GCSE
MATHEMATICS
8300/1H

Higher Tier Paper 1 Non-Calculator

Mark scheme

June 2023

Version: Final 1.0

236G8300/1H/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 $\leqslant$ 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(a)	(0).35	B1	oe
	Additional Guidance		
	Mark the answer line. If this is blank, mark the working		
	If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct		
	eg1 $0.35 = \frac{7}{20}$ on answer line		B1
	eg2 $\frac{35}{100}$ and 3.5 in working with $\frac{35}{100}$ on answer line		B1
	eg3 $\frac{35}{100}$ and 3.5 in working with 3.5 on answer line		B0
	eg4 $\frac{35}{100}$ and 3.5 in working with answer line blank		B0

Q	Answer	Mark	Comments
1(b)	$\frac{5}{18}$	B1	oe eg $\frac{10}{36}$
	Additional Guidance		
	Mark the answer line. If this is blank, mark the working		
	Allow 0.277… (minimum two 7s and two dots) or correct notation for recurring decimals		
	If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct		
	eg1 $\frac{5}{18}$ = 0.277… on answer line		B1
	eg2 $\frac{5}{18}$ and 0.518 in working with answer line blank		B0
	$\frac{1\frac{2}{3}}{6}$ or $\frac{1.66...}{6}$ without answer in correct form		B0

Q	Answer	Mark	Comments
1(c)	45	B1	
	Additional Guidance		
	Mark the answer line. If this is blank, mark the working		
	If values are given in one or more forms, either on the answer line or in working with nothing on the answer line, all values must be correct eg1 $\frac{270}{6} = 45$ on answer line eg2 $\frac{270}{6}$ and $44\frac{5}{6}$ in working with answer line blank		B1 B0
	Do not allow unprocessed answers eg $\frac{270}{6}$		B0

Q	Answer	Mark	Comments
2	$x < 13$ or $13 > x$	B1	
	Additional Guidance		
	$x = 13$ in working with $x < 13$ on answer line		B1
	$x < 13$ and $(x =)$ 13 on answer line		B0
	$x < 13$ in working with $x = 13$ or 13 on answer line		B0
	Ignore number lines drawn		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="7">3</td><td>$2\frac{1}{4}$</td><td>B1</td><td>oe mixed number</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">$\frac{9}{4} = 2\frac{1}{4}$ or $2.25 = 2\frac{1}{4}$ on answer line</td><td>B1</td></tr>
<tr><td colspan="2">$2\frac{1}{4} = \frac{9}{4}$ or $2\frac{1}{4} = 2.25$ on answer line</td><td>B0</td></tr>
<tr><td colspan="2">Otherwise, $2\frac{1}{4}$ and $\frac{9}{4}$ or $2\frac{1}{4}$ and 2.25 on answer line in either order (or in working with answer line blank and answer unclear)</td><td>B0</td></tr>
<tr><td colspan="2">$1\frac{5}{4}$</td><td>B0</td></tr>
<tr><td colspan="2">$2\left(\frac{1}{4}\right)$ or $2 + \frac{1}{4}$</td><td>B0</td></tr>
</table>

Q	Answer	Mark	Comments
4	**Alternative method 1 – numerical**		
	1 and 5 and 3 or 9 (parts) or numbers in the ratio 1 : 5 : 3 or (angle sum on a straight line =) 180	M1	oe may be seen in a ratio eg $\frac{1}{5} : 1 : \frac{3}{5}$ or $\frac{1}{3} : \frac{5}{3} : 1$ numbers can be in any order eg 30, 10, 50
	$180 \div (1 + 5 + 3)$ or 20 or $180 \div \frac{9}{5}$	M1dep	oe
	100	A1	
	Alternative method 2 – algebraic		
	x and $5x$ and $3x$ or $9x$ or (angle sum on a straight line =) 180	M1	oe correct terms with any angle as x any letter, any order may be seen on diagram
	Correct equation with correct method to solve for one angle	M1dep	eg $x + 5x + 3x = 180$ and $180 \div (1 + 5 + 3)$
	100	A1	
	Additional Guidance		
	$x + 5x + 3x = 360$ or $360 \div 9$		M1M0A0
	$\frac{1}{5}x + x + \frac{3}{5}x = 180$ and $180 \div \left(\frac{1}{5} + 1 + \frac{3}{5}\right)$		M1M1
	$\frac{1}{3}x + \frac{5}{3}x + x = 180$ and $180 \div \left(\frac{1}{3} + \frac{5}{3} + 1\right)$		M1M1
	Angle *EBD* marked as 100 on the diagram with answer line blank		M1M1A1
	20 and 100 in working with no or incorrect answer chosen		M1M1A0

Q	Answer	Mark	Comments
5	All conditions met: • first number is prime • second number is prime • correctly evaluated • even answer • answer in range	B3	if their product is incorrectly evaluated or missing, then 'even answer' and 'answer in range' refer to the correct product for their multiplication B2 4 conditions met B1 3 conditions met
	Additional Guidance		
	$2 \times 29 = 58$ (or $29 \times 2 = 58$) is the only fully correct solution		B3
	Allow 50 to 60 inclusive for 'answer in range'		
	Award the best mark from boxes or in working for up to B2		
	The two prime numbers do not have to be different		

Q	Answer	Mark	Comments
6	$\frac{5}{6} \times 96$ or 80	M1	oe eg $96 \div 6 \times 5$ implied by 176
	$\frac{1}{4} \times$ their 80 or 20	M1dep	oe eg $80 \div 4$
	$\frac{2}{3} \times 96$ or 64	M1	oe eg $96 \div 3 \times 2$ accept 0.66 or better for $\frac{2}{3}$
	84(.00)	A1	SC2 100.8(0) or [77.32, 77.34] condone incorrect money notation eg 84.0 or 84.00p
	Additional Guidance		
	SC2 for 100.8(0) is from misreading as Andrew gets £96		
	SC2 for [77.32, 77.34] is from $\frac{2}{3}$ of 80 plus $\frac{1}{4}$ of 96		
	Do not accept '$\frac{5}{6}$ of 96' or '$\frac{1}{4}$ of 80' or '$\frac{2}{3}$ of 96' for M marks unless accompanied by a correct method or value		

Q	Answer	Mark	Comments
7	**Alternative method 1 – evaluation and division**		
	(5^2 =) 25 or (3 × 5^2 =) 75 or 600 ÷ 3 or 200 or 600 ÷ 5^2 or 24	M1	oe oe eg 3 × 200 = 600 oe eg 25 × 24 = 600
	600 ÷ 3 ÷ 5^2 or 8	M1dep	oe eg 8 × 75 = 600
	3 with M1 awarded and not from incorrect working	A1	
	Alternative method 2 – product of prime factors		
	600 written as a product of factors where at least one factor is prime	M1	eg 2 and 300 or 5 and 120 or 2 and 2 and 150 may be seen on a factor tree or in repeated division allow one strand to be incorrect if a previous value completes the product eg 20 × 30 followed by 2 × 10 × 5 × 8 implies 2 × 10 × 30 for M1
	2 and 2 and 2 and 3 and 5 and 5	M1dep	may be seen on a factor tree or in repeated division
	3 with M1 awarded and not from incorrect working	A1	
	Additional Guidance		
	8 × 3 × 25 = 600 and answer 3		M1M1A1
	2^3 on answer line with M2 awarded		M1M1A0
	Answer 3 on answer line with no working		M0M0A0
	Do not allow 600 ÷ 3 × 5^2 for M2 in alt 1 unless recovered, but do allow $\frac{600}{3\times5^2}$ or 600 ÷ (3 × 5^2)		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="3">8</td><td>$13x + 22$</td><td>B2</td><td>B1 $15x + 20$ or $-2x + 2$
or $13x + a$ or $bx + 22$, where a and b can be any numbers</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Do not ignore further working for B2
eg $13x + 22 = 35x$
eg $13x + 22$, $x = \frac{22}{13}$</td><td>
B1
B1</td></tr>
</table>

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="13">9</td><td>Any two from:
Reference to graph passing through point where $x = 0$
Reference to graph being incorrect for negative x values
Reference to the graph stopping before the end of the axes/axis</td><td>B2</td><td>B1 any one correct reference
eg the graph touches the y-axis
eg the graph to the left of the y-axis should be below the x-axis
eg the graph should go to the ends of the axes</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Ignore non-contradictory, irrelevant responses alongside a correct response</td><td></td></tr>
<tr><td colspan="2">Draws correct graph</td><td>B2</td></tr>
<tr><td colspan="2">Draws graph with one section correct for positive values of x or negative values of x</td><td>B1 for that section</td></tr>
<tr><td colspan="2">‘It isn’t the graph of $y = \frac{1}{x}$’ scores B0, but B1 may still be scored for the other criticism</td><td></td></tr>
<tr><td colspan="2">‘There are no numbers on the axes’ scores B0, but B1 may still be scored for the other criticism</td><td></td></tr>
<tr><td colspan="2">Mark for graph touching y-axis</td><td></td></tr>
<tr><td colspan="2">You cannot have $x = 0$</td><td>B1</td></tr>
<tr><td colspan="2">The line in the top right should be moved to the right</td><td>B1</td></tr>
<tr><td colspan="2">It says x doesn’t = 0 but it (the sketch) does</td><td>B1</td></tr>
<tr><td colspan="2">One line is touching the y-axis</td><td>B1</td></tr>
<tr><td colspan="2">The lines should be symmetrical</td><td>B0</td></tr>
<tr><td></td><td colspan="2">You cannot have $y = 0$</td><td>B0</td></tr>
<tr><td></td><td colspan="2">One line is touching the y-axis but the other isn’t</td><td>B0</td></tr>
</table>

Question 9 Additional Guidance continues on the next page

9 cont	**Mark for negative values being in the wrong quadrant**	
	There shouldn't be anything in the top-left section	B1
	There should be something in the bottom-left section	B1
	It is the graph of $y = \frac{1}{x^2}$	B1
	It should have rotational symmetry	B1
	It should be symmetrical about $y = x$	B1
	It should be symmetrical about $y = -x$	B1
	It should be symmetrical	B0
	One should be negative	B0
	The bit on the left is wrong	B0
	The negative values are plotted incorrectly	B0
	Reference to the graph stopping before the end of the axes	
	It stops before the end of the axes	B1
	The lines don't go far enough	B1
	The lines need to be higher up	B0

Q	Answer	Mark	Comments
10	**Alternative method 1 – algebra based on Sunita's age**		
	5×3 or 15	M1	may be implied by their algebraic total of the three ages being divided by 3
	$x - 1$ or $2x$ or $4x - 1$	M1	oe expressions any letter throughout
	x + their $(x - 1)$ + their $2x$ = their 15 or $4x - 1$ = their 15	M1dep	oe equation eg $\frac{x + x - 1 + 2x}{3} = 5$ dep on M1M1
	$(x =)$ 4	M1dep	correct solution to their equation if the solution has a decimal part allow truncation or rounding to the nearest whole number
	8	A1	
	Alternative method 2 – algebra based on Joel's age		
	5×3 or 15	M1	may be implied by their algebraic total of the three ages being divided by 3
	$\frac{y}{2}$ or $\frac{y}{2} - 1$ or $2y - 1$	M1	oe expressions any letter throughout $2y - 1$ must not come from $y + y - 1$
	y + their $\frac{y}{2}$ + their $(\frac{y}{2} - 1)$ = their 15	M1dep	oe equation eg $\frac{y + \frac{y}{2} + \frac{y}{2} - 1}{3} = 5$ dep on M1M1
	$2y$ + their y + their $(y - 2) = 2 \times$ their 15 or $4y - 2 = 30$ or $2y - 1 = 15$	M1dep	their equation with no denominator
	8	A1	

Question 10 continues on the next page

10 cont	**Alternative method 3 – trial and improvement**			
	5×3 or 15	M1	may be implied by their total of the three ages being divided by 3	
	Trial of three numbers which fit the criteria, with either their sum correctly evaluated or their sum divided by 3	M1	eg $2 + 1 + 4 = 7$ or $(2 + 1 + 4) \div 3$ condone missing brackets	
	Second trial of three numbers which fit the criteria, with either their sum correctly evaluated or their sum divided by 3	M1dep	dep on previous M1 eg $3 + 2 + 6 = 11$ or $(3 + 2 + 6) \div 3$ condone missing brackets	
	4, 3 and 8 selected as their final combination	M1dep	any order implies M4	
	8	A1		
	Additional Guidance			
	Up to M4 may be awarded for correct work seen in multiple attempts even if not subsequently used			
	Correct expressions, but the sum of the three ages is equated to 5 eg $4x - 1 = 5$			M0M1M0M0A0
	In alt 1, the correct value of x or the correct age for Joel for their two terms for Beth and Joel, with one correct, implies the first 4 marks eg x and $x + 1$ and $2x$, with $x = 3.5$ or answer 7			M1M1M1M1A0
	In alt 2, the correct value of y for their two terms for Sunita and Beth, with one correct, implies the first 4 marks eg y and $\frac{y}{2}$ and $(\frac{y}{2} + 1)$, with $y = 7$ or answer 7			M1M1M1M1A0
	In alt 1 and alt 2, condone missing brackets in equations if not recovered for up to M1M1M1 eg $x + x - 1 + 2x \div 3 = 5$ not recovered			M1M1M1M0A0

Q	Answer	Mark	Comments
11(a)	$\frac{13}{100}$ or 0.13 or 13%	B1	oe fraction, decimal or percentage

Q	Answer	Mark	Comments
11(b)	$\frac{59}{100}$ or 0.59 or 59%	B1	oe fraction, decimal or percentage SC1 answers 13 in (a) and 59 in (b) or $\frac{13}{x}$ in (a) and $\frac{59}{x}$ in (b) where x is an integer $\geqslant 59$

Q	Answer	Mark	Comments
11(c)	$\frac{89}{100}$ or 0.89 or 89%	B1	oe fraction, decimal or percentage SC1 answers 13 in (a) and 89 in (c) or $\frac{13}{x}$ in (a) and $\frac{89}{x}$ in (c), where x is an integer $\geqslant 89$ or answers 59 in (b) and 89 in (c) or $\frac{59}{x}$ in (b) and $\frac{89}{x}$ in (c), where x is an integer $\geqslant 89$
	Additional Guidance		
	13 in (a) and 59 in (b) and 89 in (c) scores 0, SC1, SC1		

Q	Answer	Mark	Comments
12(a)	$1 \leqslant a < 10$	B1	allow 1.0 etc
	Additional Guidance		
	Accept $9.\dot{9}$ for 10		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th colspan="2">Comments</th></tr>
<tr><td rowspan="3">12(b)</td><td>0.0072</td><td>B2</td><td colspan="2">B1 7.2×10^3
or 7.2×10^{-3}
ignore extra 0s which don't affect the value</td></tr>
<tr><td colspan="4">Additional Guidance</td></tr>
<tr><td colspan="3">0.0072 in working with 7.2×10^{-3} on the answer line</td><td>B1</td></tr>
</table>

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th colspan="2">Comments</th></tr>
<tr><td rowspan="8">13(a)</td><td>$(y =)\ ax + b$
and
$(y =)\ ax + 2a + b$</td><td>B2</td><td colspan="2">any letter for x other than a or b or y
B1
$(y =)\ ax + b$
or
$(y =)\ a(x + 2) + b$
or $(y =)\ ax + 2a + b$
or
substitution of two values for x with a difference of 2 and correct working to show that the output increases by $2a$
eg substituting $x = 3$ and $x = 5$ to get
$3a + b$ and $5a + b$</td></tr>
<tr><td colspan="4">Additional Guidance</td></tr>
<tr><td colspan="3">Allow xa for ax throughout</td><td></td></tr>
<tr><td colspan="3">Do not allow $a \times x + b$ for $ax + b$ unless recovered</td><td></td></tr>
<tr><td colspan="3">Allow, eg $(x + 2) \times a + b$ for $a(x + 2) + b$</td><td></td></tr>
<tr><td colspan="3">Do not allow missing brackets unless recovered
eg do not allow $x + 2 \times a$ for $a(x + 2)$</td><td></td></tr>
<tr><td colspan="3">Do not accept written answers without the necessary algebra
eg The input has increased by 2 and will then be multiplied by a, so the output will increase by $2a$</td><td>B0</td></tr>
<tr><td colspan="3">Ignore further non-contradictory work if B2 awarded</td><td></td></tr>
</table>

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="12">13(b)</td><td colspan="3">Alternative method 1 – using k</td></tr>
<tr><td>$\frac{f(6)}{f(2)}$ $\left(= \frac{36k}{4k}\right)$ = 9
or
f(3) = 9k</td><td>M1</td><td>condone eg k36</td></tr>
<tr><td>$\frac{f(6)}{f(2)}$ = 9 and f(3) = 9k
and No</td><td>A1</td><td>condone k9</td></tr>
<tr><td colspan="3">Alternative method 2 – substituting a value for k</td></tr>
<tr><td>Identifies a value of k other than 1
and
correctly evaluates $\frac{f(6)}{f(2)}$ or f(3)</td><td>M1</td><td>eg k = 2
and
$\frac{f(6)}{f(2)}$ = 9 or f(3) = 18</td></tr>
<tr><td>Identifies a value of k other than 1
and
correctly evaluates $\frac{f(6)}{f(2)}$ and f(3)
and No</td><td>A1</td><td>eg k = 2 and $\frac{f(6)}{f(2)}$ = 9 and f(3) = 18
and No</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">9k from $\frac{f(6)}{f(2)}$ is M0, but M1 can be awarded if accompanied by f(3) = 9k</td><td></td></tr>
<tr><td colspan="2">Do not allow 9 from $\frac{36}{4}$ (unless $\frac{36}{4}$ is from $\frac{36k}{4k}$)</td><td></td></tr>
<tr><td colspan="2">Do not allow 9 from $\frac{36k^2}{4k^2}$</td><td></td></tr>
<tr><td colspan="2">Students may correctly state that $\frac{f(6)}{f(2)}$ and f(3) are (only) equal when k = 1
This may replace ‘No’ in their answer, but does not score without 9k and 9</td><td></td></tr>
<tr><td colspan="2">Do not allow unprocessed values, eg 6^2, 2^2 or 3^2</td><td></td></tr>
</table>

Q	Answer	Mark	Comments
14	12 24 30 41	B2	B1 their median = 2 × their LQ with the first eight values in order and their UQ and their last number ⩾ their median or their UQ = 2.5 × their LQ with the first ten numbers in order and their last number ⩾ their UQ or their range = 2 × their interquartile range with all values in order

Additional Guidance	
Take the boxes to be the LQ, median, UQ and highest value in that order	
Decimal values can score up to B1 eg 11.5 23 29 40 has median = 2 × LQ	B1
Ignore blank boxes for B1	
If all boxes are blank, mark the working lines	

Q	Answer	Mark	Comments
15	True Not true Not true True	B4	B1 each correct answer

Additional Guidance	
Allow a cross if it’s the only answer in that row	
If one tick and one or two crosses are given in a row, mark the tick	

Q	Answer	Mark	Comments
16	**Alternative method 1 – equates coefficients and eliminates an unknown**		
	$8x - 20y = 52$ and $15x + 20y = 40$ or $6x - 15y = 39$ and $6x + 8y = 16$	M1	oe equates coefficients of one unknown allow one term error
	$8x + 15x = 52 + 40$ or $23x = 92$ or $-15y - 8y = 39 - 16$ or $-23y = 23$	M1dep	oe eliminates an unknown must be correct for their equations
	$x = 4$ and $y = -1$	A2	A1 $x = 4$ from correct method or $y = -1$ from correct method
	Alternative method 2 – substitutes for x		
	$x = 6.5 + 2.5y$ or $x = \frac{8}{3} - \frac{4}{3}y$	M1	oe makes x the subject of one equation allow one term error
	$3(6.5 + 2.5y) + 4y = 8$ or $11.5y = -11.5$ or $2(\frac{8}{3} - \frac{4}{3}y) - 5y = 13$ or $-\frac{23}{3}y = \frac{23}{3}$	M1dep	oe eliminates x must be correct for their rearrangement
	$x = 4$ and $y = -1$	A2	A1 $y = -1$ from this method

Question 16 continues on the next page

16 cont	**Alternative method 3 – substitutes for y**		
	$y = 0.4x - 2.6$ or $y = 2 - 0.75x$	M1	oe makes y the subject of one equation allow one term error
	$3x + 4(0.4x - 2.6) = 8$ or $4.6x = 18.4$ or $2x - 5(2 - 0.75x) = 13$ or $5.75x = 23$	M1dep	oe eliminates y must be correct for their rearrangement
	$x = 4$ and $y = -1$	A2	A1 $x = 4$ from this method
	Alternative method 4 – makes the same unknown the subject in both equations		
	$x = 6.5 + 2.5y$ or $x = \frac{8}{3} - \frac{4}{3}y$ or $y = 0.4x - 2.6$ or $y = 2 - 0.75x$	M1	oe makes y or x the subject of one equation allow one term error
	$6.5 + 2.5y = \frac{8}{3} - \frac{4}{3}y$ or $\frac{23}{6}y = -\frac{23}{6}$ or $0.4x - 2.6 = 2 - 0.75x$ or $1.15x = 4.6$	M1dep	oe makes y or x the subject of both equations (maximum one term error) and eliminates y or x must be correct for their rearrangements
	$x = 4$ and $y = -1$	A2	A1 $x = 4$ from correct method or $y = -1$ from correct method
	Additional Guidance		
	Up to M2 may be awarded for correct work seen in multiple attempts, even if not subsequently used		
	In alts 2, 3 and 4 allow rounding or truncating to 1dp or better for up to M1M1 eg (Alt 4) $6.5 + 2.5y = 2.7 - 1.3y$		M1M1
	Answers from trial and improvement or with no working score 0 or 4		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="8">17</td><td colspan="3">Alternative method 1 – expressions in x</td></tr>
<tr><td>$4\pi x^2 \div 2$ or $2\pi x^2$
or πx^2
or $\pi(3x)^2$ or $9\pi x^2$
or $2 \times \pi(3x)^2$ or $18\pi x^2$
or $2\pi x(3x)$ or $6\pi x^2$</td><td>M1</td><td>oe area of curved face of hemisphere
oe area of flat face of hemisphere
oe area of one flat face of cylinder
oe area of both flat faces of cylinder
oe area of curved face of cylinder</td></tr>
<tr><td>$4\pi x^2 \div 2 + \pi x^2$ or $3\pi x^2$
or
$\pi(3x)^2 + \pi(3x)^2 + 2\pi x(3x)$
or $9\pi x^2 + 9\pi x^2 + 6\pi x^2$
or $24\pi x^2$</td><td>M1dep</td><td>oe total surface area of the hemisphere

oe total surface area of the cylinder</td></tr>
<tr><td>$3\pi x^2$ and $24\pi x^2$ and $1 : 8$</td><td>A1</td><td>either order</td></tr>
<tr><td colspan="3">Alternative method 2 – substituting a value for x</td></tr>
<tr><td>Substitutes a value for x and works out the area of at least one of
area of curved face of hemisphere
area of flat face of hemisphere
area of one flat face of cylinder
area of both flat faces of cylinder
area of curved face of cylinder</td><td>M1</td><td>eg using $x = 5$, at least one of
50π
25π
225π
450π
150π</td></tr>
<tr><td>Substitutes a value for x and works out an expression for the total surface area of the hemisphere or the cylinder</td><td>M1dep</td><td>eg using $x = 5$
total surface area of hemisphere =
$25\pi + 50\pi$ or 75π
or
total surface area of cylinder =
$225\pi + 225\pi + 150\pi$ or 600π</td></tr>
<tr><td>Both correct total surface areas for their value of x and $1 : 8$</td><td>A1</td><td>either order</td></tr>
</table>

Question 17 continues on the next page

Q	Additional Guidance	
17 cont	1 : 8 or 8 : 1 without correct working or values	M0M0A0
	Condone π missing consistently for all marks	
	Allow 'correct' and consistent values of π throughout (eg 3, 3.14, $\frac{22}{7}$)	
	Condone use of r for x throughout	
	Do not allow $3\pi x^2$ from $3x \times \pi \times x$ oe	

Q	Answer	Mark	Comments
18	290	B1	

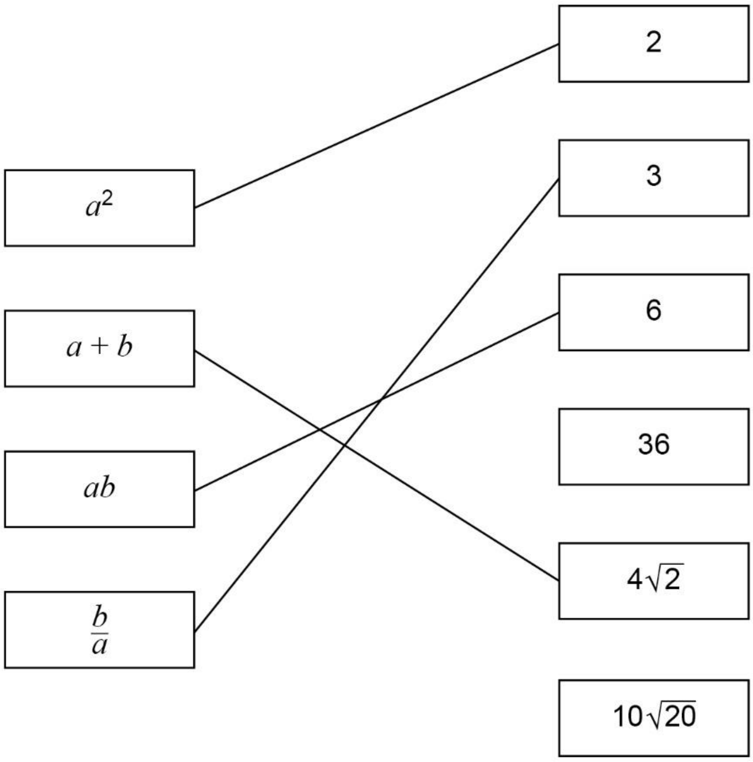
Q	Answer	Mark	Comments
19	$4 \times 3 \times 2\ (\times 1) \times 2$ or $5 \times 4 \times 3 \times 2\ (\times 1) \times \frac{2}{5}$ or $120 \times \frac{2}{5}$	M1	oe
	48	A1	SC1 12 or 24 or 72 or 120
	Additional Guidance		
	12 is the number of possible 5-digit numbers ending in two odd digits		
	24 is the number of possible 5-digit numbers ending in 7 or the number of possible 5-digit numbers ending in 9		
	72 is the number of possible 5-digit even numbers		
	120 is the number of possible 5-digit numbers		
	Ignore any listing of possible numbers		

Q	Answer	Mark	Comments
20	**Alternative method 1 – finds K in terms of L and substitutes**		
	$3K = 4L$ or $K = L + 2M$	M1	oe correct equation eg $K = \frac{4L}{3}$ or $L = \frac{3K}{4}$ may be implied by values on diagram
	$\frac{4L}{3} = L + 2M$	M1dep	oe correct equation in L and M eg $4L = 3L + 6M$
	6	A1	condone 6M (= L)
	Alternative method 2 – finds two variables in terms of the other variable		
	Finds one variable in terms of one other eg L is $\frac{3}{4}$ of K	M1	oe fractions, decimals, percentages or ratio eg $K : L = 1 : \frac{3}{4}$ may be implied by values on diagram
	Finds two variables in terms of the other eg L is $\frac{3}{4}$ of K and M is $\frac{1}{8}$ of K	M1dep	oe fractions, decimals, percentages or ratio eg $K : L : M = 1 : \frac{3}{4} : \frac{1}{8}$ may be implied by values on diagram
	6	A1	condone 6M (= L)
	Alternative method 3 – assumes a mass for one unknown		
	Assumes a mass for one unknown and works out the mass of one other	M1	eg K = 2 kg and L = 1.5 kg
	Assumes a mass for one unknown and works out the masses of the other two	M1dep	eg K = 2 kg and L = 1.5 kg and M = 0.25 kg
	6	A1	condone 6M (= L)
	Additional Guidance		
	Condone 1.33 or better for $\frac{4}{3}$, but 0.125 for $\frac{1}{8}$ must be correct		
	3K : 4L is not enough for M1		
	Ignore units		

Q	Answer	Mark	Comments
21	$(x-3)^2-24$ or $a=3$ and $b=24$	B2	B1 $(x-3)^2$ … or $(x-3)(x-3)$ … or $a=3$ (implied by 3, –24) or $x^2-2ax+a^2-b$ or $-2a=-6$ or $2a=6$ or $a^2-b=-15$ or correct b for their a

Additional Guidance

$(x+3)^2-24$ (24 is correct for $a=-3$)	B1
$(x-6)^2-51$ (51 is correct for $a=6$)	B1
$(x+6)^2-51$ (51 is correct for $a=-6$)	B1

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th colspan="2">Comments</th></tr>
<tr><td rowspan="4">22</td><td>$a + b \to 4\sqrt{2}$
$ab \to 6$
$\frac{b}{a} \to 3$</td><td>B3</td><td colspan="2">B1 each correct match</td></tr>
<tr><td colspan="4">Additional Guidance</td></tr>
<tr><td colspan="3">
</td><td>B3</td></tr>
<tr><td colspan="3">Two lines from a left-hand box is choice</td><td>B0</td></tr>
</table>

Q	Answer	Mark	Comments
23	**Alternative method 1 – subtracting powers of 10 algebraically**		
	Denotes the given recurring decimal by a letter and multiplies by one of 10, 100, etc	M1	eg $10x = 1.33\ldots$ or $100x = 13.3\ldots$
	Denotes the given recurring decimal by a letter and multiplies by one or two of 10, 100, etc and subtracts accordingly	M1dep	eg $10x - x = 1.333\ldots - 0.1333\ldots$ or $9x = 1.2$ or $\frac{1.2}{9}$ or $100x - x = 13.333\ldots - 0.1333\ldots$ or $99x = 13.2$ or $\frac{13.2}{99}$ or $100x - 10x = 13.333\ldots - 1.333\ldots$ or $90x = 12$ or $\frac{12}{90}$
	$\frac{2}{15}$	A1	
	Alternative method 2 – subtracting powers of 10 numerically		
	Multiplies the given decimal by one of 10, 100, etc	M1	eg $0.1\dot{3} \times 10 = 1.\dot{3}$
	Multiplies the given decimal by one or two of 10, 100, etc and subtracts appropriately in fraction form	M1dep	eg $0.1\dot{3} \times 100 = 13.\dot{3}$ and $0.1\dot{3} \times 10 = 1.\dot{3}$ and $\frac{13.3 - 1.3}{100 - 10}$ or $\frac{12}{90}$
	$\frac{2}{15}$	A1	

Question 23 continues on the next page

23 cont	**Alternative method 3 – splitting into a known fraction and a recurring decimal**		
	Splits into 0.1 and $0.0\dot{3}$ and uses a correct first step from alt 1 or alt 2 with $0.0\dot{3}$	M1	eg $10x = 0.33\ldots$ or $0.0\dot{3} \times 100 = 3.33\ldots$ 0.1 does not need to be seen separately at this stage
	Correct method to evaluate $0.0\dot{3}$ as a fraction and addition to $\frac{1}{10}$ or $\frac{1}{30} + \frac{1}{10}$ or $\frac{4}{30}$	M1dep	oe fraction
	$\frac{2}{15}$	A1	
	Additional Guidance		
	Condone decimals within fractions up to M2 eg $\frac{1.2}{9}$		M2
	Equals signs may be implied throughout		
	Subtraction signs must be seen or the results correct		
	Recurring decimals should be denoted by correct notation or at least two of the recurring digits followed by at least two dots. However, condone missing dots if the result is, or would be, correct eg condone $13.3 - 1.3 = 100x - 10x$		

Q	Answer	Mark	Comments
24	**Alternative method 1 – using the equations of the lines**		
	$\frac{22 - y}{8 - 0} = 2$ or $22 = 2 \times 8 + c$ or $(c =)\ 22 - 2 \times 8$ or $c = 6$ or P is at (0, 6) or (PR =) $y = 2x + 6$ or y-coordinate of P is 6 or y-coordinate of Q is 6	M1	oe equation using any letter y is the y-coordinate of P ignore missing brackets may be seen on diagram may be seen on diagram
	$2m = -1$ or $(m =) -\frac{1}{2}$	M1	oe gradient of RQ
	$22 = \text{their } -\frac{1}{2} \times 8 + c$ or $22 = -4 + c$ or $c = 26$ or (RQ =) $y = -\frac{1}{2}x + 26$	M1dep	oe equation in c dep on previous mark oe equation of RQ
	their $(-\frac{1}{2}x + 26)$ = their 6 or x-coordinate of Q is 40	M1dep	oe equation in x where x is the x-coordinate of Q dep on M3 $-\frac{1}{2} = \frac{22 - \text{their } 6}{8 - x}$ implies M4 if their 6 is correct or from correct working
	(40, 6)	A1	

Question 24 continues on the next page

<table>
<tr><td rowspan="8">24 cont</td><td colspan="3">Alternative method 2 – using similar triangles</td></tr>
<tr><td>Drops a perpendicular from R to point S on PQ
and
uses $RS = 2PS = 16$ to work out that P is at (0, 6)</td><td>M1</td><td>any or no letter

eg $22 - 2 \times 8$</td></tr>
<tr><td>$2m = -1$
or $(m =) -\frac{1}{2}$
or
$\frac{RS}{SQ} = \frac{1}{2}$</td><td>M1</td><td>oe
gradient of RQ</td></tr>
<tr><td>16×2 or 32</td><td>M1dep</td><td>length of SQ
may be seen on diagram
dep on previous mark</td></tr>
<tr><td>8 + their 32
or
x-coordinate of Q is 40</td><td>M1dep</td><td></td></tr>
<tr><td>(40, 6)</td><td>A1</td><td></td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Note that 40 (for the x-coordinate of Q) implies M3 (on alt 2) and implies M4 if 6 is also seen (on alt 1)</td><td></td></tr>
</table>

Q	Answer	Mark	Comments
25	$\sin 30 = \frac{1}{2}$ or $\tan 45 = 1$ or $\cos 30 = \frac{\sqrt{3}}{2}$	M1	oe eg $\tan 45 = \frac{\sqrt{2}}{\sqrt{2}}$ or $4 \sin 30 = 2$ or $2 \cos 30 = \sqrt{3}$ implied by position in the expression may be seen in a table
	substitution of all three correct values	M1dep	eg $\frac{4 \times \frac{1}{2} - 1}{2 \times \frac{\sqrt{3}}{2}}$ or $\frac{2-1}{2 \times \frac{\sqrt{3}}{2}}$ or $\frac{2-1}{\sqrt{3}}$
	$\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$	M1dep	
	($\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$ =) tan 30 or $x = 30$ with full working seen for M3	A1	
	Additional Guidance		
	Allow $\sqrt{1}$ for 1 throughout		
	Reference to 30° being an acute angle is not required		

Q	Answer	Mark	Comments
26	**Alternative method 1**		
	$20\pi \div 2\pi$ or 10	M1	oe may be seen on diagram implied by diameter = 20
	$x^2 + x^2 =$ (their 10)^2 or $2x^2 = 100$ or $x^2 = 50$ or their 10 × sin 45 or their 10 × cos 45 or their 10 × $\frac{1}{\sqrt{2}}$	M1	oe any letter (condone a) their 10 is their length *OQ* (the radius of the circle)
	$\sqrt{\text{their } 10^2 \div 2}$ or $\sqrt{50}$ or $5\sqrt{2}$ or $4 \times \sqrt{50}$ or 4 × their 10 × sin 45 or 4 × their 10 × cos 45 or $40 \times \frac{1}{\sqrt{2}}$ or $\frac{40\sqrt{2}}{2}$ or $20\sqrt{2}$	M1dep	oe value for the length of one side of the square or the perimeter of the square eg $\frac{10}{\sqrt{2}}$ dep on previous mark
	2 with full working seen for M3	A1	

Question 26 continues on the next page

26 cont	**Alternative method 2**		
	$20\pi \div 2\pi$ or 10 or side length of square = $5\sqrt{a}$	M1	oe may be seen on diagram implied by diameter = 20
	(Perimeter of square = $20\sqrt{a}$ and) side length of square = $5\sqrt{a}$ and $\left(5\sqrt{a}\right)^2 + \left(5\sqrt{a}\right)^2$ = (their 10)^2	M1	oe their 10 is their length *OQ* (the radius of the circle) condone missing brackets if recovered
	$25a + 25a$ = (their 10)^2 or $50a = 100$	M1dep	dep on M1M1
	2 with full working seen for M3	A1	
	Additional Guidance		
	2 with no working		M0M0M0A0
	$\sqrt{2}$ on answer line (may score method marks)		A0

Q	Answer	Mark	Comments
27	(Total time =) $\frac{30}{a} + \frac{30}{b}$	M1	oe eg $\frac{30b}{ab} + \frac{30a}{ab}$ or $\frac{30(b+a)}{ab}$
	correct expression for total distance ÷ total time	M1dep	eg $(30 + 30) \div \left(\frac{30}{a} + \frac{30}{b}\right)$ or $60 \div \frac{30(b+a)}{ab}$ or $60 \times \frac{ab}{30(b+a)}$
	$60 \times \frac{ab}{30(a+b)} = \frac{2ab}{a+b}$	A1	condone $b + a$ for $a + b$ condone $30a + 30b$ for $30(a + b)$
	Additional Guidance		
	Students can gain M1M1 if they incorrectly simplify a correct expression for total time before forming the division eg $\frac{30}{a} + \frac{30}{b} = \frac{60}{a+b}$ followed by $60 \div \frac{60}{a+b}$		M1M1A0
	Allow correct cancellation of 60 and 30 at any stage of the working		