GCSE
MATHEMATICS
8300/3H

Higher Tier Paper 3 Calculator

Mark scheme

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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 Examiner.

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.
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.
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.
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.
[a, b)	Accept values $a \leq$ value $< b$
3.14 …	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
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 student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

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

Questions which do not ask students to show working

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

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student 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

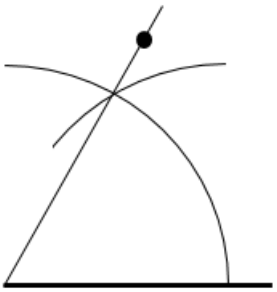
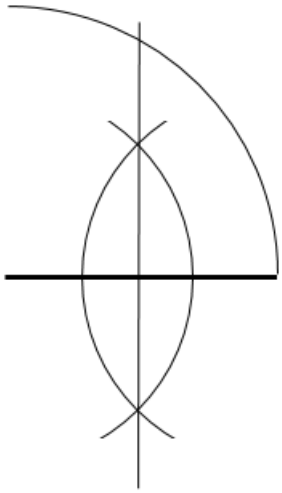
Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Question	Answer	Mark	Comments
1	0.26	B1	
2	$\frac{3}{2}$	B1	
3	$-2x$	B1	
4	$6.365 \leqslant x < 6.375$	B1	

Question	Answer	Mark	Comments
5	**Alternative method 1**		
	$7x - 3x = 36 - 16$	M1	oe elimination of one variable implied by $4x = n$, where $n < 36$ and $n \neq 16$
	$4x = 20$ or $x = 5$	A1	oe
	$y = 0.5$	A1	oe
	Alternative method 2		
	$7 \times 2y - 3 \times 2y = 7 \times 16 - 3 \times 36$ or $14y - 6y = 112 - 108$	M1	oe elimination of one variable implied by $21x + 14y = 112$ and $21x + 6y = 108$ followed by $8y = n$, where $n < 112$ and $n \neq 36, 16$ or 20
	$8y = 4$ or $y = 0.5$	A1	oe
	$x = 5$	A1	
	Alternative method 3		
	$36 - 7x = 16 - 3x$ or $\frac{36 - 2y}{7} = \frac{16 - 2y}{3}$	M1	oe elimination of one variable
	$4x = 20$ or $x = 5$ or $8y = 4$ or $y = 0.5$	A1	oe collects terms oe
	$x = 5$ and $y = 0.5$	A1	oe
	Additional Guidance		
	$x = 5$ and $y = 0.5$		M1A1A1
	One correct value with one incorrect value (or no second value) and no working eg $x = 5$ and $y = 2$ or eg $x = 5$		M1A1A0
	Embedded, correct values in both equations eg $7 \times 5 + 2 \times 0.5 = 36$ and $3 \times 5 + 2 \times 0.5 = 16$		M1A1A0
	Embedded, correct values in one equation only eg $7 \times 5 + 2 \times 0.5 = 36$		M1A0A0

Question	Answer	Mark	Comments
6(a)	3 × 18 or 54 or 2 × 18 + 14 or 50 or 18 + 3 × 14 or 60 or 4 × 14 or 56 or 1 – 0.25 or 0.75 seen	M1	oe
	3 × 18 × (1 – 0.25) or 3 × 18 × 0.75 or 40.5 or 18 × (1 – 0.25) or 18 × 0.75 or 13.5(0)	M1dep	oe
	40.50	A1	condone £40.50p
	Additional Guidance		
	40.5 on answer line		M1M1A0

Question	Answer	Mark	Comments
6(b)	Should have multiplied 15 by 6 or 90	B1	oe eg 15×6 accept $\frac{240 \times 600}{40 \times 40}$ or $\frac{144000}{1600}$
	Additional Guidance		
	Ignore irrelevant statements alongside a correct answer		
	15×6 seen but evaluated incorrectly		B1
	Should have multiplied not added		B1
	Should have multiplied at the end		B1
	Adding was wrong		B1
	He has added		B1
	Times the number for length and width		B1
	Times the length and width		B0
	Calculation at the end is wrong		B0
	Should have multiplied		B0
	Needs to work out the area		B0
	21 is wrong		B0
	Answer is wrong		B0

Question	Answer	Mark	Comments
7	Side of length [7.8, 8.2] cm drawn	B1	
	Correct construction with intersecting arcs, same radius as their base ± 2 mm to identify the third vertex or correct construction with intersecting arcs, equal radii ± 2 mm, line drawn at 60° and third vertex correctly positioned or correct construction with intersecting arcs, equal radii ± 2 mm and construction arc drawn to correctly identify the third vertex	M1	 or  or 
	Triangle with equal sides [7.8, 8.2], with correct construction seen	A1ft	ft B0M1 triangle with equal sides ± 2 mm, with correct construction seen
	Additional Guidance		
	No construction arcs drawn can score a maximum of B1		

Question	Answer	Mark	Comments
8(a)	$\frac{2}{5} \times 35$ or $\frac{3}{8} \times 48$	M1	oe
	14 or 18	A1	
	32	A1	
	Additional Guidance		
	Do not ignore further working after 32 seen		
	$\frac{32}{83}$ on answer line		M1A1A0
8(b)	**Alternative method 1**		
	35 + 48 – their 32 or 35 – their 14 + 48 – their 18 or 51	M1	oe their 32 from (a) their 14 and their 18 from (a)
	$\frac{51}{83}$ or 0.61(4…) or 61(.4…)%	A1ft	ft their 32 from (a)
	Alternative method 2		
	$\left(1-\frac{2}{5}\right) \times 35 + \left(1-\frac{3}{8}\right) \times 48$ or $\frac{3}{5} \times 35 + \frac{5}{8} \times 48$ or 21 + 30	M1	oe
	$\frac{51}{83}$ or 0.61(4…) or 61(.4…)%	A1	
	Additional Guidance		
	Ignore incorrect conversion if correct fraction seen		
	If their answer in part (a) is a fraction, only allow follow through if their numerator is used in part (b)		
	Alt 1 ft decimal or percentage answers accept rounding to at least 2 sf		

Question	Answer	Mark	Comments	
9	**Alternative method 1**			
	$\frac{450}{65-35}$ or $\frac{450}{30}$ or 15	M1	oe	
	(360 – 65 – 35) × their 15 or 260 × their 15	M1dep	oe M2 $\frac{260}{30}$ × 450 or 8.66(…) × 450 or 8.67 × 450	
	3900	A1		
	Alternative method 2			
	$\frac{360}{65-35}$ × 450 or $\frac{360}{30}$ × 450 or 12 × 450 or 5400	M1	oe	
	$\frac{360-65-35}{360}$ × their 5400 or $\frac{260}{360}$ × their 5400	M1dep	oe eg 0.72(…) × their 5400	
	3900	A1		
	Additional Guidance			
	260 ÷ 30 = 8.6 and 8.6 × 450 fully correct working seen			M1M1A0
10	÷ 8	B1		

Question	Answer	Mark	Comments
11	8	B1	
	$\frac{1}{0.4}$ or $\frac{10}{4}$ or 2.5 or $\frac{1}{\frac{2}{5}}$ or $\frac{5}{2}$ or $2\frac{1}{2}$	M1	8 × 0.4 or 3.2 implies B1M1 16 : 5 or equivalent ratio implies B1M1
	3.2 : 1 or $\frac{16}{5}$: 1 or $3\frac{1}{5}$: 1	A1ft	ft B0M1
	Additional Guidance		
	$8^3 = 512$ or $8 \times 8 \times 8 = 512$ alone is not sufficient for B1		
	ft answers must have *n* exact or correctly rounded to at least 2 sf eg $\sqrt{512} = 22.62$ (incorrect and truncated) 2.5 9.05 : 1	 B0 M1 A1ft	
	ft answer exact surd value eg $\sqrt{512} = 16\sqrt{2}$ 2.5 9.05 : 1 or $\frac{32}{5}\sqrt{2}$: 1	 B0 M1 A1ft	

Question	Answer	Mark	Comments
12	**Alternative method 1**		
	280 ÷ 35 or 8	M1	oe eg 80 ÷ 10
	(350 – 280) ÷ (40 – 35) or 70 ÷ 5 or 14	M1	oe
	6	A1	
	Alternative method 2		
	320 or 350 – 320 or 30 or 350 – 280 and 320 – 280 or 70 and 40	M1	oe
	(350 – 320) ÷ 5 or (70 – 40) ÷ 5 or 30 ÷ 5	M1dep	oe
	6	A1	
	Additional Guidance		
	Do not allow a misread from the graph		
	Alt 2 40 must come from 320 – 280 and not 40 hours worked		

Question	Answer	Mark	Comments
13(a)	120 and 132 and 96 and 156 and states that 4 out of 5 would be above 100 or 8.3… and states that 4 out of 5 would be above 100 or 10.4 × 12 = 124.8 and states this is above 100 or the hypothesis is correct or median or mode = 10 and 10 × 12 = 120 and states that median or mode is above 100 or 52 × 12 (= 624) and 5 × 100 (= 500) and states 624 > 500	B2	B1 10 × 12 or 120 and 11 × 12 or 132 and 8 × 12 or 96 and 13 × 12 or 156 or 100 ÷ 12 or 8.3… or states that 4 out of 5 would be above 100 with no or incorrect evaluations or 10.4 × 12 = 124.8 or median or mode = 10 and 10 × 12 = 120 or 52 × 12 (= 624) and 5 × 100 (= 500)
	Additional Guidance		
	'4 out of 5' is implied by 'most people'		
	(10 + 11 + 8 + 10 + 13) ÷ 5 = 10.4		B0
	52 × 12 or 624 alone		B0

Question	Answer	Mark	Comments
13(b)	Any two correct reasons from The sample is biased The sample is too small They may not read at the same rate in other months	B2	oe eg people in book clubs read more books eg she should ask a lot more people eg that month may not be representative B1 any one correct reason
	Additional Guidance		
	Needs to use data from more months		B1
	The results of just 5 people used		B1

Question	Answer	Mark	Comments
14	$y = x^3 + 2$ or $a = 2$	M1	implied by at least two correct points identified or plotted from (–3, –25), (–2, –6), (–1, 1), (0, 2), (1, 3), (2, 10)
	At least five correct points identified or plotted for their value of a	M1	correct points are (–3, –25), (–2, –6), (–1, 1), (0, 2), (1, 3), (2, 10) may be seen in a table or in working
	Seven correct points plotted and joined with a smooth curve	A1	$\pm \frac{1}{2}$ square SC1 fully correct curve for $y = x^3$ for $-3 \leq x \leq 2$
	Additional Guidance		
15	37 500 × 0.2 or 7500	M1	
	(9260 – their 7500) ÷ 0.4 or 1760 ÷ 0.4 or 4400	M1dep	
	their 4400 + 37 500 + 12 500	M1dep	dep on M2
	54 400	A1	
	Additional Guidance		
	Trial and improvement for any part only scores if the correct value is found		
16(a)	2 × 14 × 9 × 8	M1	oe
	2016	A1	
	Additional Guidance		
	2016 ÷ 4 = 504 penalise further working after 2016 seen		M1A0
	2 × 14 × 9 × 8 × 4 with 2016 not seen		M0A0
	2 × 14 × 9 × 8 ÷ 4 with 2016 not seen		M0A0

Question	Answer	Mark	Comments
16(b)	(1 ×) 14 × 9 × 6	M1	oe
	756	A1	
	Additional Guidance		
	756 ÷ 4 = 189 penalise further working after 756 seen		M1A0
	756 × 4 = 3024		M1A0
	14 × 9 × 6 ÷ 4 with 756 not seen		M0A0
17	(f(10) =) $3 \times 10^2 - 4 \times 10 + 8$ or (f(10) =) 300 – 40 + 8 or (f(10) =) 268 or (f(5) =) $3 \times 5^2 - 4 \times 5 + 8$ or (f(5) =) 75 – 20 + 8 or (f(5) =) 63 or (2f(5) =) 2 × 63 or 126	M1	
	268 and 126 and No	A1	
	Additional Guidance		
18	$-\frac{1}{7}$ and $\frac{3}{2}$	B1	

Question	Answer	Mark	Comments
19(a)	tan *DBH* = $\frac{8}{13}$	M1	oe $\tan^{-1}\frac{8}{13}$
	31.6…	A1	
	Additional Guidance		
	31.6… in working, 32 on answer line – correct rounding		M1A1
	31.6… in working, 31 on answer line – incorrect rounding		M1A0
	$\tan\frac{8}{13}$ or $\tan = \frac{8}{13}$		M0A0
19(b)	58.39… or 58.4	B1ft	ft 90 – their 31.6…
	Additional Guidance		
	Correct or follow through		
20	$\sqrt{2}$	B1	

Question	Answer	Mark	Comments
21	**Alternative method 1**		
	1125 ÷ 5 × 2 or 450	M1	oe
	their 450 ÷ 6 × (7 ÷ 4) or 75 × 1.75 or 131.25	M1dep	
	1125 ÷ their 131.25	M1dep	
	8.57… or 8.6 or $8\frac{4}{7}$ or 8	A1	
	Alternative method 2		
	5 ÷ 2 or 2.5 and 7 ÷ 4 or 1.75	M1	oe
	their 2.5 ÷ their 1.75 or 1.42857… or $\frac{10}{7}$	M1dep	oe
	6 × their 1.42857…	M1dep	
	8.57… or 8.6 or $8\frac{4}{7}$ or 8	A1	
	Alternative method 3		
	(Small bottle fills) $6 \times \frac{4}{7}$ or $\frac{24}{7}$	M1	
	(Large bottle fills) their $\frac{24}{7} \times \frac{5}{2}$ or $\frac{120}{14}$	M1dep	
	their 120 ÷ their 14	M1dep	
	8.57… or 8.6 or $8\frac{4}{7}$ or 8	A1	

Mark scheme for Question 21 continues on next page

Question	Answer	Mark	Comments
21 cont	**Alternative method 4**		
	Any two of $b_1 = 6g_1$ and $b_2 = 2.5b_1$ and $g_2 = 1.75g_1$	M1	oe any letters for small bottle (b_1), small glass (g_1), large bottle (b_2) and large glass (g_2)
	$b_2 = 2.5 \times 6g_1$ or $b_2 = 15g_1$	M1dep	oe
	b_2 = their $15\left(\frac{g_2}{1.75}\right)$	M1dep	
	8.57… or 8.6 or $8\frac{4}{7}$ or 8	A1	
	Additional Guidance		
	If the student attempts more than one method, mark each method and award the highest mark		
	Correct answer seen in working, 9 on answer line		M1M1M1A0

Question	Answer	Mark	Comments
22	**Alternative method 1**		
	$(x-5)^2$ or $(5-x)^2$ or $x^2-10x+25\ (=0)$ or $b=-10$ or $c=25$	M1	
	$b=-10$ and $c=25$	A1	
	Alternative method 2 – using b^2-4ac		
	$b^2-4\ (\times 1)\times c=0$ or $b^2-4\ (\times 1)\times(-25-5b)=0$ or $b^2+100+20b=0$ or $(b+10)^2=0$	M1	
	$b=-10$ and $c=25$	A1	
	Additional Guidance		
	Do not allow $c=25$ from $(x+5)^2$ or $(5+x)^2$		

Question	Answer	Mark	Comments
23	$\frac{3}{8}$	B1	

24	Enlargement	B1	
	Scale factor (×) $-\frac{1}{2}$	B1	oe
	Centre (1, –1)	B1	
	Additional Guidance		
	Enlarge (×) $-\frac{1}{2}$ (1, –1)		B1B1B1
	'Reduces' or 'gets smaller' or 'shrinks'		1st B0
	Do not accept ÷ $\left(-\frac{1}{2}\right)$ for scale factor		2nd B0
	Centre 1, –1		3rd B0
	Combined transformation given		B0B0B0

Question	Answer	Mark	Comments
25	**Alternative method 1**		
	Correct method to work out any viable distance, eg $\frac{1}{2} \times \frac{5}{60} \times 102$ or 4.25 or $102 \times \frac{40}{60}$ or 68 or $\frac{1}{2}(102 + 96) \times \frac{15}{60}$ or $96 \times \frac{15}{60}$ and $\frac{1}{2} \times 6 \times \frac{15}{60}$ or 24 and 0.75 or 24.75 or $\frac{1}{2}\left(\frac{40}{60} + \frac{45}{60}\right) \times 102$ or 72.25	M1	first section second section third section first and second sections
	Correct method to work out all parts of distance, eg $\frac{1}{2} \times \frac{5}{60} \times 102$ or 4.25 and $102 \times \frac{40}{60}$ or 68 and $\frac{1}{2}(102 + 96) \times \frac{15}{60}$ or 24.75	M1dep	97 scores M1M1
	130 – their whole distance or 130 – 97	M1dep	eg 130 – their 4.25 – their 68 – their 24.75 dep on M2
	33	A1	

Mark scheme for Question 25 continues on the next page

Question	Answer	Mark	Comments
25 cont	**Alternative method 2**		
	Correct method to work out 60 × any viable distance, eg $\frac{1}{2} \times 5 \times 102$ or 255 or 102×40 or 4080 or $\frac{1}{2}(102 + 96) \times 15$ or 96×15 and $\frac{1}{2} \times 6 \times 15$ or 1440 and 45 or 1485 or $\frac{1}{2}(40 + 45) \times 102$ or 4335	M1	first section second section third section first and second sections
	Correct method to work out 60 × all parts of distance, eg $\frac{1}{2} \times 5 \times 102$ or 255 and 102×40 or 4080 and $\frac{1}{2}(102 + 96) \times 15$ or 1485	M1dep	5820 implies M1M1
	130 – their whole distance or $130 - \frac{5820}{60}$ or 130 – 97	M1dep	eg $130 - \frac{\text{their } 255 + \text{their } 4080 + \text{their } 1485}{60}$ dep on M2
	33	A1	
	Additional Guidance		
	Accept fractions used as decimals correct to 2 dp or better		

Question	Answer	Mark	Comments
26(a)	$\frac{1}{2} \times 9.7 \times 3.8 \times \sin 73°$ or 17.6…	M1	oe
	their 17.6… × 6 ÷ 8.5 or 105.7… ÷ 8.5 or 12.4…	M1dep	oe
	13	A1	
	Additional Guidance		
	$\frac{1}{2} \times 9.7 \times 3.8 = 18.43$ $18.43 \times 6 \div 8.5 = 13.0…$		M0M0A0
26(b)	$9.7^2 + 3.8^2 - 2 \times 9.7 \times 3.8 \times \cos 73°$ or 94.09 + 14.44 – 73.72 cos 73° or 86.976… or 86.98 or 87	M1	oe
	$\sqrt{\text{their } 86.976...}$	M1dep	
	9.3(2…) or 9.33	A1	
	$\frac{\sin x}{\text{their } 9.32...} = \frac{\sin 42}{8}$ or $\sin^{-1}[0.7778, 0.7804]$	M1	oe their 9.32… must be their length of the vertical line
	[51, 51.3]	A1ft	ft their 9.3(2…) or 9.33
	Additional Guidance		
	Their 9.32… must come from M1M1 or be clearly identified in working or on the diagram as the length of the vertical line		

Question	Answer	Mark	Comments
27	(*PQ* =) $\mathbf{a} + \mathbf{b} + \mathbf{c}$	M1	oe
	(*XY* =) $\frac{2}{3}\mathbf{a} + \mathbf{b} + \frac{2}{3}\mathbf{c}$ or (*XY* =) $-\frac{1}{3}\mathbf{a} + \mathbf{a} + \mathbf{b} + \mathbf{c} - \frac{1}{3}\mathbf{c}$	M1	
	(*PQ* =) $\mathbf{a} + \mathbf{b} + \mathbf{c}$ and (*XY* =) $\frac{2}{3}\mathbf{a} + \mathbf{b} + \frac{2}{3}\mathbf{c}$ and No, as *XY* is not a multiple of *PQ*	A1	oe
	Additional Guidance		

Question	Answer	Mark	Comments
28	$\frac{y+3}{2} = x$ or $x = 2y - 3$ and $x + 3 = 2y$ or $2x - 3 = 55$	M1	
	$\frac{x+3}{2}$ or $\frac{55+3}{2}$	A1	
	$2x^2 - 3$ or $2 \times 4^2 - 3$ or $2 \times 16 - 3$	M1	
	$\frac{55+3}{2} = 29$ and $2 \times 4^2 - 3 = 29$ or $2 \times 16 - 3 = 29$	A1	
	Additional Guidance		
	29 with no working or only from incorrect working		M0A0M0A0