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General Certificate of Secondary Education
November 2012

Mathematics 43603H

Unit 3 Higher tier

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 candidates' 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 candidates' 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 candidates' 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

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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.
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.
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 within the scheme for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
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 …	Allow answers which begin 3.14 eg 3.14, 3.142, 3.149.
Use of brackets	It is not necessary to see the bracketed work to award the marks.

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.

Unit 3 Higher Tier

Q	Answer	Mark	Comments
1a	$2 \times \pi \times 9.4$ or $18.8 \times \pi$	M1	oe
	[59, 59.1] or 18.8π or $\frac{94\pi}{5}$	A1	
1b	their $59 \div 2 + 9.4 + 9.4$	M1	oe
	48.3 or $9.4\pi + 18.8$ or $\frac{47\pi}{5} + 18.8$	A1ft	[48.3, 48.4]
2a	Correct reflection drawn	B2	B1 for reflection in $y = 1$
2b	Any 180° rotation drawn	M1	
	Correct rotation drawn	A1	

Q	Answer	Mark	Comments
3	78 × 5 or 1.99 × 2	M1	oe Attempt at a sensible scale for one of the bottles (e.g multiple of 5 for 78p or multiple of 2 for £1.99 or one from list below)
	78 × 5 (390) and 1.99 × 2 (3.98) or 78 ÷ 60 (1.3) and 199 ÷ 150 (1.326) or 78 ÷ 4 (19.5) and 199 ÷ 10 (19.9) or 60 ÷ 78 (0.769) and 150 ÷ 199 (0.7537) or 78 × 2.5 (195) or 199 ÷ 2.5 (79.6)	M1 dep	oe Attempt to compare equal quantities (any units) Note: May use 600 and 1500 (ml)
	e.g. (£) 3.90 and (£) 3.98	A1	oe Correct values for their comparison Money units can be in p or £ Capacity units must be consistent
	Small	Q1	Strand (iii) Correct conclusion from correct values Must compare equal quantities
4	[5.9, 6.1] seen	B1	
	their 6 × 800 (÷ 100) or 1 cm = 8 m seen or implied	M1	oe
	their 6 × 800 ÷ 100 × 250	M1dep	
	12 000	A1	[11 800, 12 200] Digits 12 or 118 or 122 imply B1M1

Q	Answer	Mark	Comments
5a	$A = w^2$ or $A = w \times w$ or $\sqrt{A} = w$	B1	Do not ignore further working
5b	$V = w^3$ or $V = w \times w \times w$ or $V = w^2 \times w$ or $\sqrt[3]{V} = w$	B1	Do not ignore further working
5c	$\sqrt{20}$ seen	M1	oe eg decimals
	their $\left(\sqrt{20}\right)^3$ or $20 \times$ their $\sqrt{20}$	M1dep	oe eg decimals Accept $40 \times \sqrt{5}$
	[89.3, 91.2] or $40\sqrt{5}$ or $\sqrt{8000}$	A1	Accept $20\sqrt{20}$
6a	$60 \div 2$ (= 30) or 90 seen or 210 seen or 12 (parts) seen	M1	$360 \div (2 + 3 + 7)$
	$60 \div 2 \times 12$ or $60 + 90 + 210$	M1	oe $360 \div 12$ (= 30)
	360	A1	$2 \times 30 = 60$
6b	$180 - (x + 30)$ or $180 - x - 30$	M1	oe Do not condone missing brackets unless recovered
	$150 - x$ or $-x + 150$	A1	

Q	Answer	Mark	Comments
7	$\frac{1}{2}$ (6.5 + 8.3) 3.2	M1	
	23.68 or 23.7	A1	May be implied by a full method
	their 23.68 × 200 or $\frac{1}{2}$ (8.3 + 6.5) 3.2 × 200	M1	
	4736 or 4740	A1 ft	Note: The following imply M0A0M1A1ft 9472 or 9470 or 9480 or 1481(.25) or 1480 or 5315(.25) or 5320 or 4164(.15) or 4160 or 3956 or 3960 or 3740
8	$x^2 = 5$	M1	2.2(36 …) or $\sqrt{5}$ or $\frac{\sqrt{20}}{2}$
	2.2 and –2.2	A1	2.2 or 2.23… implies M1
9	$(x + 4)(x – 5)$ (= 90)	M1	
	$x^2 + 4x – 5x – 20$ (= 90)	M1	Allow 1 error
	$x^2 – x – 110$ (= 0)	M1dep	Collecting their 4 terms and 90 dependent on 2nd M1 only
	$(x + 10)(x – 11)$	M1	$(x + a)(x + b)$ where $ab = \pm$ their 110 Use of formula - allow one error
	11	A1	Note: 11 and – 10 implies M4A0
10a	$\pi \times r^2 \times 4r$	M1	oe
	$V = 4\pi r^3$	A1	
10b	$4 \times \pi \times 8^3$	M1	oe Correct substitution shown for their formula
	2048 π or [6430, 6440]	A1	

Q	Answer	Mark	Comments
11	$15 + 20m = 40 + 15m$	M1	$0 = -25 + 5m$ or $0 = 25 - 5m$
	$20m - 15m = 40 - 15$	M1	$5m = 25$ or $-5m = -25$
	$m = 5$	A1	
	$(T =)$ 115	A1 ft	
	Alternative method		
	$\frac{T - 15}{20} = \frac{T - 40}{15}$	M1	
	$15(T - 15) = 20(T - 40)$	M1	
	$15T - 225 = 20T - 800$	M1	
	$(T =)$ 115	A1	
12a	$\frac{3}{5}$ or 0.6	B1	
12b	35 or 35.0 or 34.99(…)	B1	Do not accept 34.9
13a	$35^2 + 30^2$	M1	
	$\sqrt{35^2 + 30^2}$	M1 dep	
	46(.097…) or $5\sqrt{85}$ or $\sqrt{2125}$	A1	
13b	$35^2 + 30^2 + 87^2$ or their $46^2 + 87^2$ or $2125 + 87^2$	M1	
	$\sqrt{35^2 + 30^2 + 87^2}$ or $\sqrt{\text{their } 46^2 + 87^2}$ or $\sqrt{2125 + 87^2}$ or $\sqrt{9694}$	M1 dep	
	98.(…) and No	A1	

Q	Answer	Mark	Comments
14a	124 ÷ 2 (÷ 2) or 62 (÷ 2)	M1	(180 – 118) (÷ 2) or (180 – 90 – 28) (÷ 2) 62 may be on diagram
	31	A1	
14b	ETO = their 31	M1	
	90 – their 31 or 90 seen	M1dep	ETD = 59 or TDE = 59 scores M1M1
	59	A1ft	
15	$W \propto \frac{1}{x}$ or $W \propto \frac{k}{x}$ or $Wx = k$	M1	Accept any letter for k $6 = \frac{k}{20}$ or $\frac{24}{20} = \frac{6}{W}$ oe
	k = 120 or $Wx = 120$	M1	oe $24W = 120$
	120 ÷ 24	M1	oe 6 ÷ 1.2
	5	A1	

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th colspan="2">Comments</th></tr>
<tr><td>16a</td><td>$1.6 \times 6\frac{1}{2}$</td><td>M1</td><td colspan="2"></td></tr>
<tr><td></td><td>10.4</td><td>A1</td><td colspan="2">oe</td></tr>
<tr><td>16b</td><td>Use or sight of 4.5(4) litres = 1 gallon</td><td>B1</td><td colspan="2">oe</td></tr>
<tr><td></td><td>A correct single step calculation</td><td>M1</td><td>50×1.6 or 80</td><td>100 ÷ 1.6
100 ÷ 5.5
or 5.5 ÷ 100
5.5 ÷ 4.5
or 4.5 ÷ 5.5
50 ÷ 4.5
or 4.5 ÷ 50</td></tr>
<tr><td></td><td>A different correct single step calculation
or
A correct two-step calculation</td><td>M1dep</td><td>$50 \times 1.6 \div 4.5$
$4.5 \div (50 \times 1.6)$
$(50 \div 4.5) \times 5.5$
$(100 \div 1.6) \div 5.5$
$(100 \div 1.6) \times 4.5$</td><td>80 ÷ 4.5
4.5 ÷ 80
100 ÷ (5.5 ÷ 4.5)
100 ÷ 5.5 × 4.5</td></tr>
<tr><td></td><td>Two matching values
(May be rounded)
(May be multiples of figures listed)</td><td>A1</td><td colspan="2">
<table>
<tr><th>Units</th><th>Manufacturer</th><th>My Car</th></tr>
<tr><td>Km per litre</td><td>18.18</td><td>17.7*</td></tr>
<tr><td>Km per gallon</td><td>81.8*</td><td>80</td></tr>
<tr><td>Litres per 100 km</td><td>5.5 (given)</td><td>5.625*</td></tr>
<tr><td>Litres per km</td><td>0.055</td><td>0.05625*</td></tr>
<tr><td>Miles per litre</td><td>11.36*</td><td>11.1</td></tr>
<tr><td>Litres per mile</td><td>0.088*</td><td>0.09</td></tr>
<tr><td>Miles per 5.5 litres</td><td>62.5</td><td>61.1*</td></tr>
<tr><td>Km per 5.5 litres</td><td>100 (given)</td><td>97.8*</td></tr>
<tr><td>Gallons per mile</td><td>0.019..*</td><td>0.02</td></tr>
<tr><td>Miles per gallon</td><td>51.1*</td><td>50 (given)</td></tr>
<tr><td>Gallons per km</td><td>0.0122..</td><td>0.0125*</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Litres per 800 km</td><td>44</td><td>45*</td></tr>
</table>
*these values imply a correct two-step calculation for M2
Values may be rounded or truncated such that correct comparisons can still be made.
</td></tr>
<tr><td></td><td>More fuel</td><td>Q1</td><td colspan="2"></td></tr>
</table>

Q	Answer	Mark	Comments
17a	$2\mathbf{x} + 4\mathbf{y}$ or $4\mathbf{y} + 2\mathbf{x}$	B1	
17b	their $(2\mathbf{x} + 4\mathbf{y}) \times 1.5$	M1	oe
	$3\mathbf{x} + 6\mathbf{y}$ or $3(\mathbf{x} + 2\mathbf{y})$	A1 ft	ft if vector answer in (a)
18a	Correct sketch	B1	
18b	Correct sketch	B1 ft	ft their (a) transformed up Labels not required

Q	Answer	Mark	Comments
19	Scale factor $\frac{18}{8}$ or $\frac{8}{18}$ seen or $AC = 5 \times 2.25$ (= 11.25) or angle B = angle E seen or angle A = angle D seen	B1	oe 11.25 may be on diagram
	Use of cosine rule to work out any angle	M1	$8^2 = 4^2 + 5^2 - 2 \times 4 \times 5 \times \cos C$ $18^2 = 9^2 +$ their $11.25^2 - 2 \times 9 \times$ their $11.25 \times \cos C$
			$4^2 = 5^2 + 8^2 - 2 \times 5 \times 8 \times \cos D$ $9^2 = 18^2 +$ their $11.25^2 - 2 \times 18 \times$ their $11.25 \times \cos A$
			$5^2 = 4^2 + 8^2 - 2 \times 4 \times 8 \times \cos E$ their $11.25^2 = 9^2 + 18^2 - 2 \times 9 \times 18 \times \cos B$
	Correct rearranging of formula to isolate cosine	M1dep	$\frac{4^2 + 5^2 - 8^2}{2 \times 4 \times 5}$ or $\frac{-23}{40}$ $\frac{9^2 +$ their $11.25^2 - 18^2}{2 \times 9 \times$ their $11.25}$ or $\frac{-23}{40}$
			$\frac{5^2 + 8^2 - 4^2}{2 \times 5 \times 8}$ or $\frac{73}{80}$ $\frac{\text{their}11.25^2 + 18^2 - 9^2}{2 \times \text{their}11.25 \times 18}$ or $\frac{73}{80}$
			$\frac{4^2 + 8^2 - 5^2}{2 \times 4 \times 8}$ or $\frac{55}{64}$ $\frac{9^2 + 18^2 - \text{their}11.25^2}{2 \times 9 \times 18}$ or $\frac{55}{64}$
	Obtaining one angle	A1	eg $C = 125.(\ldots)$ or 125 $B = 30.(\ldots)$ or 31 = E $A = 24.(\ldots)$ or 24 = D May be seen on diagram

	Substitution into $\frac{1}{2}ab\sin C$	M1	$\frac{1}{2}$ × their 11.25 × 9 × sin their 125 $\frac{1}{2}$ × their 11.25 × 18 × sin their 24 $\frac{1}{2}$ × 18 × 9 × sin their 31 oe
			$\frac{1}{2}$ × 4 × 5 × sin their 125 $\frac{1}{2}$ × 5 × 8 × sin their 24 $\frac{1}{2}$ × 4 × 8 × sin their 31
	[41, 42]	A1	

UMS conversion calculator www.aqa.org.uk/umsconversion