GCSE
MATHEMATICS
8300/2H

Higher Tier Paper 2 Calculator

Mark scheme

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19BG8300/2H/MS

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	$12x^3 + 20x^2$	B1	
	Additional Guidance		
2	10^6	B1	
	Additional Guidance		
3	$\frac{2}{3}$	B1	
	Additional Guidance		
4	$y = \frac{1}{x}$	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
5	720	B2	B1 at least 3 multiples of 120 (> 120) and at least 3 multiples of 144 (> 144) eg 240 360 480 and 288 432 576 or (120 =) 2 × 2 × 2 × 3 × 5 or (144 =) 2 × 2 × 2 × 2 × 3 × 3 or (Answer =) 2 × 2 × 2 × 2 × 3 × 3 × 5 or (Answer =) $2^4 \times 3^2 \times 5$ or (Answer =) any multiple of 720 (> 720) eg 1440 or 17 280

Additional Guidance	
Prime factor responses for B1 may be in index form eg (120 =) $3 \times 5 \times 2^3$	B1
Prime factor responses for B1 may be seen on a factor tree or a Venn diagram or in repeated division eg1 2 2 2 3 5 on a factor tree for 120 eg2 2 2 2 2 3 3 inside one circle on a Venn diagram	 B1 B1
For B1 allow some incorrect multiples if 3 correct of each eg1 240 380 480 720 900 (3 correct) and 288 432 576 868 (3 correct) eg2 Answer 1440 but some incorrect multiples seen	 B1 B1
Any multiple of 720 (> 720) given in unsimplified form eg1 $2^7 \times 3^3 \times 5$ eg2 2 × 2 × 2 × 2 × 2 × 5 × 3 × 3	 B1 B1
B1 can still be awarded even if subsequently works out HCF	
Answer 720 with some incorrect multiples seen	B2
For products of prime factors, ignore inclusion of × 1	

Question	Answer	Mark	Comments

6(a)	Positive	B1	accept +ve or +
	Additional Guidance		
	Ignore any reference to the strength of the correlation		
	As one jump increases so does the other so positive		B1
	As one jump increases so does the other		B0

6(b)	Straight line of best fit passing through (150, [504, 512]) and (180, [550, 558])	B1	accept if clear intention to draw a straight line ignore anything either side of the gates
	Correct reading $\pm\frac{1}{2}$ square for their straight line of best fit	B1ft	ft straight line with positive gradient accept if clear intention to draw a straight line ignore any working lines on their graph
	Additional Guidance		
	No line of best fit		B0B0ft
	Short straight line with positive gradient and correct reading $\pm\frac{1}{2}$ square for their line		B0B1ft
	Two lines of best fit, mark the line that leads to their answer		
	Two lines of best fit, no answer, apply the usual rules of choice		

Question	Answer	Mark	Comments
6(c)	Valid reason	B1	eg 195 cm is outside the range of values or cannot extrapolate
	Additional Guidance		
	Allow '195' or 'his jump' or 'it' to represent 195 cm		
	B1 responses - do **not** allow points/data/plots/results to be replaced by graph or line		
	195 exceeds the data		B1
	It is beyond/outside the data		B1
	195 is higher than 185		B1
	Nobody else jumped that high		B1
	His jump is more than the others		B1
	The correlation stops at 560		B1
	All the other points/data/plots/results are less than 195		B1
	The points/data/plots/results don't reach 195		B1
	The points/data/plots/results don't reach that far		B1
	The points/data/plots/results stop at 185		B1
	The pattern/trend/correlation may change after the points/data/plots/results		B1
	The pattern/trend/correlation may change		B0
	It doesn't fit the pattern/trend/correlation		B0
	Line is not long enough		B0
	No points at/near/around/close to 195		B0
	195 is anomalous or 195 is an outlier		B0
	Not enough data		B0
	This data is not on the graph		B0
	It is too different to the other points		B0
	Ignore extra statements that do not contradict a valid reason		

Question	Answer	Mark	Comments
7	**Alternative method 1**		
	110 ÷ 2 or 55 or 2 ÷ 110 or 0.018(1…) or 0.0182 or 44 ÷ 110 or 0.4 or 110 ÷ 44 or 2.5	M1	oe
	44 ÷ (110 ÷ 2) or 0.8 or $\frac{4}{5}$	M1dep	oe eg 2880 or calculation that would evaluate to 0.8 eg 2 ÷ 110 × 44 or 44 ÷ 110 × 2 or 2 ÷ (110 ÷ 44) or $\frac{110+44}{110\div 2} - 2$ or 2.8 – 2
	48	A1	
	Alternative method 2		
	110 ÷ 2 ÷ 60 or 0.916… or 0.917 or 0.92 or 2 × 60 ÷ 110 or 1.09(0…) or 1.091	M1	oe
	44 ÷ (110 ÷ 2 ÷ 60)	M1dep	oe calculation that would evaluate to 48 eg 44 × 2 × 60 ÷ 110
	48	A1	

Additional Guidance is on the next page

Question	Answer	Mark	Comments

	Additional Guidance	
7 cont	Ignore units for M marks eg 55 miles	M1
	Do not award A1 if premature approximation for 48 seen eg	
	(Alt 1) 0.018 × 44 = 0.8 Answer 48	M2A1
	(Alt 1) 0.018 × 44 = 0.792 and 0.792 × 60 = 47.52 Answer 48	M2A0
	(Alt 2) 44 ÷ 0.917 = 48	M2A1
	(Alt 2) 44 ÷ 0.917 = 47.9 Answer 48	M2A0
	(Alt 2) 44 × 1.09 = 48	M2A1
	(Alt 2) 44 × 1.09 = 47.96 Answer 48	M2A0
	48 followed by answer 2 h 48 min	M2A0
	48 followed by answer 168 min	M2A0
	Allow M1 even if not subsequently used	
	Alt 1 Working in seconds leading to 2880	M2

Question	Answer	Mark	Comments
8	$a = 7$	B2	B1 $3ax - 10a$ or $3ax = 21x$ or $3ax - 21x = 0$ or $3a = 21$ or $3a - 21 = 0$ or $21 \div 3$ oe or $-10a = 2b$ oe
	$b = -35$	B1ft	ft $-5 \times$ their a where $a \neq 0$
	Additional Guidance		
	Ignore collection error if correct expansion seen eg $3ax - 10a - 21x + 2b = 0$ (should be $-2b$)		B1
	Ignore incorrect simplification if correct expansion seen eg $3ax - 10a = -7ax$		B1
	Allow eg $a \times 3x$ for $3ax$		
	Allow eg $a3x$ for $3ax$		
	Embedded 7 with $a = 7$ not stated eg $7(3x - 10)$ or $7 \times 3x = 21x$ or $21 \div 7 = 3$		B1
	Allow B1 even if not subsequently used		
9	$\frac{180 - 56}{2}$ or 62	M1	oe may be on diagram
	180 + their 62 or 360 – 56 – their 62	M1dep	oe eg 62 + 62 + 118
	242	A1	
	Additional Guidance		
	62 seen even if not subsequently used		M1
	Answer (0)62		M1M0A0
	56 only		M0
	242 seen but answer given as 62		M1M0A0
	242 seen but then further work eg 360 – 242 and answer 118		M1M0A0

Question	Answer	Mark	Comments
10	**Alternative method 1**		
	21 – 17 or 17 – 21 or 17 + 4 or 21 – 4 or (difference is) 4 or (7th term =) 21 + 4 or 25 or (4th term =) 17 – 4 or 13	M1	may be seen as 17 21 4 allow (difference is) –4
	17 + (100 – 5) × 4 or 17 + 95 × 4 or 17 + 380 or 21 + (100 – 6) × 4 or 21 + 94 × 4 or 21 + 376 or 17 – 4 × 4 + 99 × 4 or 1 + 99 × 4 or 1 + 396 or 17 – 5 × 4 + 100 × 4 or –3 + 100 × 4 or –3 + 400	M1dep	must be using 4 oe calculation that would evaluate to 397 5th term + 95 × 4 6th term + 94 × 4 1st term + 99 × 4 0th term + 100 × 4
	397	A1	
	Alternative method 2		
	$4n$	M1	oe eg n × 4
	$4n$ – 3	A1	oe
	397	A1	

Additional Guidance is on the next page

Question	Answer	Mark	Comments

	Additional Guidance	
10 cont	Term to term rule described eg Add on 4 each time	M1
	$a + 5d = 21$, $a + 4d = 17$ only	M0
	Difference shown as 4 then eg $n + 4$	M1
	Only eg $n + 4$ or $3n + 4$	M0
	$4n - 3$ seen even if not subsequently used	M1A1
	$4n$ seen eg $4n + 13$ even if not subsequently used	M1
	Correct list going up in 4s stopping at 397	M1M1A1
	List going up in 4s with an error or not reaching 397	M1M0A0
	No subtraction seen and incorrect difference eg 17 21 (+3)	M0
	Alt 2 allow $n4$	M1
	$4n - 3 = 100$	M1A1A0
	Allow M1 even if not subsequently used	

Question	Answer	Mark	Comments
11	120 000 × 1.05 or 126 000	M1	oe eg 120 000 + 0.05 × 120 000 may be implied by eg 144 000
	120 000 × 1.05^4 or $\frac{583\,443}{4}$	M1dep	oe eg their 126 000 × 1.05 or 132 300 and their 132 300 × 1.05 or 138 915 and their 138 915 × 1.05
	145 860(.75) or 145 860.8(0) or 145 861 or 145 900 or 146 000	A1	if no value given implied by M2 seen and 150 000
	150 000	B1ft	ft any answer seen with > 2sf condone 150 000.00
	Additional Guidance		
	126 000 × 1.05^3		M1M1
	Answer only 145 860(.75) or 145 860.8(0) or 145 861 or 145 900 or 146 000		M1M1A1B0
	Answer only 150 000		Zero
	For year on year working allow rounding/truncation if method shown for up to M2A0B1ft eg 126 000 × 1.05 = 132 000 and 132 000 × 1.05 = 138 000 and 138 000 × 1.05 = 144 900 Answer 140 000		 M1 M1A0B1ft
	120 000, 126 000, 132 000, 138 000, 144 000 with no method shown does not imply truncation, this is just adding on 6 000 each year		M1M0A0
	120 000 + 4 × 0.05 × 120 000 or 120 000 + 0.2 × 120 000 implies M1		M1M0A0
	Misreads can score up to M2A0B1ft		
	Treat calculating 5 years as a misread but otherwise the wrong number of years eg 120 000 × 1.05^2 will score a maximum of M1M0A0B1ft		

Question	Answer	Mark	Comments
12	**Alternative method 1**		
	15^2 or 225 and $(16 \div 2)^2$ or 8^2 or 64	M1	oe
	$\sqrt{15^2 + (16 \div 2)^2}$ or $\sqrt{\text{their } 225 + \text{their } 64}$ or $\sqrt{289}$ or 17	M1dep	oe full trigonometric method leading to 17 scores M2 eg $\dfrac{15}{\sin\left(\tan^{-1}\dfrac{15}{8}\right)}$
	6 × their 17 + 3 × 16 or 102 + 48	M1dep	oe
	150	A1	SC2 $48 + 6\sqrt{161}$ or [124.08, 124.2]
	Alternative method 2		
	$(48 \div 2)^2$ or 24^2 or 576 and $(15 \times 3)^2$ or 45^2 or 2025	M1	oe eg $(16 \times 1.5)^2$ and $(3 \times 15)^2$
	$\sqrt{(48 \div 2)^2 + (3 \times 15)^2}$ or $\sqrt{\text{their } 576 + \text{their } 2025}$ or $\sqrt{2601}$ or 51	M1dep	oe full trigonometric method leading to 51 scores M2 eg $\dfrac{45}{\sin\left(\tan^{-1}\dfrac{15}{8}\right)}$ or $\dfrac{45}{\sin\left(\tan^{-1}\dfrac{45}{24}\right)}$
	2 × their 51 + 3 × 16 or 102 + 48	M1dep	oe
	150	A1	SC2 $48 + 6\sqrt{161}$ or [124.08, 124.2]
	Additional Guidance		
	$15^2 - 8^2$ or $45^2 - 24^2$		M1M0M0A0 (unless SC2 scored)
	Allow 61.9(2…) or 61.93 or 62 for $\tan^{-1}\dfrac{15}{8}$ but do not award A1 if premature approximation seen		

Question	Answer	Mark	Comments
13(a)	15 × 24 or 360 and 40 × 76 or 3040 and 55 × 52 or 2860 and 75 × 48 or 3600 or 9860	M1	allow one incorrect midpoint
	(their 360 + their 3040 + their 2860 + their 3600) ÷ 200 or 9860 ÷ 200	M1dep	condone bracket error seen eg 360 + 3040 + 2860 + 3600 ÷ 200
	49.3	A1	accept 49 if full working shown using correct midpoints
	Additional Guidance		
	Four values or products with three correct from 360, 3040, 2860 and 3600 implies the first mark and could be used to score up to M2		
	Correct products seen in the table or working but a different method shown in the working lines eg 200 ÷ 4		M0
	Ignore attempts to convert to minutes and seconds after 49.3 seen eg 49 min 18 s or 49 min 30 s		
	49.3 in working with answer $30 \leqslant t < 50$		M2A0

Question	Answer	Mark	Comments
13(b)	24 ÷ 30 or 0.8 or 76 ÷ 20 or 3.8 or 52 ÷ 10 or 5.2 or 48 ÷ 30 or 1.6 or four frequency densities in correct proportion	M1	implied by a correct bar eg 8 and 38 and 52 and 16
	At least three of 0.8 and 3.8 and 5.2 and 1.6	M1dep	implied by at least three bars in correct proportion
	At least 3 bars in correct proportion with matching scale on vertical axis or at least 3 bars in correct proportion with a matching key	M1dep	
	Fully correct histogram with scale on vertical axis or a key	A1	$\pm\frac{1}{2}$ small square ignore frequency polygon if included
	Additional Guidance		
	Allow up to M2 even if not subsequently used		
	Correct bars must have correct widths		

Question	Answer	Mark	Comments
14(a)	$\frac{1}{2}(13 + 10) \times 12$ or 138 or $\frac{1}{2} \times 10 \times 8$ or 40	M1	oe
	$\frac{1}{2}(13 + 10) \times 12$ or 138 and $\frac{1}{2} \times 10 \times 8$ or 40 or 178	M1dep	oe
	25 ÷ (their 138 + their 40)	M1dep	oe
	0.14(0…)	A1	
	Additional Guidance		

Question	Answer	Mark	Comments
14(b)	less than and valid reason	B2	eg less than and you should be dividing by a bigger number or less than and the (actual) area is bigger B1 less than
	Additional Guidance		
	If no box is ticked, condone if less than is clearly stated in working lines		
	Wrong box or > 1 box ticked		B0
	less than and he has not included all the base		B2
	less than and it doesn't cover 100% of the base		B2
	less than and it doesn't include the parts outside the areas		B2
	less than and the area is an underestimate		B2
	less than and it is an underestimate		B1
	less than and it is only an estimate		B1
	less than and the answer to (a) is not the exact area		B1
15	$w = \sqrt[3]{y^2}$	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
16(a)	$\frac{a}{100} \times b = \frac{b}{100} \times a$	B1	oe eg both are equal to $\frac{ab}{100}$
	Additional Guidance		
	$ab = ba$		B0
	Only numerical example(s)		B0
16(b)	No and valid reason	B1	eg No and it should be (160% of 40 =) 40% of 160 or No and it should be 60% of 140 (= 140% of 60) or No and 160 ≠ 60 or No and 40 ≠ 140 or No and 64 and 84
	Additional Guidance		
	If neither box is ticked condone if No is clearly stated in working lines		
	Yes or both boxes ticked		B0
	No and the as aren't the same		B1
	No and the bs aren't the same		B1
	No and 160 ≠ 140		B0
	No and 40 ≠ 60		B0
	No and a values change from 160 to 140		B0
	No and b values change from 40 to 60		B0
	No and 96 and 84		B0
	No and they give different answers		B0

Question	Answer	Mark	Comments
17(a)	12	B2	B1 (1 – 0.85) × 80 or 0.15 × 80 or 0.85 × 80 or 68
	Additional Guidance		
	For B1 allow oe calculations eg 17 × 4		B1
17(b)	25	B2	B1 0.71 × 80 or 56.8 or 56 or (1 – 0.71) × 80 or 0.29 × 80 or 23.2 or 24 or (0.71 – 0.3875) × 80 or 0.3225 × 80 or 25.8
	Additional Guidance		
	For B1 allow oe calculations eg $\left(0.71-\frac{31}{80}\right)\times 80$		B1
	Answer only 26		B0

Question	Answer	Mark	Comments
18(a)	**Alternative method 1** large rectangle – 4 squares		
	$x(x + 5)$	M1	
	$x^2 + 5x – 400 = 1000$ or $x^2 + 5x – 400 – 1000 = 0$ or $x^2 + 5x = 1000 + 400$ with M1 seen	M1dep	400 may be seen as 4×10^2 or 4×100 oe equation with brackets expanded and 400 and 1000 seen
	$x^2 + 5x – 1400 = 0$ with M2 seen	A1	must have = 0
	Alternative method 2 three vertical rectangles		
	$(x + 5)(x – 20)$ or $(2 \times)10(x – 15)$	M1	$(x – 20)$ may be seen as $(x – 10 – 10)$ $(x – 15)$ may be seen as $(x + 5 – 10 – 10)$
	$x^2 – 20x + 5x – 100 + 20x – 300 = 1000$ or $x^2 – 15x – 100 + 20x – 300 = 1000$ with M1 seen	M1dep	oe equation with brackets expanded and 100 and 300 and 1000 seen allow 150 seen twice for 300
	$x^2 + 5x – 1400 = 0$ with M2 seen	A1	must have = 0

Mark scheme and Additional Guidance continue on the next page

Question	Answer	Mark	Comments

18(a) cont	**Alternative method 3** three horizontal rectangles		
	$x(x - 15)$ or $(2 \times)10(x - 20)$	M1	$(x - 20)$ may be seen as $(x - 10 - 10)$ $(x - 15)$ may be seen as $(x + 5 - 10 - 10)$
	$x^2 - 15x + 20x - 400 = 1000$ with M1 seen	M1dep	oe equation with brackets expanded and 400 and 1000 seen allow 200 seen twice for 400
	$x^2 + 5x - 1400 = 0$ with M2 seen	A1	must have = 0
	Alternative method 4 central rectangle + four outer rectangles		
	$(x - 15)(x - 20)$ or $(2 \times)10(x - 15)$ or $(2 \times)10(x - 20)$	M1	$(x - 20)$ may be seen as $(x - 10 - 10)$ $(x - 15)$ may be seen as $(x + 5 - 10 - 10)$
	$x^2 - 20x - 15x + 300 + 20x - 300 + 20x - 400 = 1000$ or $x^2 - 35x + 300 + 20x - 300 + 20x - 400 = 1000$ with M1 seen	M1dep	oe equation with brackets expanded and 300 seen twice and 400 and 1000 seen allow 150 seen twice for one of the 300s allow 200 seen twice for 400
	$x^2 + 5x - 1400 = 0$ with M2 seen	A1	must have = 0
	Additional Guidance		
	If 1st M1 seen award M1 even if expression is not subsequently used		
	For M1 allow multiplication signs eg $x \times (x + 5)$		M1
	$x(x + 5) = x^2 + 5x$ 1000 + 400 = 1400 $x^2 + 5x = 1400$ (previous line shows 1000 and 400) $x^2 + 5x - 1400 = 0$		M1 M1 A1
	$x(x + 5) = x^2 + 5x$ $x^2 + 5x = 1400$ (equation does not have 1000 and 400) $x^2 + 5x - 1400 = 0$		M1 M0 A0
	Only equation seen is $x^2 + 5x - 1400 = 0$ the maximum mark is M1		

Question	Answer	Mark	Comments
18(b)	No and valid reason	B1	eg No and x cannot be negative (in this context)
	Additional Guidance		
	If neither box is ticked condone if No is clearly stated in working lines		
	Yes or both boxes ticked		B0
	Allow 'it' to represent x		
	No and x is (only) 35		B1
	No and it cannot be –40		B1
	No and the width would be negative		B1
	No and the width should be positive		B1
	No she put –40		B1
	No and you can't have two answers		B0
	No and the answers are too big		B0
	No and it should be 40 (and –35)		B0
19	periodic	B1	
	Additional Guidance		
20	(7, 30)	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
21	**Alternative method 1**		
	$n-1$ and n and $n+1$	M1	oe eg $(n-1)n(n+1)$ or $n(n-1)(n+1)$
	$n(n^2+n-n-1)$ with M1 seen or $n(n^2-1)$ with M1 seen or $(n^2-n)(n+1)$ with M1 seen or $(n^2+n)(n-1)$ with M1 seen	M1dep	
	$n^3-n^2+n^2-n+n$ with M2 seen or n^3-n+n with M2 seen	M1dep	
	n^3 with M3 seen	A1	
	Alternative method 2		
	x and $x+1$ and $x+2$	M1	oe eg $x(x+1)(x+2)$ or $(x+1)x(x+2)$
	$(x^2+x)(x+2)$ with M1 seen or $(x^2+2x)(x+1)$ with M1 seen or $x(x^2+2x+x+2)$ with M1 seen or $x(x^2+3x+2)$ with M1 seen	M1dep	
	$x^3+3x^2+2x+x+1$ with M2 seen or $x^3+x^2+2x^2+2x+x+1$ with M2 seen	M1dep	
	x^3+3x^2+3x+1 and $(x+1)^3$ with M3 seen	A1	allow x^3+3x^2+3x+1 and n^3 with M3 seen if $n=x+1$ stated
	Additional Guidance		
	Only numerical example(s)		Zero
	Condone use of any letter eg N		

Question	Answer	Mark	Comments
22	The gradient of the chord from *A* to *B*	B1	
	Additional Guidance		

23(a)	Valid criticism	B1	eg the scale factor should be 4 or surface area is 248 cm^2
	Additional Guidance		
	sf = 2^2		B1
	62 × 4		B1
	62 × 2^2		B1
	The area is 248 (ignore units)		B1
	Should be 2 × 10 × 6 + 2 × 10 × 4 + 2 × 6 × 4		B1
	Condone It should be 4		B1
	4		B0
	He should have multiplied all lengths by 2		B0
	It should be 10 × 4 × 6		B0

Question	Answer	Mark	Comments
23(b)	**Alternative method 1**		
	$\sqrt[3]{\frac{125}{8}}$ or $\frac{5}{2}$ or $\sqrt[3]{\frac{8}{125}}$ or $\frac{2}{5}$	M1	oe eg $\sqrt[3]{15.625}$ or 2.5 or $\sqrt[3]{0.064}$ or 0.4
	$5 \times \sqrt[3]{\frac{125}{8}}$ or $5 \div \sqrt[3]{\frac{8}{125}}$	M1dep	oe
	12.5 or $12\frac{1}{2}$ or $\frac{25}{2}$	A1	
	Alternative method 2		
	$5 \times 3 \times 2 \times \frac{125}{8}$ or 468.75	M1	oe eg $5 \times 3 \times 2 \times 15.625$ or $30 \times \frac{125}{8}$
	$x \times \frac{3x}{5} \times \frac{2x}{5}$ = their 468.75	M1dep	oe eg $\frac{6}{25}x^3$ = their 468.75
	12.5 or $12\frac{1}{2}$ or $\frac{25}{2}$	A1	
	Additional Guidance		
	$\sqrt{\frac{125}{8}}$ or $\sqrt{\frac{8}{125}}$		M0M0A0
	$x \times \frac{x}{\frac{5}{3}} \times \frac{x}{\frac{5}{2}}$ = their 468.75		M1M1
	Allow 1.66 or 1.67 for $\frac{5}{3}$ eg $x \times \frac{x}{1.66} \times \frac{x}{2.5}$ = their 468.75		M1M1

Question	Answer	Mark	Comments
24	**Alternative method 1**		
	–2 used for value of x	M1	
	–2 used for value of x and 13 used for value of y	M1dep	
	15	A1	
	Alternative method 2		
	–2 used for x value	M1	
	$11 - 2 \times -2$	M1dep	oe
	15	A1	
	Additional Guidance		
	Answer only of 13		M0M0A0
	Answer only of –2		M0M0A0
	13 used for value of $y - x$ does not score 2nd M1		

Question	Answer	Mark	Comments
25	$CED = 4x$ or $ACB = 180 - y - (90 - x)$	M1	may be on diagram
	$CED = 4x$ and $DCE = \frac{180 - 4x}{2}$ or $ACB = 180 - y - (90 - x)$ and $DCE = 180 - y - (90 - x)$	M1dep	may be on diagram allow $DCE = ACB$ for $DCE = 180 - y - (90 - x)$
	M2 seen and $y + 90 - x + \frac{180 - 4x}{2} = 180$ and $y = 3x$ or M2 seen and $\frac{180 - 4x}{2} = 180 - y - (90 - x)$ and $y = 3x$	A1	M2 seen and $2(180 - y - (90 - x)) + 4x = 180$ and $y = 3x$
	M2A1 seen and all reasons given	A1	eg alt(ernate) seg(ment theorem) and (base angles of) isos(celes) triangle (are equal) and (vertically) opp(osite) angles (are equal) and angles in a triangle (sum to 180°)

Additional Guidance is on the next page

Question	Answer	Mark	Comments

	Additional Guidance	
25 cont	Allow $CE = DE$ for the reason (base angles of) isos(celes) triangle (are equal)	
	Allow $90 - y + x$ or $180 - y - 90 + x$ for $180 - y - (90 - x)$	
	Allow $90 - 2x$ for $\frac{180 - 4x}{2}$	
	Allow clear indication of angles eg allow *E* for *CED* do not allow *C* for *ACB* unless seen on diagram	
	Assuming $y = 3x$	Zero
	For 1st A1, allow equivalent equations eg For $2(180 - y - (90 - x)) + 4x = 180$ allow $2(180 - y - (90 - x)) = 180 - 4x$	

Question	Answer	Mark	Comments
26	**Alternative method 1**		
	$P = kQ^2$ or $1.25 = k \times 0.5^2$ or $Q = \frac{c}{R}$ or $0.5 = \frac{c}{6}$	M1	oe
	$k = \frac{1.25}{0.5^2}$ or $k = 5$ or $P = 5Q^2$ or $c = 0.5 \times 6$ or $c = 3$ or $Q = \frac{3}{R}$	M1	oe
	$P = 5Q^2$ and $Q = \frac{3}{R}$ or $k = 5$ and $c = 3$	A1	oe
	$0.8 = \text{their } 5 \times \left(\frac{\text{their } 3}{R}\right)^2$ or $(R =) \sqrt{\frac{\text{their } 5 \times (\text{their } 3)^2}{0.8}}$	M1	ft their equations of the form $P = kQ^2$ and $Q = \frac{c}{R}$ oe eg $(Q =) \sqrt{\frac{0.8}{\text{their } 5}}$ or $Q = 0.4$ and $(R =) \frac{\text{their } 3}{\text{their } 0.4}$
	7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$	A1ft	ft their equations of the form $P = kQ^2$ and $Q = \frac{c}{R}$ with 3rd M1 scored

Mark scheme and Additional Guidance continue on the next page

Question	Answer	Mark	Comments
26 cont	**Alternative method 2**		
	$P = \frac{k}{R^2}$ or $1.25 = \frac{k}{6^2}$	M1	oe
	$k = 1.25 \times 6^2$	M1dep	oe
	$P = \frac{45}{R^2}$ or $k = 45$	A1	oe
	$0.8 = \frac{\text{their } 45}{R^2}$ or $(R =) \sqrt{\frac{\text{their } 45}{0.8}}$	M1	oe ft their equation of the form $P = \frac{k}{R^2}$
	7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$	A1ft	ft their equation of the form $P = \frac{k}{R^2}$ with 3rd M1 scored
	Additional Guidance		
	Allow k and c to be any letters, including using both as k in Alt 1		
	Alt 1 $kP = Q^2$ leading to k = 0.2		M1M1
	Alt 2 $kP = \frac{1}{R^2}$ leading to $k = \frac{1}{45}$ (allow 0.022…)		M1M1A1

Question	Answer	Mark	Comments
27	$\sqrt[3]{13}$ or 2.35(1…)	M1	$\sqrt[3]{6+7}$ or $\sqrt[3]{3\times2+7}$
	2.413(…) or 2.4238… or 2.424 or 2.4256… or 2.4259…	M1dep	
	2.426	A1	
	Additional Guidance		
	Answer 2.426 (eg from using starting value of 1)		M2A1
	Answer only 2.425		M0M0A0
	$\sqrt{13}$		M0M0A0
	Condone $2 = \sqrt[3]{13}$ etc		