ÷ sin 36	M1Dep	
	[32, 32.35]	A1	32 with working
13	3 × 9 (= 27)	M1	
	6 × x = their 27	M1Dep	
	4.5	A1	
14	$4(x + 1) + 3(x + 5)$	M1	
	$7x + 19$	A1	
	Their $7x + 19 = 12$	M1	
	– 1	A1ft	ft on one error and both Ms awarded. sc 1 answer with no valid algebra shown.

Q	Answer	Mark	Comments
15	45 ÷ 3 (= 15)	M1	Can be embedded in a calculation
	7 × their 15	M1Dep	2 × their 15 and 5 × their 15 or 30 and 75 seen even if not added eg 30 : 75 or 75 – 30
	105	A1	
15 **Alt 1**	Chooses a multiple of 7 and divides in ratio 2 : 5 then calculates the difference	M1	eg 70 ⇒ 20 : 50 ⇒ 50 – 20 = 30
	Chooses a second multiple of 7 closer to 105 and divides in ratio 2 : 5 then calculates the difference	M1Dep	eg 91 ⇒ 26 : 65 ⇒ 65 – 26 = 39
	105	A1	
15 **Alt 2**	$x : x + 45 = 2 : 5$ or $\frac{x}{x + 45} = \frac{2}{5}$	M1	
	$x = 30$	M1Dep	
	105	A1	
16	$\frac{5 \pm \sqrt{(-5)^2 - 4(3)(-3)}}{2(3)}$ or $(x - \frac{5}{6})$	M1	Allow one error for M1 from Wrong sign for $-b$ Wrong sign for $-b^2$ Wrong sign for $-4ac$ But not 2 on bottom or not dividing whole top by $2a$ or wrong formula
	$\frac{5 \pm \sqrt{61}}{6}$ or $(x - \frac{5}{6})^2 - \frac{25}{12} - 3$	A1	
	2.14 and –0.47	A1ft	ft on wrong sign for $-b$: 0.47 and –2.14 ft on wrong sign for $-b^2$: 1.39 and 0.28
17(a)	$x \div \sin 39° = 21 \div \sin 124°$	M1	oe
	$x = (21 \times \sin 39°) \div \sin 124°$	A1	
	[15.9, 16]	A1	16 with working

Q	Answer	Mark	Comments
17(b)	cos y = $(19^2 + 14^2 – 28^2) \div (2 \times 19 \times 14)$	M1	$28^2 = 19^2 + 14^2 – 2\times14\times19\times\cos y$
	cos y = –0.42669…	A1	
	[115, 115.3]	A1	115 with working
18(a)	(h =) 5 × tan 67.5 or 5 ÷ tan 22.5	M1	
	Area = 0.5 × 10 × their height	M1Dep	
	5 × 12.07106781 = 60.35..	A1	oe Must calculate a value that rounds to 60.4 but it is not necessary to state 60.35 ≈ 60.4 **NB** if height calculated using 60.4 this is M0 **unless** the height is then use with an angle and a trig ratio to relate to 10 or 5, in which case it would be M2. Be careful of premature rounding as 12.1 leads to 12.1 × tan 22.5 = 5.011 whereas 12.07 × tan(22.5) leads to 4.999. If answer is not within range [4.999, 5.001] do not award the last A1.
18(a) Alt 1	Find side of isosceles triangle x = 5/sin 22.5 or 5/cos 67.5	M1	Hypotenuse = 13.065…
	Area = ½ their 13.066^2 × sin 45 or Area = ½ × their 13.066 × 10 × sin 67.5	M1Dep	
	Area = 60.35..	A1	Must calculate a value that rounds to 60.4 but it is not necessary to state 60.35 ≈ 60.4
18(b)	Area octagon = 8 × their 60.4 (= 483.2)	B1	If a square drawn round the octagon, sides are 24.14…, so area is 582.7396, the 4 corners (area 50 each) must be subtracted
	100 ÷ their 483.2	M1	
	[20.5, 21]	A1	

Q	Answer	Mark	Comments
19(a)	$(2x + 3)(2x + 3) = 5(3x + 2)$	M1	$4x^2 + 6x + 6x + 9$ and $15x + 10$
	$4x^2 + 6x + 6x + 9 = 15x + 10$	A1	Equality can be implied by subtraction
	Terms rearranged so that all are on LHS and an indication of cancelling. Minimum is $4x^2 + 6x + 6x + 9 – 15x – 10 = 0$	A1	Must have = 0 If brackets expanded and terms rearranged into a quadratic of form $ax^2 + bx + c = 0$
19(b)	$(4x + 1)(x – 1) = 0$	B1	$\frac{3 \pm \sqrt{25}}{8}$ If no working in (b) this mark can be awarded if seen in (a)
	–0.25	Q1	Strand (i) Do not award if 1 given as a value. Must make the decision to choose the value that gives a rectangle.
20	Angle *A* = angle *B* = 90	B1	
	BN = *AM* (given)	B1	Given need not be stated
	ML = *MN* and sides of (same) square	B1	oe, eg *ML* = *MN* (*MNQL* is a square)
	Congruent due to RHS	B1	Reason can be in words but must be clearly RHS, eg right angle triangle with a side and the hypotenuse
20 **Alt 1**	Angle *BMN* = Angle *ALM*	B1	These must be explained using 180 on a straight line and 180 in a triangle
	Angle *BNM* = Angle *AML*	B1	
	BN = *AM* (given)	B1	Given need not be stated
	Congruent due to ASA	B1	Reason can be in words but must be clearly ASA, eg two angles and the side between them

Q	Answer	Mark	Comments
20 Alt 2	*ML* = *MN* and sides of (same) square	B1	**NB** Pythagoras stated or used is a reason for third side.
	BM = *AL* and both sides of larger square – *AM* or *DL*	B1	This must be justified
	BN = *AM* (given)	B1	Given need not be stated
	Congruent due to SSS	B1	Reason can be in words but must be clearly SSS, eg all sides equal
20 Alt 3	Angle *A* = angle *B* = 90	B1	
	BM = *AL* and both sides of larger square – *AM* or *DL*	B1	This must be justified
	BN = *AM* (given)	B1	Given need not be stated
	Congruent due to SAS (Do not accept ASS)	B1	Reason can be in words but must be clearly SAS, eg two sides and the angle between them