GCSE
MATHEMATICS
8300/1H

Higher Tier Paper 1 Non-Calculator

Mark scheme

June 2024

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 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.

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 $a \leqslant$ 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.

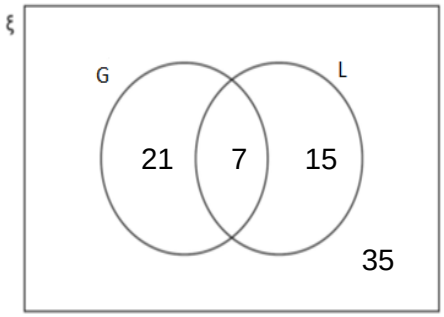
Q	Answer	Mark	Comments
1	$(12^2 =)\ 144$ or $(\sqrt{36} =)\ 6$ or $(\frac{1}{3} \times \sqrt{36} =) 2$	M1	implied by correct answer accept $(\sqrt{36} =)\ \pm 6$ or $(\frac{1}{3} \times \sqrt{36} =) \pm 2$
	$(12^2 =)\ 144$ and $(\frac{1}{3} \times \sqrt{36} =) 2$	M1dep	implied by correct answer $144 \times \frac{1}{2}$ or $\frac{432}{6}$ oe fraction implies M1M1 accept $(\frac{1}{3} \times \sqrt{36} =) \pm 2$
	72	A1	accept ± 72 SC2 288
	Additional Guidance		
	-72 only		M1M1A0
	Condone missing brackets if recovered eg $12^2 \div \frac{1}{3} \times 6$ with answer 72		M1M1A1
	$\frac{144}{\frac{1}{3} \times 6}$ with no further correct work		M1M0A0
	Using a decimal for $\frac{1}{3}$ must be recovered		

Q	Answer	Mark	Comments
2	[31, 34]	B1	

Q	Answer	Mark	Comments
3	$\begin{pmatrix} 3 \\ -7 \end{pmatrix}$	B1	
	Additional Guidance		
	Condone + sign and/or fraction line eg $\begin{pmatrix} +3 \\ -7 \end{pmatrix}$	B1	
	(3, –7)	B0	

Q	Answer	Mark	Comments
4(a)	8350	B1	

Q	Answer	Mark	Comments
4(b)	8449	B1	

Q	Answer	Mark	Comments
5(a)	Fully correct diagram  	B3	B2 two or three correct numbers in correct positions B1 one correct number in correct position
	Additional Guidance		
	Only mark the numbers in the diagram		

Q	Answer	Mark	Comments
5(b)	$\frac{7}{22}$ or 0.318(…) or 31.8(…)%	B1ft	oe fraction, decimal or percentage correct or ft their diagram
	Additional Guidance		
	Answer as a ratio with or without $\frac{7}{22}$ seen	B0	
	Answer in words with $\frac{7}{22}$ seen	B1	
	Answer in words without $\frac{7}{22}$ seen	B0	
	$\frac{7}{22}$ seen with incorrect conversion to decimal or percentage	B1	
	Ignore any attempt to simplify or convert their $\frac{7}{22}$	B1ft	

Q	Answer	Mark	Comments
6a	At least 3 points correctly plotted	M1	$\pm\frac{1}{2}$ square
	All 4 points correctly plotted and joined with straight lines	A1	$\pm\frac{1}{2}$ square lines may be dashed
	Additional Guidance		
	Mark intention for straight lines		
	Condone one continuous, smooth curve		
	Ignore the graph before 2015 and after 2022		
	Ignore a line of best fit		

Q	Answer	Mark	Comments
6b	[82, 90]	B1	
	Additional Guidance		
	Answer in range with or without working, with no graph or incorrect graph		B1

Q	Answer	Mark	Comments
7a	Correct statement	B1	eg she used the height instead of the slant height or she used the vertical height or she used 12 (instead of 13)
	Additional Guidance		
	Check diagram		
	For 'vertical' accept anything that implies she has used the wrong height		
	Condone 'length' to mean 'height' or 'slant height'		
	12 or 13 circled on the diagram must be accompanied by a supporting statement		
	Indicates '12' in the calculation		B1
	She should have done $\pi \times 5 \times 13$		B1
	It should be 65π		B1
	She used the wrong height / the (value of) l is wrong		B1
	She hasn't used the slant height (she used the (vertical) height)		B1
	She hasn't used the 13		B1
	She hasn't used the 13 and should be $5 \times 12 \times 13 \times \pi$		B0
	The multiplication used the wrong number(s)		B0
	She hasn't used a value for π		B0
	An incorrect statement with a correct statement eg she used 13 instead of 12 and didn't square the radius		B0

Q	Answer	Mark	Comments
7b	$\pi \times 5 \times 5$ or 25π or $3 \times 5 \times 5$	M1	oe accept [3.14, 3.142] or $\frac{22}{7}$ for π
	75	A1	
	Additional Guidance		
	$\pi 25$		M1

Q	Answer	Mark	Comments
7c	'More than' indicated or implied by statement and valid reason	B1	eg valid reasons 3.14 is greater (than 3) Beth's number is bigger (than Adam's) (the correct answer is) 78.5 (with their answer to (b) less than 78.5)
	Additional Guidance		
	If calculations are used, the outcomes must be correct		
	Accept 78 or 79 for 78.5 unless from incorrect working		
	'Less than' indicated		B0
	Do not penalise use of the same incorrect formula in (b) and (c) eg $3 \times 10 = 30$ in (b) and $3.14 \times 10 = 31.4$ in (c) with 'More than' ticked		B1
	Ignore a non-contradictory reason with a correct reason eg 3.14 is bigger than 3 and nearer the true value of pi		B1
	Acceptable reasons		
	Adam has rounded (pi) down / Adam only used 3		B1
	There is an extra 0.14 to multiply by		B1
	Her number has decimal places		B1
	Her number is to more significant figures		B1
	Non-acceptable reasons		
	3.14 will give a bigger answer / 3.14 is more accurate		B0

Q	Answer	Mark	Comments
8	$7x - 4x$ or $3x$ or $4x - 7x$ or $-3x$ or $-22 - 29$ or -51 or $22 + 29$ or 51	M1	
	$3x = 51$ or $-3x = -51$	A1	$\frac{51}{3}$ or $\frac{-51}{-3}$ implies M1A1 implied by correct answer
	17	A1ft	ft M1A0 from an equation of the form $\pm 3x = a$ or $bx = \pm 51$
	Additional Guidance		
	Trial and improvement scores 0 or 3		
	If a follow through answer does not simplify to an integer, accept it as a fraction, mixed number or decimal to at least 1dp. eg from $3x = 7$ accept $\frac{7}{3}$ or $2\frac{1}{3}$ or 2.3 or better Ignore any attempt to convert a correct ft fraction		M1A0A1ft
	Embedded answer		M1A1A0

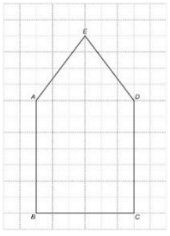
Q	Answer	Mark	Comments
9	$\frac{26(.0)}{16.4}$	M1	oe eg $\frac{13}{8.2}$ or $1\frac{9.6}{16.4}$
	$\frac{260}{164}$ or $1\frac{96}{164}$	A1	oe with no decimals eg $\frac{130}{82}$ or $\frac{2600}{1640}$ implied by correct answer
	$\frac{65}{41}$ or $1\frac{24}{41}$	B1ft	ft correct simplification of their fraction using the digits 26 and 164 SC2 $\frac{41}{65}$ SC1 $\frac{65}{106}$ (total area as denominator)
	Additional Guidance		
	Ignore units		
	Ignore an incorrect conversion of $\frac{65}{41}$ to a mixed number		M1A1B1
	$\frac{26(.0)}{16.4} = \frac{2600}{164} = \frac{650}{41}$		M1A0B1ft

Q	Answer	Mark	Comments
10a	Line joining open circles above, on or below –2 and 4	B1	condone arrows on a correct line with open circles
	Additional Guidance		
	Mark intention		
	If the student has drawn the circles on the line, they must have drawn their own line connecting the circles		
	Closed circle(s)		B0

Q	Answer	Mark	Comments
10b	$5y \geqslant 11 - 14$ or $5y \geqslant -3$ or $14 - 11 \geqslant -5y$ or $3 \geqslant -5y$ or $y + \frac{14}{5} \geqslant \frac{11}{5}$ or $-\frac{3}{5}$	M1	oe fractions or decimals may be seen in an equation or inequality
	$y \geqslant -\frac{3}{5}$ or $-\frac{3}{5} \leqslant y$	A1	oe fraction or decimal for $-\frac{3}{5}$
	Additional Guidance		
	Allow use of other inequality signs or = if recovered		
	Accept any letter for y		
	Condone $\frac{-3}{5}$ or $\frac{3}{-5}$ for $-\frac{3}{5}$		
	Ignore any attempt to convert $-\frac{3}{5}$ to a decimal		
	$y \geqslant -\frac{3}{5}$ in working and $-\frac{3}{5}$ on answer line		M1A0

Q	Answer	Mark	Comments
11	Enlarge(ment)	B1	
	$\frac{1}{2}$	B1	oe condone half
	(1, –7)	B1	condone missing bracket(s)
	Additional Guidance		
	For the third mark, a vector on its own does not imply a translation		
	Do not accept halved or half the size		
	Multiple transformations stated or implied		B0B0B0

Q	Answer	Mark	Comments
12	$2 \times 12 \times \pi$ or 24π or $\frac{60}{360}$ or division by 6	M1	oe accept [3.14, 3.142] or $\frac{22}{7}$ for π accept use of 0.17 or better for $\frac{1}{6}$
	$\frac{60}{360} \times 2 \times 12 \times \pi$	M1dep	oe eg $\frac{24\pi}{6}$
	4π	A1	condone $\pi 4$
	Additional Guidance		
	Answer 24π from $\pi \times 12^2 \times \frac{60}{360}$ scores M1 for $\frac{60}{360}$		M1M0A0

Q	Answer	Mark	Comments
13	Fully correct diagram with all these 6 conditions met • Line length 6 cm from *B* • Line perpendicular to *AB* from *B* • Line length 7 cm parallel to *AB* • Area of pentagon = 54 cm^2 • Pentagon has exactly one line of symmetry • Labelled pentagon	B4	B3 5 conditions met B2 4 conditions met B1 3 conditions met condone label *E* missing
	Additional Guidance		
	Mark intention		
	Ignore any lines inside the shape eg lines of symmetry		
	A diagram that is not a pentagon can only meet the first 3 conditions		B0 or B1
			B4

Q	Answer	Mark	Comments
14	**Alternative method 1: elimination**		
	at least one correct equation	M1	eg $4x + 3y = 4.7(0)$ or $5x + y = 4.5(0)$ or $15x + 3y = 13.5(0)$ or $9x + 4y = 9.2(0)$ may work in pounds or pence any letters
	correctly multiplies one or two correct equations to equate coefficients of x or y	M1dep	eg $4x + 3y = 4.7(0)$ and $15x + 3y = 13.5(0)$ or $20x + 15y = 23.5(0)$ and $20x + 4y = 18.(00)$
	correctly adds or subtracts correct equations to eliminate one variable	M1dep	eg $11x = 8.8(0)$ or $11y = 5.5(0)$ may be implied by one correct value of x or y with M2 scored
	chocolate bar £0.80 and packet of mints £0.50 or chocolate bar 80p and packet of mints 50p	A1	correct money notation condone £0.80p and £0.50p

Question 14 continues on the next page

14 cont	**Alternative method 2: substitution**		
	$4x + 3y = 4.7(0)$ or $5x + y = 4.5(0)$ or $15x + 3y = 13.5(0)$ or $9x + 4y = 9.2(0)$	M1	oe may work in pounds or pence any letters
	correctly makes x or y the subject of a correct equation	M1dep	eg $x = \frac{4.7(0) - 3y}{4}$ or $x = \frac{4.5(0) - y}{5}$ or $y = \frac{4.7(0) - 4x}{3}$ or $y = 4.5(0) - 5x$
	correctly substitutes to eliminate a variable	M1dep	eg $5\frac{(4.7(0) - 3y)}{4} + y = 4.5(0)$ or $4\frac{(4.5(0) - y)}{5} + 3y = 4.7(0)$ or $5x + \frac{4.7(0) - 4x}{3} = 4.5(0)$ or $4x + 3(4.5(0) - 5x) = 4.7(0)$ may be implied by one correct value of x or y with M2 scored
	chocolate bar £0.80 and packet of mints £0.50 or chocolate bar 80p and packet of mints 50p	A1	correct money notation condone £0.80p and £0.50p
	Additional Guidance		
	Up to M3 may be awarded for correct work with no answer or incorrect answer if this is seen amongst multiple attempts		
	Condone multiple letters in equations eg cb for x		
	Trial and improvement is 0, 3 (incorrect money notation) or 4 (fully correct)		
	Final answer chocolate bar £0.8 and packet of mints £0.5		M3A0
	Final answer chocolate bar 0.80p and packet of mints 0.50p		M3A0

Q	Answer	Mark	Comments
15(a)	14 and 15	B1	either order
	Additional Guidance		
	Ignore incorrect calculations		
	Answer 14^2 and 15^2		B0

Q	Answer	Mark	Comments
15(b)	2^7 or 128 or 7^3 or 343 or $(5\times)\sqrt[3]{1\,000\,000}$ or $(5\times)\,100$ or 500	M1	
	At least two of 128, 343 and 500 or 471	A1	
	471 and 500	A1	

Q	Answer	Mark	Comments
16	A correct comparison of the average age of the two clubs	B1	eg the average (age) of the cyclists was higher/older the median (age) of the swimming club was lower/younger, (so the average was lower/younger)
	A correct comparison of the consistency of the ages of the two clubs	B1	eg the cycling club has more consistent ages the interquartile range of the swimming club was higher, so they were less consistent in age
	Additional Guidance		
	Statements must be comparisons eg1 (the average age at) the cycling club was higher eg2 (the average age at) the cycling club was high		B1 B0
	Statements reversed		B0
	Do not allow incorrect values supporting statements		
	Ignore non-contradictory statements with correct statements		
	Average age statements		
	The swimming club are (8.5 years) younger (on average)		B1
	Cycling club members are (8.5 years) older (on average)		B1
	Younger people prefer swimming (to cycling)		B1
	Young people prefer swimming (to cycling)		B0
	Average age has 8.5 years difference		B0
	The cycling club has more older people		B0

Additional guidance for this question continues on the next page

Q	Additional Guidance cont	
	Consistency statements	
	The cycling club is more consistent / has better consistency	B1
	There is a smaller (interquartile) range for cycling, so it's more consistent	B1
	Ages of the cycling club are closer together	B1
	Consistency at the cycling club is bigger	B1
	Consistency at the cycling club is smaller	B0
	More people are in the same age group in the cycling club	B0
	The difference in interquartile range is 2.7	B0
	The swimming club had a higher (interquartile) range	B0
	The swimming club had a higher range of ages	B0
	More of an age gap / age range in the swimming club than the cycling club	B0

Q	Answer	Mark	Comments
17	**Alternative method 1: multiplies by x first**		
	$xy = 3x + 7$	M1	allow yx for xy throughout
	$xy - 3x = 7$ or $3x - xy = -7$	M1dep	oe collection of terms
	$x(y - 3) = 7$ or $x(3 - y) = -7$ or $\frac{7}{y-3}$ or $\frac{-7}{3-y}$	M1dep	
	$x = \frac{7}{y-3}$ or $x = \frac{-7}{3-y}$	A1	oe in the form $x =$ may have brackets on the denominator
	Alternative method 2: splits up the fraction first		
	$y = 3 + \frac{7}{x}$ or $y - \frac{7}{x} = 3$	M1	allow $\frac{3x}{x}$ for 3
	$y - 3 = \frac{7}{x}$ or $3 - y = -\frac{7}{x}$	M1dep	
	$\frac{1}{y-3} = \frac{x}{7}$ or $x(y - 3) = 7$ or $x(3 - y) = -7$ or $\frac{7}{y-3}$ or $\frac{-7}{3-y}$	M1dep	
	$x = \frac{7}{y-3}$ or $x = \frac{-7}{3-y}$	A1	oe in the form $x =$ may have brackets on the denominator

Additional guidance for this question is on the next page

17 cont	**Additional Guidance**	
	Up to M2 may be awarded for correct work with no answer or incorrect answer if this is seen amongst multiple attempts	
	$\frac{7}{y-3}$ on answer line with $x = \frac{7}{y-3}$ in working	M3A1
	Allow the equation with x on the right, eg $\frac{7}{y-3} = x$	M3A1
	Condone $x = 7/y - 3$ if not from incorrect working	M3A1
	Allow appropriate × or ÷ signs throughout for up to M3	

Q	Answer	Mark	Comments
18	$x^2 + y^2 = 6^2$ or $x^2 + y^2 = 36$	B1	oe equation
	Additional Guidance		
	$x^2 + y^2 = 6^2$ followed by an incorrect evaluation of 6^2		B1
	Condone $x^2 + y^2 = r^2$ and $r = 6$		B1

Q	Answer	Mark	Comments
19	**Alternative method 1: expressing C in terms of A**		
	$(C =) \frac{5}{2}A$	M1	oe eg $(C =) A + 1.5A$ or $(C =) 2.5A$
	$\left(\frac{C}{B} =\right) \frac{\frac{5}{2}A}{\frac{7}{4}A}$	M1dep	oe fraction with A on numerator and denominator eg $\left(\frac{C}{B} =\right) \frac{2.5A}{1.75A}$ or $\frac{5}{2}A \div \frac{7}{4}A$
	$\left(\frac{C}{B} =\right) \frac{\frac{5}{2}}{\frac{7}{4}}$ or $14C = 20B$	M1dep	oe fraction with A eliminated eg $\left(\frac{C}{B} =\right) \frac{2.5}{1.75}$ oe method to eliminate A
	$\frac{10}{7}$ or $1\frac{3}{7}$	A1	oe fraction SC3 $\frac{7}{10}$ oe fraction with A eliminated SC2 $\frac{6}{7}$ oe fraction with A eliminated
	Alternative method 2: using a value for A		
	Chooses a value for A works out the correct value of B or C	M1	eg $A = 100$ and $B = 175$ or $A = 20$ and $C = 50$
	Chooses a value for A and works out correct values for B and C	M1dep	eg $A = 10$ and $B = 17.5$ and $C = 25$
	Puts the correct values for B and C into fraction form (may have non-integer values)	M1dep	oe eg $\frac{25}{17.5}$
	$\frac{10}{7}$ or $1\frac{3}{7}$	A1	oe fraction eg $\frac{250}{175}$ SC3 $\frac{7}{10}$ oe fraction with A eliminated SC2 $\frac{6}{7}$ oe fraction with A eliminated

Additional guidance for this question is on the next page

19 cont	**Additional Guidance**	
	Ignore an incorrect conversion of $\frac{10}{7}$ to a mixed number	
	$\frac{6}{7}$ is from taking C as $1.5A$	SC2
	Condone the inclusion of B in the fraction eg $(C=)\frac{10}{7}(\times)B$ or $(C=)\frac{10B}{7}$	M3A1
	Alt 2 The chosen value of A does not need to be explicitly stated if method is shown and working is unambiguous or values are in correct proportion	

Q	Answer	Mark	Comments
20	$a = -3$	B1	
	8 or (their $-3)^2 - 1$ correctly evaluated	B1ft	
	4 or their $8 \div 2$ correctly evaluated	B1ft	
	Additional Guidance		
	$a = -3$ $b = -10$ $c = -5$		B1B0B1ft

Q	Answer	Mark	Comments
21	**Alternative method 1: using x = 1.018…**		
	Multiplication by power of 10	M1	eg $10x = 10.18…$ or $100x = 101.81…$ or $1000x = 1018.18…$ any or no letter
	Correct equation formed from subtraction of two equations to eliminate recurring digits	M1dep	eg $99x = 100.8$ or $990x = 1008$ or $x = \frac{1008}{990}$
	$(x =) \frac{1008}{990}$ and $\frac{56}{55}$ with no incorrect working	A1	oe from using different powers of 10
	Alternative method 2: using x = 0.018…		
	Multiplication by power of 10	M1	eg $10x = 0.1818…$ or $100x = 1.818…$ or $1000x = 18.18…$ any or no letter
	Correct equation formed from subtraction of two equations to eliminate recurring digits	M1dep	eg $99x = 1.8$ or $990x = 18$ or $x = \frac{1.8}{99}$
	$(x =) \frac{1.8}{99}$ or $\frac{18}{990}$ and $(x =) \frac{1}{55}$ and $\frac{56}{55}$ **or** $\frac{100.8}{99}$ or $\frac{1008}{990}$ **and** $\frac{56}{55}$ with no incorrect working	A1	oe from using different powers of 10

Question 21 continues on the next page

Q	Answer	Mark	Comments
21 cont	**Alternative method 3: using x = 1.018… and addition**		
	Multiplication by power of 10	M1	eg $10x = 10.18…$ or $100x = 101.81…$ or $1000x = 1018.18…$ any or no letter
	Correct addition of two correct equations leading to 0.9 recurring	M1dep	eg $110x = 111.99…$ or $1100x = 1119.99…$
	$(x =) \frac{112}{110}$ and $\frac{56}{55}$ with no incorrect working	A1	oe from using different powers of 10
	Additional Guidance		
	Up to M2 may be awarded for correct work with no answer or incorrect answer if this is seen amongst multiple attempts		
	For all marks, numbers must be correct		
	Working with 1.018018018… scores 0		
	Recurring decimals should be denoted by correct notation or at least two of the recurring digits followed by at least two dots		
	In alt1 and alt2 condone incorrect recurring notation if the result of the subtraction is a correct equation		

Q	Answer	Mark	Comments
22	**Alternative method 1: drawing *AO* and *BO* and sum of angles in a quadrilateral**		
	$PBO = 90$ or $PAO = 90$	M1	may be seen on diagram or implied by subsequent working accept rectangle drawn at angle
	$360 - 90 - 90 - 24$ or 156	M1dep	oe eg $180 - 24$ or $90 - 12$ may be seen on diagram
	78	A1	
	Alternative method 2: drawing *AO* and *BO* and using circle theorems		
	$AOB = 2x$	M1	may be seen on diagram
	$2x = 156$	M1dep	
	78	A1	
	Alternative method 3: drawing *AB*, sum of angles in a triangle and alt segment		
	$2PAB + 24 = 180$ or $2PBA + 24 = 180$	M1	
	$(180 - 24) \div 2$ or 78 or $(180 - 24) \div 2$ or 78	M1dep	may be seen on diagram
	$x = 78$	A1	
	Alternative method 4: drawing *PO* and *AO* or *BO* and sum of angles in a triangle		
	$PBO = 90$ or $PAO = 90$	M1	may be seen on diagram or implied by subsequent working accept rectangle drawn at angle
	$180 - 90 - 12$ or 78	M1dep	oe eg $90 - 12$ may be seen on diagram
	78	A1	

Additional guidance for this question is on the next page

Q	Answer	Mark	Comments
22 cont	**Additional Guidance**		
	Answer 78		M1M1A1
	Working takes precedence over diagram		

Q	Answer	Mark	Comments
23(a)	$\frac{25}{16}$ or $1\frac{9}{16}$	B1	oe with no surds or indices
	Additional Guidance		
	Ignore an incorrect conversion of $\frac{25}{16}$ to a mixed number		
	$\frac{5\sqrt{5}\sqrt{5}}{16}$ or $\frac{5^2}{16}$		B0

Q	Answer	Mark	Comments
23(b)	$4 + 2\sqrt{3} + 2\sqrt{3} + (\sqrt{3})^2$ or $4 + 4\sqrt{3} + (\sqrt{3})^2$ or $7 + 4\sqrt{3}$	M1	oe 4 terms with at least 3 correct or 3 terms with 2 correct including $4\sqrt{3}$ terms may be seen in a grid
	$7 \times 2 + 7\sqrt{3} + 2 \times 4\sqrt{3} + 4\sqrt{3} \times \sqrt{3}$ or $8 + 8\sqrt{3} + 6 + 4\sqrt{3} + 4 \times 3 + 3\sqrt{3}$ or $14 + 7\sqrt{3} + 8\sqrt{3} + 12$ or $8 + 4\sqrt{3} + 4\sqrt{3} + 6 + 4\sqrt{3} + 6 + 6 + 3\sqrt{3}$	M1dep	oe full expansion with correct multiplication of their 2, 3 or 4 terms by $(2 + \sqrt{3})$ terms may be seen in a grid
	$8 + 4\sqrt{3} + 4\sqrt{3} + 6 + 4\sqrt{3} + 6 + 6 + 3\sqrt{3}$ and $26 + 15\sqrt{3}$ **or** $14 + 7\sqrt{3} + 8\sqrt{3} + 12$ and $26 + 15\sqrt{3}$	A1	oe with full expansion terms may be seen in a grid condone $15\sqrt{3} + 26$
	Additional Guidance		
	Remember that the answer is given in the question		
	3 may be seen as $(\sqrt{3})^2$ for M1 only		
	Condone missing brackets if multiplications are correct		

Q	Answer	Mark	Comments
24(a)	$2k^2 + 3 - (9k + 7)$ (= 1) or $2k^2 - 9k - 4$ (= 1)	M1	oe eg $9k + 7 + 1 = 2k^2 + 3$ or $9k + 8 = 2k^2 + 3$
	$2k^2 - 9k - 5$ (= 0)	A1	terms in any order implied by $k = 5$ (and $-\frac{1}{2}$) or correct answer
	$(2k + 1)(k - 5)$ (= 0) or $(k =) \frac{--9 \pm \sqrt{9^2 - 4 \times 2 \times -5}}{2 \times 2}$ or $(k =) \frac{9 \pm \sqrt{121}}{4}$ or $(k =) 2.25 \pm \sqrt{7.5625}$	M1	oe correct factorisation or correct use of quadratic formula or correct use of completing the square for their 3-term quadratic
	$(k =) 5$ (or $-\frac{1}{2}$)	A1ft	ft at least one solution for their 3-term quadratic implied by correct answer
	54	A1	

Additional Guidance	
Answer 54 not from incorrect working	5 marks
Trial and improvement scores 0 or 5	
Use of inequalities can score up to M0A0M1A1ftA0	
Condone 52, 53, 54 on answer line	5 marks
54 and 4.5	4 marks
$2k^2 + 3 - 9k + 7$ (= 1) $2k^2 - 9k + 9$ (= 0) $(2k - 3)(k - 3)$ (= 0) $k = 3$ (or $\frac{3}{2}$) 22	M0 A0 M1 A1ft A0

Q	Answer	Mark	Comments
24(b)	**Alternative method 1**		
	$\left(\sqrt{x}+1\right)^2$ or $\left(\sqrt{x}+1\right)\left(\sqrt{x}+1\right)$	M1	
	$\left(\sqrt{x}+1\right)^2$ or $\left(\sqrt{x}+1\right)\left(\sqrt{x}+1\right)$ and $x+\sqrt{x}+\sqrt{x}+1$ $=x+2\sqrt{x}+1$	A1	SC1 takes any square number and shows that $x+2\sqrt{x}+1$ gives the next square number
	Alternative method 2		
	$x=n^2$	M1	any letter for n except x
	$(n+1)^2=n^2+2n+1$ $=x+2\sqrt{x}+1$	A1	SC1 takes any square number and shows that $x+2\sqrt{x}+1$ gives the next square number
	Alternative method 3		
	$x=n^2$	M1	any letter for n except x
	$n^2+2\sqrt{n^2}+1=n^2+2n+1$ and $(n+1)^2$	A1	SC1 takes any square number and shows that $x+2\sqrt{x}+1$ gives the next square number
	Additional Guidance		
	Remember that the answer is given in the question		
	eg for SC1 $x=9$, $9+2\times3+1=16$		SC1
	Allow $x^{\frac{1}{2}}$ for $\sqrt{x}$ throughout		
	If only multiplication in a grid is seen then this is not sufficient for A1		

Q	Answer	Mark	Comments
25	**Alternative method 1: substitutes values**		
	(sin 30° =) $\frac{1}{2}$ or 6 sin 30° = 3 **or** (cos 30° =) $\frac{\sqrt{3}}{2}$ or 2 cos 30° = $\sqrt{3}$ **or** (tan 30° =) $\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$ or 4 tan 30° = $\frac{4}{\sqrt{3}}$ or $\frac{4\sqrt{3}}{3}$	M1	may be seen beside the given expression or in a table
	$6\left(\frac{1}{2}\right)$ and $2\left(\frac{\sqrt{3}}{2}\right)$ and $4\left(\frac{1}{\sqrt{3}}\right)$ or $6\left(\frac{1}{2}\right)$ and $2\left(\frac{\sqrt{3}}{2}\right)$ and $4\left(\frac{\sqrt{3}}{3}\right)$ or $\frac{6}{2}$ and $\frac{2\sqrt{3}}{2}$ and $\frac{4\sqrt{3}}{3}$	M1dep	oe
	Processing at least as far as $\frac{6}{2} + \frac{8\sqrt{3}}{2\sqrt{3}}$ or $\frac{6}{2} + \frac{8\sqrt{3}\sqrt{3}}{6}$ or $\frac{6}{2} + \frac{24}{6}$	M1dep	oe
	7 from correct working	A1	SC2 $4 + 4\sqrt{3}$ oe

The mark scheme for this question continues on the next page

25 cont	**Alternative method 2: uses a trig identity**		
	$6 \sin 30° + 2 \cos 30° \times 4 \dfrac{\sin 30°}{\cos 30°}$	M1	oe
	$6 \sin 30° + 8 \sin 30°$ or $14 \sin 30°$	M1dep	oe
	$14 \times \dfrac{1}{2}$	M1dep	oe
	7 from correct working	A1	SC2 $4 + 4\sqrt{3}$ oe
	Additional Guidance		
	Alt 2 is not on this specification, but may be seen if other qualifications have been studied, eg AQA Certificate – Level 2 Further Maths		
	Incorrect order of operations gives $4 + 4\sqrt{3}$ oe		SC2
	Allow $\sqrt{1}$ for 1 throughout		