GCSE

Mathematics

Unit 2: Higher   43602H
Mark scheme

43602H
June 2016

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.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

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.
ft	Follow through marks. Marks awarded following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme 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.
3.14…	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416

Examiners should consistently apply the following principles

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

Questions which ask candidates to show working

Instructions on marking will be given but usually marks are not awarded to candidates who show no working.

Questions which do not ask candidates to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.
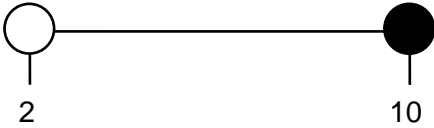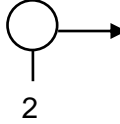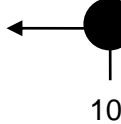
Continental notation
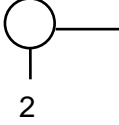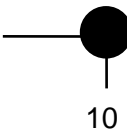
Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the candidate intended it to be a decimal point.

Q	Answer	Mark	Comments
1	$7x – 3x$ or $4x$ or $23 + 9$ or 32	M1	oe $3x – 7x$ or $–4x$ or $–9 – 23$ or $–32$
	$7x – 3x = 23 + 9$ or $4x = 32$	M1	oe $3x – 7x = –9 – 23$ or $–4x = –32$
	8	A1ft	ft M1M0 with one rearrangement or arithmetic error

Q	Answer	Mark	Comments
2	(third term =) $4a$ or (fourth term =) $8a$ or $7a$ ($= 63$) or $15a$	M1	
	$a = 63 \div 7$ or $a = 9$ or 8×9 or 15×9	M1	seen or implied
	135	A1	

<table>
<tr><td colspan="4" align="center">Additional Guidance</td></tr>
<tr><td colspan="3">$a = 9$ is implied by second term 18 or third term 36 or fourth term 72, not from an incorrect sequence</td><td></td></tr>
</table>

Q	Answer	Mark	Comments
3(a)	Straight line from (0900, 0) to (1100, 120)	B1	

Q	Answer	Mark	Comments
3(b)	Straight line from (1030, 0) to (1200, 120)	B1ft	ft (1200, their 120) from their distance at 1100 in part (a)

Q	Answer	Mark	Comments
3(c)	80	B1ft	ft speed from their distance-time graph for Train *B*

<table>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">If their distance-time graph for train B goes from (1030, 0) to (1200, 120) the answer for (c) must be 80</td><td></td></tr>
<tr><td colspan="2">For ft their distance-time graph for Train B must be a straight line for at least 90 minutes</td><td></td></tr>
</table>

Q	Answer	Mark	Comments
4	0.8 × 1550 or 1240	M1	oe
	1950 ÷ 3 × 2 or 1300	M1	oe
	their 1300 – 0.05 × their 1300 or 0.95 × their 1300 or 1235	M1	their 1300 can be their 1240 if greater than 1250
	1240 and 1235	A1	as final values
	(Car) B	Q1ft	Strand (iii) ft for correct decision based on their values, with at least M2 scored and one correct final value SC2 1368 and 1200 or 1162.5(0) and 1202.5(0) SC1 1368 or 1162.5(0) or 1202.5(0)

<table>
<tr><td colspan="2">Additional Guidance</td></tr>
<tr><td>Car A = 1240 and Car B = 1300 with correct decision of Car A</td><td>M1M1M0A0Q1ft</td></tr>
</table>

Q	Answer	Mark	Comments
	Alternative method 1		
	$\frac{3}{12}$ (+) $\frac{2}{12}$ or $\frac{5}{12}$ or $\frac{6}{24}$ (+) $\frac{4}{24}$ or $\frac{10}{24}$	M1	oe common denominator
	1 – their $\frac{5}{12}$ or $\frac{7}{12}$ or 12 – their 5 or 1 – their $\frac{10}{24}$ or $\frac{14}{24}$ or 24 – their 10 or 14 (blue discs)	M1	oe their $\frac{5}{12}$ must be from $\frac{1}{4} + \frac{1}{6}$
	7	A1	
5	**Alternative method 2**		
	Multiple of 12 for total number of discs or Number of red discs and white discs in ratio 3 : 2	M1	Implied by LCM of 12 eg 6R, 4W
	Numbers of discs in ratio 3 : 2 : 7	M1	eg 6R, 4W, 14B
	7	A1	

Additional Guidance	
7 out of 12 on answer line	M1M1A1
$\frac{7}{12}$ on answer line	M1M1A0
3 (red) 2 (white) 7 (blue) without 7 on answer line	M1M1A0
$\frac{1}{4} + \frac{1}{6} = \frac{2}{10}$ $1 - \frac{2}{10}$	M0M1A0

Q	Answer	Mark	Comments
6	$2x(3x – 7)$	B2	B1 $2(3x^2 – 7x)$ or $x(6x – 14)$ SC1 $2x(3x + 7)$

<table>
<tr><td rowspan="7">6</td><td colspan="2" align="center">Additional Guidance</td></tr>
<tr><td>Allow multiplication signs for B2 or B1
eg $2x \times (3x – 7)$</td><td align="center">B2</td></tr>
<tr><td>Condone missing final bracket
eg $2x(3x – 7$</td><td align="center">B2</td></tr>
<tr><td>Accept $(2x + 0)(3x – 7)$</td><td align="center">B2</td></tr>
</table>

7(a)	–3, –2, –1, 0, 1	B1	Any order

<table>
<tr><td colspan="2" align="center">Additional Guidance</td></tr>
<tr><td>–3, –2, –1, 0, 1, 2</td><td align="center">B0</td></tr>
</table>

Q	Answer	Mark	Comments
7(b)		B2	B1 or ... and ... or

Additional Guidance	
Intention must be clear to indicate $x > 2$ with minimum of a line drawn to the right of hollow circle positioned at 2	B1
Intention must be clear to indicate $x \leq 10$ with minimum of a line drawn to the left of filled circle positioned at 10	B1

Q	Answer	Mark	Comments
8	**Alternative method 1**		
	$150 \div (5 - 2)$ or $150 \div 3$ or 50	M1	
	their 50×7 or their 50×5 or 250 and their 50×2 or 100	M1 dep	
	350	A1	SC1 210
	Alternative method 2		
	$\dfrac{5}{2} = \dfrac{x+150}{x}$	M1	oe $5x = 2(x + 150)$
	$(x =)$ 100 and $(x + 150 =)$ 250	M1	
	350	A1	SC1 210
	Additional Guidance		
	250 and 100 is at least M1M1		

9(a)	5	B1	

9(b)	1	B1	

Q	Answer	Mark	Comments
9(c)	$\sqrt[3]{27}$ or 3	M1	
	$\dfrac{1}{7^2}$ or $\left(\dfrac{1}{7}\right)^2$ or $\dfrac{1}{49}$	M1	
	$\dfrac{3}{49}$	A1	

Q	Answer	Mark	Comments
10	$x + y = 7$	B1	oe allow = or any inequality sign
	$x \geq 2$ or $y > 1$	B1	oe
	$x \geq 2$ and $y > 1$ and $x + y < 7$	Q1	oe Strand (i) correct use of notation SC2 $x \leq 2$ and $y < 1$ and $x + y > 7$ or $x > 2$ and $y \geq 1$ and $x + y \leq 7$

Q	Answer	Mark	Comments
11	**Alternative method 1**		
	$\dfrac{x-20}{x+280} = \dfrac{1}{4}$ or $4(x-20) = x + 280$	M1	oe
	$4x - 80 = x + 280$ or $x - 20 = \dfrac{x}{4} + 70$	M1	oe correct expansion of their brackets or division scores M2
	$4x - x = 280 + 80$ or $3x = 360$ or $x - \dfrac{x}{4} = 70 + 20$ or $\dfrac{3x}{4} = 90$	M1	collecting their four terms scores M3
	$x = 120$	A1	SC3 − 380

Q	Answer	Mark	Comments
11 cont	**Alternative method 2**		
	$x + 280 - (x - 20)$ (= 3 parts)	M1	
	300 (= 3 parts) and 100 (= 1 part)	M1	scores M2
	$x - 20 = 100$ or $x + 280 = 400$	M1	scores M3
	$x = 120$	A1	SC3 – 380
	Alternative method 3		
	$x - 20 + x + 280 = 5(x - 20)$	M1	
	$2x + 260 = 5x - 100$	M1	scores M2
	$3x = 360$	M1	scores M3
	$x = 120$	A1	SC3 – 380

	Additional Guidance	
	$x - 20 = 4(x + 280)$	M0
	$x - 20 = 4x + 1120$	M1
	$-1140 = 3x$	M1

12(a)	5.83×10^{-4}	B1	

12(b)	941 600	B1	
	Additional Guidance		
	Accept 941,600 or 941 600.0(…)		B1

Q	Answer	Mark	Comments
12(c)	7 200 000 000 ÷ 300 or 7200 × 10^6 ÷ 300 or 7.2 × 10^9 ÷ 300 or 24 million	M1	oe
	24 000 000 or 24 × 10^6 or 0.024 × 10^9	A1	oe
	2.4 × 10^7	A1ft	ft M1 and their 24 000 000 written in standard form

13(a)	15 and 13	B1

Additional Guidance	
Do not accept incorrect order eg 13 and 15	B0

Q	Answer	Mark	Comments
13(b)	$n^2 + 5n + 2n + 6$ or $n^2 + 7n + 6$	M1	
	$(n + a)(n + b)$	M1	where $ab = 6$ or $a + b = 7$
	$(n + 1)(n + 6)$ with full working seen	A1	ignore further work

Additional Guidance	
$(n + 1) × (n + 6)$ with full working seen	M1M1A1

Q	Answer	Mark	Comments
14	**Alternative method 1 (Elimination)**		
	$3a - 5 = b$ or $3a + 3b = 69$ or $a + b = 23$	M1	oe $\dfrac{b+5}{3} = a$ or $\dfrac{64+5}{3} = a + b$ forms one correct equation
	$3a - b = 5$ and $3a + 3b = 69$ or $3a - b = 5$ and $a + b = 23$	M1	oe forms two correct equations with equal coefficients for one unknown
	$4a = 28$ or $a = 7$ or $4b = 64$ or $b = 16$	A1	oe correctly eliminates one unknown
	$a = 7$ and $b = 16$	Q1	strand (ii) complete and correct algebra SC2 for $a = 7$ and $b = 16$ with one correct equation SC1 for $a = 7$ and $b = 16$ without working or using trial and improvement

Q	Answer	Mark	Comments
14 cont	**Alternative method 2 (Substitution)**		
	$3a - 5 = b$ or $3(a + b) - 5 = 64$ or $3a + 3b = 69$ or $a + b = 23$	M1	oe $\dfrac{b + 5}{3} = a$ or $\dfrac{64 + 5}{3} = a + b$ forms one correct equation
	$b = 3a - 5$ and $3a + 3b = 69$ or $a = 23 - b$ and $3a - b = 5$	M1	oe $3a + 3(3a - 5) = 69$ or $3(23 - b) - b = 5$ forms two correct equations with an unknown as the subject of one of them
	$12a = 84$ or $a = 7$ or $4b = 64$ or $b = 16$	A1	oe correctly substitutes for one unknown and simplifies
	$a = 7$ and $b = 16$	Q1	strand (ii) complete and correct algebra SC2 for $a = 7$ and $b = 16$ with one correct equation SC1 for $a = 7$ and $b = 16$ without working or using trial and improvement
	Additional Guidance		
	Be careful for M1M1 that the equations are not equivalent eg $a = 23 - b$ and $3a + 3b = 69$		M1M0

15	$(2x + 1)(2x - 1)$	M1	
	$(2x + 5)(2x + 1)$	M1	
	$\dfrac{2x - 1}{2x + 5}$	A1	Do not allow further work

Q	Answer	Mark	Comments
16(a)	**Alternative method 1**		
	$x^2 - 3x - 3x$ or $x^2 - 6x$ or $b = 9 - a$ or $\dfrac{a}{2} = -3$	M1	oe
	$a = -6$	A1	
	$b = 15$	A1	
	Alternative method 2		
	Substitutes a value for x into the identity and obtains a correct equation in a and b	M1	
	$a = -6$	A1	
	$b = 15$	A1	
	Additional Guidance		
	$x = 0$ gives $b = 9 - a$ $x = 1$ gives $1 + a + b = 4 - a$ $x = 2$ gives $4 + 2a + b = 1 - a$ $x = 3$ gives $9 + 3a + b = -a$		

16(b)	2	B1	

Q	Answer	Mark	Comments
17(a)	$\dfrac{16}{\sqrt{2}} \times \dfrac{\sqrt{2}}{\sqrt{2}}$ or $\dfrac{16\sqrt{2}}{\sqrt{4}}$ or $\dfrac{16\sqrt{2}}{2}$ or $\sqrt{\dfrac{256}{2}}$ or $\sqrt{128}$ or $\sqrt{64} \times \sqrt{2}$	M1	oe
	$8\sqrt{2}$	A1	do not ignore further work

Q	Answer	Mark	Comments
17(b)	$25 - 5\sqrt{3} - 5\sqrt{3} + 3$ or $25 - 10\sqrt{3} + 3$	M1	allow one error in four terms
	$28 - 10\sqrt{3}$ or $a = 28$ and $b = 10$	A1	

Q	Answer	Mark	Comments
18	$6(x + 3)$ or $(-)2(x - 2)$ or $6x + 18$ or $2x - 4$ or $-2x + 4$ or $(x - 2)(x + 3)$	M1	
	$6x + 18 - 2x + 4$ or $4x + 22$ or $x^2 - 2x + 3x - 6$ or $x^2 + x - 6$	M1	allow three correct terms after expansion ignore RHS and denominator allow three correct terms after expansion as denominator or RHS
	$x^2 - 3x - 28 = 0$	A1	
	$(x - 7)(x + 4)$ $(= 0)$	M1	correct method to solve their quadratic equation by correct substitution into the quadratic formula or correct completion of the square or correct factorisation
	$(x =)\ 7$ and $(x =) - 4$	A1	SC2 $(x =)\ 7$ or $(x =) - 4$
	Additional Guidance		
	Correct substitution into quadratic formula $$x = \frac{--3 \pm \sqrt{(-3)^2 - 4 \times 1 \times -28}}{2 \times 1}$$		