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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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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.

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 $a \leqslant$ 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.

Q	Answer	Mark	Comments
1	$2x = 7 \times 5$ or $2x = 35$ or $\frac{x}{5} = 7 \div 2$ or $\frac{x}{5} = \frac{7}{2}$ or $7 \div \frac{2}{5}$ or $\frac{7 \times 5}{2}$	M1	oe eg $\frac{x}{5} = 3.5$ or $7 \div 0.4$ or $35 \div 2$
	$\frac{35}{2}$ or $17\frac{1}{2}$ or 17.5	A1	
	Additional Guidance		
	Ignore conversion attempt after correct answer seen		

Q	Answer	Mark	Comments
2	$(x + 4)(x - 4)$	B1	either order
	Additional Guidance		
	Ignore missing last bracket eg $(x + 4)(x - 4$	B1	
	Ignore attempts to solve their expression equated to 0 eg $(x + 4)(x - 4)$ and $x = \pm 4$	B1	
	$(x + 4)(x - 4) = (x + 4)^2$	B0	

Q	Answer	Mark	Comments	
3	**Alternative method 1: works out each day's number of people**			
	160 × 1.25 or 200	M1	oe eg 160 + 160 × 0.25	
	their 200 × 1.1(0)	M1dep	oe eg 200 + 200 × 0.1(0)	
	220	A1		
	Alternative method 2: uses a compound increase			
	1.25 × 1.1(0) or 1.375	M1	oe	
	160 × 1.375	M1dep	oe eg 160 + 160 × 0.375	
	220	A1		
	Additional Guidance			
	Ignore further work eg 220 followed by (total number of people =) 580			M1M1A1

Q	Answer	Mark	Comments	
4	810 ÷ 3 or 270	M1	oe implied by 1350	
	810 ÷ 3 × (5 – 3) or 810 ÷ 3 × 5 × $\left(1-\frac{3}{5}\right)$ or 810 ÷ 3 × 5 – 810 or 540	M1dep	oe eg 1350 ÷ 5 × 2 810 ÷ 3 × 2 is M2	
	0.45 × their 540 or 243	M1dep	oe 0.45 × $\frac{2}{5}$ × 1350 is M3	
	623(.00)	A1	SC2 525.8(0)	
	Additional Guidance			
	SC2 is for initially calculating $\frac{3}{5}$ of 810			

Q	Answer	Mark	Comments
5	$2(3b-5)+7$	M1	oe
	$6b-3$ or $-3+6b$	A1	implied by $12b+1$ or $24b+9$
	$12b+1$ or $1+12b$	B1ft	ft 2 × (their $6b-3$) + 7
	Additional Guidance		
	Do not ignore further work for A1 or B1(ft) eg $6b-3=3b$ eg $12b+1=13b$ eg $6b-3=3b$ followed by $2(3b)+7=6b+7$ eg $6b-3=3b$ followed by $2(3b)+7=6b+7$ followed by $6b+7=13b$		M1A0 M1A1B0 M1A0B1ft M1A0B0
	Ignore additional terms, even if incorrect, unless given as the answer eg $6b-3$, $12b+1$, $24b+9$ Answer $12b+1$ eg $6b-3$, $12b+1$, $24b+9$ Answer $24b+9$		M1A1B1 M1A1B0

Q	Answer	Mark	Comments
6	$2+3+3+4$ or 12	M1	
	360 ÷ their 12 or 30	M1dep	$360 \times \frac{4}{12}$ oe scores M2
	120	A1	

Q	Answer	Mark	Comments
7	**Alternative method 1: uses or states sin or cos 65**		
	sin or cos 65 stated or used	M1	oe implied by [0.42, 0.423] do not allow cos 25 or sin 65
	$\sin 25 = \frac{x}{5}$ or 5 × sin 25 or $\cos 65 = \frac{x}{5}$ or 5 × cos 65	M1dep	oe eg 5 × 0.423 accept [0.42, 0.423] for sin 25 or cos 65
	[2.1, 2.12] with M2 awarded	A1	
	Alternative method 2: works out vertical side first		
	5 × cos 25 or 5 × sin 65 or [4.5, 4.55]	M1	oe eg 5 × 0.906 accept [0.9, 0.91] for cos 25 or sin 65
	$\sqrt{5^2 - (\text{their } [4.5, 4.55])^2}$ or $\sqrt{[4.29, 4.75]}$ or their [4.5, 4.55] × tan 25 or their [4.5, 4.55] ÷ tan 65	M1dep	oe accept [0.46, 0.47] for tan 25 accept [2.14, 2.15] for tan 65
	[2.1, 2.12] with M2 awarded	A1	
	Additional Guidance		
	Alt 1 SOHCAHTOA with SOH selected (eg circled)		M1
	[2.1, 2.12] with no working		M0M0A0
	[2.1, 2.12] from accurate/scale drawing only		M0M0A0

Q	Answer	Mark	Comments
8(a)	$\pi \times (7.6 \div 2)^2 \times 2.5$ or 36.1π or [113.3, 113.43]	M1	oe
	170 ÷ their [113.3, 113.43]	M1	oe $\frac{170}{36.1\pi}$ their [113.3, 113.43] must not be 7.6 or 2.5
	[1.49, 1.5]	A1	
	g/cm^3	B1ft	ft change of unit
	Additional Guidance		
	Allow change of units, but stated units must be consistent with units used eg 1 changes units to mm vol = 36100π density = 0.0015 g/mm^3 eg 2 changes units to m and kg vol = 0.0001134 density = 1498.97 kg/m^3		M1M1A1B1 M1M1A1B1
	$\pi \times 3.8^2 \times 2.5 = 356.3$ and $170 \div 356.3$		M1M1
	$(\pi \times 3.8)^2 \times 2.5 = 356.3$ and $170 \div 356.3$		M0M1
	$\pi \times 7.6^2 \times 2.5 = 453.6$ and $170 \div 453.6$		M0M1

Q	Answer	Mark	Comments
8(b)	The density is less than the answer to part (a)	B1	

Q	Answer	Mark	Comments
9	**Alternative method 1: comparing actual number of 6s to expected number**		
	1038 ÷ 6 or 173	M1	
	1038 + their 173 or 1211	M1dep	1038 × $\frac{7}{6}$ oe scores M2
	Yes and 1211	A1	
	Alternative method 2: comparing actual extra number of 6s to expected number		
	1038 ÷ 6 or 173	M1	
	1092 – 1038 or 54	M1	
	Yes and 173 and 54	A1	
	Alternative method 3: comparing relative frequency to theoretical probability		
	1092 – 1038 or 54 or 1092 ÷ 1038 or 1.05(2…) or $\frac{1}{6}$	M1	oe fraction, decimal or percentage
	their 54 ÷ 1038 or their 1.05(2…) – 1 or 0.05(2…)	M1dep	oe fraction, decimal or percentage eg $\frac{9}{173}$
	Yes and 0.05(2…) and 0.16(6…) or 0.167 or 0.17	A1	oe using fractions with common denominators relative frequencies must be in a comparable form
	Additional Guidance		
	Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comments
10	(Equilateral) triangle	B1	accept regular triangle

Q	Answer	Mark	Comments
11(a)	(30, 0.4) and (40, 0.35) and (50, 0.32) plotted and graph completed with straight lines	B3	$\pm\frac{1}{2}$ a square B2 at least two correct points plotted B1 one correct point plotted
	Additional Guidance		
	Mark intention for straight lines		
	Ignore any continuation of the graph after the last point and ignore any other lines drawn, for example a line of best fit		

Q	Answer	Mark	Comments
11(b)	0.32	B1ft	oe fraction, decimal or percentage correct or ft their relative frequency for 50 throws (> 0 and < 1)

Q	Answer	Mark	Comments
12(a)	A B D C A C B D A C D B A D B C A D C B B A C D B A D C B C A D B D A C with no incorrect combinations	B3	B2 6, 7 or 8 correct combinations B1 3, 4 or 5 correct combinations
	Additional Guidance		
	Allow A B C D in a new list or if the original is crossed out		
	Ignore repeats for B2 and B1 only		

Q	Answer	Mark	Comments
12(b)	$\frac{4}{10}$	B1ft	oe fraction, decimal or percentage ft from their list in (a) with at least 3 correct combinations
	Additional Guidance		
	For follow through allow answers rounded or truncated to 2dp or better		
	In part (a) A B C D A B D C A C B D B A C D B A D C followed by $\frac{4}{5}$ in (b)		B1ft

Q	Answer	Mark	Comments
12(c)	It is not possible to tell	B1	

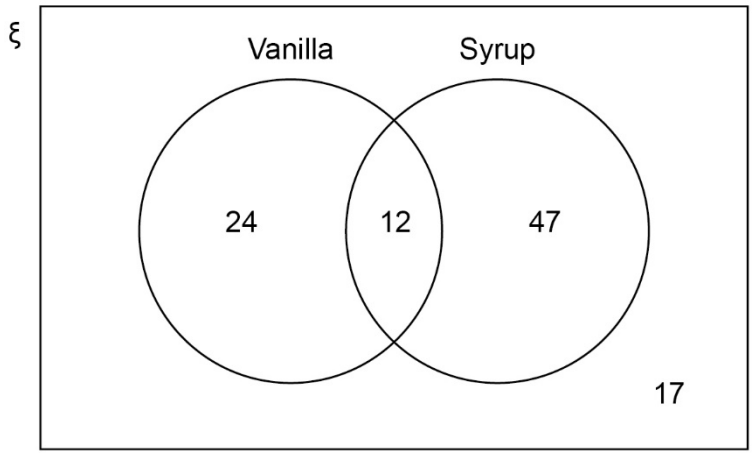
Q	Answer	Mark	Comments
13	B	B1	allow any clear indication of graph B

Q	Answer	Mark	Comments
14	**Alternative method 1: shows that x and 138° are co-interior**		
	$(5-2)\times 180$ or 540	M1	
	(their $540-144-138-90$) $\div (3+1)$ or $168\div 4$ or 42	M1dep	may be seen on diagram
	$42+138=180$	A1	oe
	Correct reasons for their proof with M2A1 awarded	B1	eg sum of angles in a pentagon co-interior angles sum to 180
	Alternative method 2: assumes that they are parallel and uses sum of angles		
	$(5-2)\times 180$ or 540	M1	
	$180-138=42$	M1	
	$3\times 42+42+144+138+90=540$	A1	
	Correct reasons for their proof with M2A1 awarded	B1	eg sum of angles in a pentagon co-interior angles sum to 180
	Additional Guidance		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comments
15	**Alternative method 1: scales up using flour in portion and whole cake**		
	27.5×6 or 165	M1	
	their $165 \div 30$ or 5.5 or $\frac{11}{2}$	M1dep	
	550	A1	
	Alternative method 2: scales up using fraction of cake that is flour		
	27.5×6 or 165	M1	
	$100 \div 30$ or $\frac{10}{3}$ or 3.3(3…)	M1	
	550	A1	
	Alternative method 3: scales up using proportion of 100 g to one sixth		
	$\frac{27.5}{30}$ or $\frac{11}{12}$ or 0.916(6…) or $\frac{30}{27.5}$ or $\frac{12}{11}$ or 1.09(…)	M1	oe fraction
	their $\frac{11}{12} \times 100$ or $\frac{1100}{12}$ or their $\frac{12}{11} \times 100$ or $\frac{1200}{11}$	M1dep	oe fraction
	550	A1	
	Alternative method 4: sets up and solves an equation		
	$\frac{100}{x} = \frac{30}{6 \times 27.5}$	M1	any letter
	$(x =)\ 100 \div \frac{30}{6 \times 27.5}$	M1dep	oe
	550	A1	
	Additional Guidance		
	Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comments
16(a)	(Gradient of AC =) $\frac{-2-3}{7-(-1)}$	M1	oe
	$-\frac{5}{8}$ or -0.625	A1	oe
	$\frac{8}{5}$ or 1.6	A1ft	oe ft their $-\frac{5}{8}$ or their -0.625

Q	Answer	Mark	Comments
16(b)	$\frac{-1+7}{2}$ or 3 or $\frac{3-2}{2}$ or 0.5	M1	oe
	(3, 0.5)	A1	oe

Q	Answer	Mark	Comments
17(a)	Fully correct diagram	B3	B2 two or three correct B1 one correct
	Additional Guidance		
			B3

Q	Answer	Mark	Comments
17(b)	$\frac{12}{36} \times \frac{24}{35}$ or $\frac{288}{1260}$ or $\frac{8}{35}$	M1	oe
	$2 \times$ their $\frac{8}{35}$	M1dep	oe
	$\frac{16}{35}$ or 0.457(1…)	A1	oe fraction, decimal or percentage SC2 $\frac{2419}{4950}$ or 0.488(6…) or 0.4887 or 0.489
	Additional Guidance		
	SC2 is for using all 100 ice creams $\frac{59}{100} \times \frac{41}{99} \times 2 = \frac{2419}{4950}$		
	Decimals or percentages must be correctly truncated or rounded to at least 3sf throughout		

Q	Answer	Mark	Comments
18	12 ÷ 30 or 0.4 or 4 ÷ 50 or 0.08	M1	oe implied by one correct bar
	Bar from 190 to 220, height 0.4 and bar from 300 to 350, height 0.08	A1	
	0.2 × 40 or 8 or 0.7 × 30 or 21	M1	oe
	8 in $150 \leqslant v < 190$ row and 21 in $220 \leqslant v < 250$ row	A1	

Q	Answer	Mark	Comments
19	Valid criticism referring to the y-intercept	B1	eg 0.5 should be 1
	Valid criticism referring to the x-intercept	B1	eg curve should not touch the x-axis
	Additional Guidance		
	The graph will never reach zero		B1
	The line should not start at 0.5		B0
	The graph should not touch the axis		B0

Q	Answer	Mark	Comments
20	**Alternative method 1: uses *DEF*, then *DCF***		
	$DEF = 180 - x$	M1	may be seen on diagram
	$DCF = 180 - (180 - x)$ or $DCF = x$	M1dep	
	$y = x$ and M2 scored and all correct statements • angles on a straight line add to 180° • opposite angles in a cyclic quadrilateral add to 180° • vertically opposite angles are equal	A1	the underlined words must be seen as a minimum but 180 may be implied by a correct equation
	Alternative method 2: uses *DCF*, then *DEF*		
	$DCF = y$	M1	may be seen on diagram
	$DEF = 180 - y$	M1dep	
	$y = x$ and M2 scored and all correct statements • vertically opposite angles are equal • opposite angles in a cyclic quadrilateral add to 180° • angles on a straight line add to 180°	A1	the underlined words must be seen as a minimum but 180 may be implied by a correct equation

The mark scheme for question 20 continues on the next page

20 cont	**Alternative method 3: exterior angle of a cyclic quadrilateral**		
	$DCF = y$	M1	may be seen on diagram
	$FEG = y$	M1dep	
	$y = x$ and M2 scored and all correct statements • vertically <u>opposite</u> <u>angles</u> are <u>equal</u> • an exterior angle in a <u>cyclic quadrilateral</u> is equal to the opposite interior angle	A1	the underlined words must be seen as a minimum but 180 may be implied by a correct equation

Q	Answer	Mark	Comments
21(a)	**Alternative method 1: sets up $y = k \times \frac{1}{x^2}$**		
	$y = k \times \frac{1}{x^2}$	M1	oe equation eg $x^2y = k$ $y \propto \frac{1}{x^2}$ with no further correct work is M0
	$(k =)\ 32 \times 0.5^2$ or $(k =)\ 8$	M1dep	oe
	$y = \frac{8}{x^2}$	A1	oe equation eg $x^2y = 8$ 32×0.5^2 must be evaluated
	Alternative method 2: sets up $c \times y = \frac{1}{x^2}$		
	$c \times y = \frac{1}{x^2}$	M1	oe equation $y \propto \frac{1}{x^2}$ with no further correct work is M0
	$(c =)\ \frac{1}{32 \times 0.5^2}$ or $(c =)\ 0.125$	M1dep	oe
	$0.125 \times y = \frac{1}{x^2}$	A1	oe equation eg $y = \frac{1}{0.125 \times x^2}$ 32×0.5^2 must be evaluated do not accept rounded decimal values for c unless exact value seen previously
	Additional Guidance		
	Condone use of $\propto$ for $=$ for up to M2 eg Alt 1 $y = k \times \frac{1}{x^2}$ $k \propto 8$ $y \propto \frac{8}{x^2}$ (if this is the only working seen award M2A0)		M1 M1 A0

Q	Answer	Mark	Comments
21(b)	**Alternative method 1: if using alt 1 in (a)**		
	their $k \div 5^2$	M1	oe
	0.32 or $\frac{8}{25}$	A1ft	oe value
	Alternative method 2: if using alt 2 in (a)		
	$\frac{1}{\text{their } c \times 5^2}$	M1	oe
	0.32 or $\frac{8}{25}$	A1ft	oe value

Q	Answer	Mark	Comments
22(a)	**Alternative method 1: splits into triangle, rectangle and triangle**		
	$\frac{1}{2}$ × 2.5 × 50 or 62.5 or 2 × 50 or 100	M1	oe
	$\frac{1}{2}$ × 1.5 × 50 or 37.5	M1	oe estimate of area under the curve
	(their 62.5 + their 100 + their 37.5) ÷ 6	M1dep	oe dep on M2 their total distance ÷ 6
	[31, 35]	A1	M3 awarded and final answer [31, 35] with no errors
	Alternative method 2: splits into a trapezium and a triangle		
	$\frac{1}{2}$ × (2 + 4.5) × 50 or 162.5 or $\frac{1}{2}$ × (2 + 3.5) × 50 or 137.5	M1	oe trapezium to the left trapezium to the right
	$\frac{1}{2}$ × 1.5 × 50 or 37.5 or $\frac{1}{2}$ × 2.5 × 50 or 62.5	M1	oe estimate of area under the curve triangle on the left
	(their 162.5 + their 37.5) ÷ 6 or (their 137.5 + their 62.5) ÷ 6	M1dep	oe dep on M2 their total distance ÷ 6
	[31, 35]	A1	M3 awarded and final answer [31, 35] with no errors

The mark scheme for question 22(a) continues on the next page

22(a) cont	**Alternative method 3: whole thing is a trapezium**		
	$\frac{1}{2} \times (2 + 6) \times 50$ or 200	M2	oe eg 4×50 or 25×8 estimate of whole area under the graph
	their $200 \div 6$	M1dep	
	[31, 35]	A1	M3 awarded and final answer [31, 35] with no errors

Q	Answer	Mark	Comments
22(b)	Correct box ticked with suitable comment	B1ft	ft their approach in part (a) eg Overestimate ticked and triangle more than area under curve or Underestimate ticked and trapezium/rectangle is less than area under curve

Q	Answer	Mark	Comments
23	$3^2 + 6^2$ or 45 or $\sqrt{45}$	M1	oe
	$x^2 + y^2 = 45$	A1	

Q	Answer	Mark	Comments
24(a)	2.28943	B1	
	2.19523	B1ft	must be to 5 decimal places ft their x_2
	Additional Guidance		
	$x_2 = 2.19523$ $x_3 = 2.18212$		B0 B1ft
	$x_2 = 2.289428485$ $x_3 = 2.19523$		B0 B1
	$x_2 = 2.28942$ $x_3 = 2.19522$		B0 B0ft

Q	Answer	Mark	Comments
24(b)	2.17998	B1	must be to 5 decimal places