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# GCSE MATHEMATICS 8300/1H

Higher Tier

Paper 1 Non-Calculator

Shadow paper based on June 2023 paper

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**Mark scheme**

June 2023

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Version: 1.0

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.

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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.

<b>M</b>	Method marks are awarded for a correct method which could lead to a correct answer.
<b>A</b>	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>B</b>	Marks awarded independent of method.
<b>ft</b>	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
<b>SC</b>	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
<b>M dep</b>	A method mark dependent on a previous method mark being awarded.
<b>B dep</b>	A mark that can only be awarded if a previous independent mark has been awarded.
<b>oe</b>	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
<b>[a, b]</b>	Accept values between a and b inclusive.
<b>[a, b)</b>	Accept values $a \leq \text{value} < b$
<b>3.14...</b>	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
<b>Use of brackets</b>	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).06	B1	oe
	<b>Additional Guidance</b>		
	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 $0.06 = \frac{3}{50}$ on answer line  eg2 $\frac{6}{100}$ and 0.6 in working with $\frac{6}{100}$ on answer line  eg3 $\frac{6}{100}$ and 0.6 in working with 0.6 on answer line		B1  B1  B0

Q	Answer	Mark	Comments
1(b)	$\frac{4}{35}$	B1	oe eg $\frac{8}{70}$
	<b>Additional Guidance</b>		
	Mark the answer line. If this is blank, mark the working		
	Allow 0.114... 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 $\frac{8}{70} = 0.114\dots$ on answer line  eg2 $\frac{8}{70}$ and 0.870 in working with answer line blank		B1  B0
$\frac{4}{5}$ or $\frac{0.8}{7}$ without answer in correct form			B0

Q	Answer	Mark	Comments
1(c)	80	B1	
	<b>Additional Guidance</b>		
	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 $\frac{160}{2} = 80$ on answer line		B1
	eg2 $\frac{160}{2}$ and $79\frac{1}{2}$ in working with answer line blank		B0
Do not allow unprocessed answers eg $\frac{160}{2}$			B0

Q	Answer	Mark	Comments
2	$x < 12$ or $12 > x$	B1	
	<b>Additional Guidance</b>		
	$x = 12$ in working with $x < 12$ on answer line		B1
	$x < 12$ and $(x =) 12$ on answer line		B0
	$x < 12$ in working with $x = 12$ or $12$ on answer line		B0
	Ignore number lines drawn		

Q	Answer	Mark	Comments
<b>3</b>	$2\frac{7}{9}$	B1	oe mixed number
	<b>Additional Guidance</b>		
	$\frac{25}{9} = 2\frac{7}{9}$ or $2.77\dots = 2\frac{7}{9}$ on answer line	B1	
	$2\frac{7}{9} = \frac{25}{9}$ or $2\frac{7}{9} = 2.77\dots$ on answer line	B0	
	Otherwise, $2\frac{7}{9}$ and $\frac{25}{9}$ or $2\frac{7}{9}$ and $2.77\dots$ on answer line in either order (or in working with answer line blank and answer unclear)	B0	
	$1\frac{16}{9}$	B0	
$2\left(\frac{7}{9}\right)$ or $2 + \frac{7}{9}$	B0		

Q	Answer	Mark	Comments
4	<b>Alternative method 1 – numerical</b>		
	1 and 6 and 3 or 10 (parts) or numbers in the ratio 1 : 3 : 6 or (angle sum on a straight line =) 180	M1	oe may be seen in a ratio eg $\frac{1}{6}:1:\frac{3}{6}$ or $\frac{1}{3}:2:1$ numbers can be in any order eg 30, 10, 60
	$180 \div (1 + 6 + 3)$ or 18 or $180 \times \frac{3}{10}$	M1dep	oe
	54	A1	
	<b>Alternative method 2 – algebraic</b>		
	$x$ and $6x$ and $3x$ or $10x$ 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 $x + 6x + 3x = 180$ and $180 \div (1 + 6 + 3)$
	54	A1	
	<b>Additional Guidance</b>		
	$x + 6x + 3x = 360$ or $360 \div 10$		M1M0A0
	$\frac{1}{6}x + x + \frac{3}{6}x = 180$ and $180 \div \left(\frac{1}{6} + 1 + \frac{3}{6}\right)$		M1M1
	$\frac{1}{3}x + \frac{6}{3}x + x = 180$ and $180 \div \left(\frac{1}{3} + \frac{6}{3} + 1\right)$		M1M1
	Angle $DBC$ marked as 54 on the diagram with answer line blank		M1M1A1
	18 and 54 in working with no or incorrect answer chosen		M1M1A0



Q	Answer	Mark	Comments
5	All conditions met: <ul style="list-style-type: none"> <li>• first number is prime</li> <li>• second number is prime</li> <li>• correctly evaluated</li> <li>• even answer</li> <li>• answer in range</li> </ul>	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
	<b>Additional Guidance</b>		
	$2 \times 23 = 46$ (or $23 \times 2 = 46$ ) is the only fully correct solution	B3	
	Allow 40 to 50 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	$\frac{3}{4} \times 72$ or 54	M1	oe eg $72 \div 4 \times 3$ implied by 126	
	$\frac{1}{6} \times$ their 54 or 9	M1dep	oe eg $54 \div 6$ accept 0.16 or better for $\frac{1}{6}$	
	$\frac{4}{9} \times 72$ or 32	M1	oe eg $72 \div 9 \times 4$ accept 0.44 or better for $\frac{4}{9}$	
	41(.00)	A1	SC2 [54.65, 54.67] or 36 condone incorrect money notation eg 41.0 or 41.00p	
	<b>Additional Guidance</b>			
	SC2 for [54.65, 54.67] is from misreading as Chloe gets £72			
	SC2 for 36 is from $\frac{4}{9}$ of 54 plus $\frac{1}{6}$ of 72			
	Do not accept ' $\frac{3}{4}$ of 72' or ' $\frac{1}{6}$ of 54' or ' $\frac{4}{9}$ of 72' for M marks unless accompanied by a correct method or value			

Q	Answer	Mark	Comments
<b>7</b>	<b>Alternative method 1 – evaluation and division</b>		
	$(3^2 =) 9$ or $(5 \times 3^2 =) 45$ or $360 \div 5$ or 72 or $360 \div 3^2$ or 40	M1	oe oe eg $5 \times 72 = 360$ oe eg $9 \times 40 = 360$
	$360 \div 5 \div 3^2$ or 8	M1dep	oe eg $8 \times 45 = 360$
	3 with M1 awarded and not from incorrect working	A1	
	<b>Alternative method 2 – product of prime factors</b>		
	360 written as a product of factors where at least one factor is prime	M1	eg 2 and 180 or 3 and 120 or 2 and 2 and 90 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 $10 \times 36$ followed by $2 \times 5 \times 6 \times 8$ implies $2 \times 5 \times 36$ for M1
	2 and 2 and 2 and 3 and 3 and 5	M1dep	may be seen on a factor tree or in repeated division
	3 with M1 awarded and not from incorrect working	A1	
	<b>Additional Guidance</b>		
	$8 \times 9 \times 5 = 360$ 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 $360 \div 5 \times 3^2$ for M2 in alt 1 unless recovered, but do allow $\frac{360}{5 \times 3^2}$ or $360 \div (5 \times 3^2)$		

Q	Answer	Mark	Comments
8	$7x + 18$	B2	B1 $10x + 12$ or $-3x + 6$ or $7x + a$ or $bx + 18$ , where $a$ and $b$ can be any numbers
	<b>Additional Guidance</b>		
	Do not ignore further working for B2 eg $7x + 18 = 25x$ eg $7x + 18, x = \frac{18}{7}$		B1  B1

Q	Answer	Mark	Comments
9	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	B2	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
	<b>Additional Guidance</b>		
	Ignore non-contradictory, irrelevant responses alongside a correct response		
	Draws correct graph	B2	
	Draws graph with one section correct for positive values of $x$ or negative values of $x$	B1 for that section	
	'It isn't the graph of $y = \frac{1}{x}$ ', scores B0, but B1 may still be scored for the other criticism		
	'There are no numbers on the axes' scores B0, but B1 may still be scored for the other criticism		
	<b>Mark for graph touching <math>y</math>-axis</b>		
	You cannot have $x = 0$	B1	
	The line in the top right should be moved to the right	B1	
	It says $x$ doesn't = 0 but it (the sketch) does	B1	
	One line is touching the $y$ -axis	B1	
	The lines should be symmetrical	B0	
	You cannot have $y = 0$	B0	
One line is touching the $y$ -axis but the other isn't	B0		

**Question 9 Additional Guidance continues on the next page**

<b>9 cont</b>	<b>Mark for negative values being in the wrong quadrant</b>	
	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
	<b>Reference to the graph stopping before the end of the axes</b>	
	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	<b>Alternative method 1 – algebra based on Wenjie’s age</b>		
	35 × 3 or 105	M1	may be implied by their algebraic total of the three ages being divided by 3
	$x + 5$ or $3x$ or $5x + 5$	M1	oe expressions any letter throughout
	$x + \text{their } (x + 5) + \text{their } 3x = \text{their } 105$ or $5x + 5 = \text{their } 105$	M1dep	oe equation eg $\frac{x + x + 5 + 3x}{3} = 35$ dep on M1M1
	$(x =) 20$	M1dep	correct solution to their equation if the solution has a decimal part allow truncation or rounding to the nearest whole number
	60	A1	
	<b>Alternative method 2 – algebra based on Conor’s age</b>		
	35 × 3 or 105	M1	may be implied by their algebraic total of the three ages being divided by 3
	$\frac{y}{3}$ or $\frac{y}{3} + 5$ or $\frac{5y}{3} + 5$	M1	oe expressions any letter throughout
	$y + \text{their } \frac{y}{3} + \text{their } \left(\frac{y}{3} + 5\right) = \text{their } 105$	M1dep	oe equation eg $\frac{y + \frac{y}{3} + \frac{y}{3} + 5}{3} = 35$ dep on M1M1
	$3y + \text{their } y + \text{their } (y + 15) = 3 \times \text{their } 105$ or $5y + 15 = 315$ or $5y = 300$	M1dep	their equation with no denominator
	60	A1	

Question 10 continues on the next page

<b>10 cont</b>	<b>Alternative method 3 – trial and improvement</b>		
	$35 \times 3$ or 105	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 $1 + 6 + 3 = 10$ or $(1 + 6 + 3) \div 3$ 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 $2 + 7 + 6 = 15$ or $(2 + 7 + 6) \div 3$ condone missing brackets
	20, 25 and 60 selected as their final combination	M1dep	any order implies M4
	60	A1	
	<b>Additional Guidance</b>		
	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 35 eg $5x + 5 = 35$		M0M1M0M0A0
	In alt 1, the correct value of $x$ or the correct age for Conor for their two terms for Megan and Conor, with one correct, implies the first 4 marks eg $x$ and $x - 5$ and $3x$ , with $x = 22$ or answer 66		M1M1M1M1A0
In alt 2, the correct value of $y$ for their two terms for Wenjie and Megan, with one correct, implies the first 4 marks eg $y$ and $\frac{y}{3}$ and $\left(\frac{y}{3} - 5\right)$ , with $y = 66$ or answer 66		M1M1M1M1A0	
In alt 1 and alt 2, condone missing brackets in equations if not recovered for up to M1M1M1 eg $x + x + 5 + 3x \div 3 = 35$ not recovered		M1M1M1M0A0	



Q	Answer	Mark	Comments
11(a)	$\frac{58}{80}$ or 0.725 or 72.5%	B1	oe fraction, decimal or percentage

Q	Answer	Mark	Comments
11(b)	$\frac{73}{80}$ or 0.9125 or 91.25%	B1	oe fraction, decimal or percentage SC1 answers 58 in (a) and 73 in (b) or $\frac{58}{x}$ in (a) and $\frac{73}{x}$ in (b) where $x$ is an integer $\geq 73$

Q	Answer	Mark	Comments	
11(c)	$\frac{41}{80}$ or 0.5125 or 51.25%	B1	oe fraction, decimal or percentage SC1 answers 58 in (a) and 41 in (c) or $\frac{58}{x}$ in (a) and $\frac{41}{x}$ in (c), where $x$ is an integer $\geq 58$ or answers 73 in (b) and 41 in (c) or $\frac{73}{x}$ in (b) and $\frac{41}{x}$ in (c), where $x$ is an integer $\geq 73$	
			<b>Additional Guidance</b>	
			58 in (a) and 73 in (b) and 41 in (c) scores 0, SC1, SC1	

Q	Answer	Mark	Comments
12(a)	$1 \leq a < 10$	B1	allow 1.0 etc
	<b>Additional Guidance</b>		
	Accept 9.9 for 10		

Q	Answer	Mark	Comments
12(b)	0.00045	B2	B1 $4.5 \times 10^4$ or $4.5 \times 10^{-3}$ ignore extra 0s which don't affect the value
	<b>Additional Guidance</b>		
	0.0045 in working with $4.5 \times 10^{-3}$ on the answer line		B1

Q	Answer	Mark	Comments
13(a)	$(y =) ax + b$ and $(y =) ax - 3a + b$	B2	any letter for $x$ other than $a$ or $b$ or $y$ B1 $(y =) ax + b$ or $(y =) a(x - 3) + b$ or $(y =) ax - 3a + b$ or substitution of two values for $x$ with a difference of 3 and correct working to show that the output decreases by $3a$ eg substituting $x = 6$ and $x = 3$ to get $6a + b$ and $3a + b$
	<b>Additional Guidance</b>		
	Allow $xa$ for $ax$ throughout		
	Do not allow $a \times x + b$ for $ax + b$ unless recovered		
	Allow, eg $(x - 3) \times a + b$ for $a(x - 3) + b$		
	Do not allow missing brackets unless recovered eg do not allow $x - 3 \times a$ for $a(x - 3)$		
	Do not accept written answers without the necessary algebra eg The input has decreased by 3 and will then be multiplied by $a$ , so the output will decrease by $3a$		B0
	Ignore further non-contradictory work if B2 awarded		

Q	Answer	Mark	Comments
13(b)	<b>Alternative method 1 – using <math>k</math></b>		
	$f(2) \times f(1) (= 8k \times k) = 8k^2$ or $f(2) = 8k$	M1	condone $k^2 8$ or $k 8$
	$f(2) \times f(1) = 8k^2$ and $f(2) = 8k$ and No	A1	condone $k^2 8$ or $k 8$
	<b>Alternative method 2 – substituting a value for <math>k</math></b>		
	Identifies a value of $k$ other than 1 and correctly evaluates $f(2) \times f(1)$ or $f(2)$	M1	eg $k = 3$ and $f(2) \times f(1) = 72$ or $f(2) = 24$
	Identifies a value of $k$ other than 1 and correctly evaluates $f(2) \times f(1)$ and $f(2)$ and No	A1	eg $k = 3$ and $f(2) \times f(1) = 72$ and $f(2) = 24$ and No
	<b>Additional Guidance</b>		
	$8k$ from $f(2) \times f(1)$ is M0, but M1 can be awarded if accompanied by $f(2) = 8k$		
	Students may correctly state that $f(2) \times f(1)$ and $f(2)$ are (only) equal when $k = 1$ This may replace 'No' in their answer, but does not score without $8k$ and $8k^2$		
	Do not allow unprocessed values, eg $2^3$ or $1^3$		

Q	Answer	Mark	Comments
14	6 21 36 46	B2	B1 their median = $3.5 \times$ their LQ with the first eight values in order and their UQ and their last number $\geq$ their median or their UQ = $6 \times$ their LQ with the first ten numbers in order and their last number $\geq$ their UQ or their range = $2 \times$ their interquartile range with all values in order
	<b>Additional Guidance</b>		
	Take the boxes to be the LQ, median, UQ and highest value in that order		
	Decimal values can score up to B1 eg 5.5 20 33 45 has UQ = $6 \times$ LQ		B1
	Ignore blank boxes for B1		
	If all boxes are blank, mark the working lines		

Q	Answer	Mark	Comments
15	Not true Not true True True	B4	B1 each correct answer
	<b>Additional Guidance</b>		
	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	<b>Alternative method 1 – equates coefficients and eliminates an unknown</b>		
	$10x + 6y = 18$ and $10x - 20y = 70$ or $20x + 12y = 36$ and $6x - 12y = 42$	M1	oe equates coefficients of one unknown allow one term error
	$-20y - 6y = 70 - 18$ or $-26y = 52$ or $20x + 6x = 36 + 42$ or $26x = 78$	M1dep	oe eliminates an unknown must be correct for their equations
	$x = 3$ and $y = -2$	A2	A1 $x = 3$ from correct method or $y = -2$ from correct method
	<b>Alternative method 2 – substitutes for <math>x</math></b>		
	$x = 7 + 2y$ or $x = \frac{9}{5} - \frac{3}{5}y$	M1	oe makes $x$ the subject of one equation allow one term error
	$5(7 + 2y) + 3y = 9$ or $13y = -26$ or $2\left(\frac{9}{5} - \frac{3}{5}y\right) - 4y = 14$ or $\frac{-26}{5}y = \frac{-52}{5}$	M1dep	oe eliminates $x$ must be correct for their rearrangement
	$x = 3$ and $y = -2$	A2	A1 $y = -2$ from this method

Question 16 continues on the next page

<b>16 cont</b>	<b>Alternative method 3 – substitutes for y</b>		
	$y = 0.5x - 3.5$ or $y = 3 - \frac{5}{3}x$	M1	oe makes $y$ the subject of one equation allow one term error
	$5x + 3(0.5x - 3.5) = 9$ or $6.5x = 20.5$ or $2x - 4\left(3 - \frac{5}{3}x\right) = 14$ or $\frac{26}{3}x = 26$	M1dep	oe eliminates $y$ must be correct for their rearrangement
	$x = 3$ and $y = -2$	A2	A1 $x = 3$ from this method
	<b>Alternative method 4 – makes the same unknown the subject in both equations</b>		
	$x = 7 + 2y$ or $x = \frac{9}{5} - \frac{3}{5}y$ or $y = 0.5x - 3.5$ or $y = 3 - \frac{5}{3}x$	M1	oe makes $y$ or $x$ the subject of one equation allow one term error
	$7 + 2y = \frac{9}{5} - \frac{3}{5}y$ or $\frac{13}{5}y = -\frac{26}{5}$ or $0.5x - 3.5 = 3 - \frac{5}{3}x$ or $\frac{13}{6}x = 6.5$	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
	$x = 3$ and $y = -2$	A2	A1 $x = 3$ from correct method or $y = -2$ from correct method
	<b>Additional Guidance</b>		
	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) $0.5x - 3.5 = 3 - 1.6x$		M1M1	
Answers from trial and improvement or with no working score 0 or 4			

Q	Answer	Mark	Comments
17	<b>Alternative method 1 – expressions in <math>x</math></b>		
	$\pi(2x)^2$ or $4\pi x^2$	M1	oe area of the base of the cylinder
	$\pi(2x)^2 \times x$ or $4\pi x^3$ or $\frac{4}{3}\pi x^3 \div 2$ or $\frac{2}{3}\pi x^3$	M1dep	oe volume of the cylinder  oe volume of the hemisphere
	$4\pi x^3$ and $\frac{2}{3}\pi x^3$ and 1 : 6	A1	either order
	<b>Alternative method 2 – substituting a value for <math>x</math></b>		
	Substitutes a value for $x$ and works the area of the base of the cylinder	M1	eg using $x = 3$ ,  $36\pi$
	Substitutes the same value for $x$ and works out the volume of the hemisphere or the cylinder	M1dep	eg using $x = 3$ volume of hemisphere = $\frac{4}{3}\pi \times 3^3 \div 2$ or $18\pi$ or volume of cylinder = $36\pi \times 3$ or $108\pi$
	Both correct volumes for their value of $x$ and 1 : 6	A1	either order
	<b>Additional Guidance</b>		
	1 : 6 or 6 : 1 without correct working or values		M0M0A0
	Condone $\pi$ missing consistently for all marks		
	Allow 'correct' and consistent values of $\pi$ throughout (eg 3, 3.14, $\frac{22}{7}$ )		
Condone use of $r$ for $x$ throughout			

Q	Answer	Mark	Comments
18	102	B1	

Q	Answer	Mark	Comments
19	$4 \times 3 \times 2 (\times 1) \times 3$ or $5 \times 4 \times 3 \times 2 (\times 1) \times \frac{3}{5}$ or $120 \times \frac{3}{5}$	M1	oe
	72	A1	SC1 36 or 24 or 48 or 120
	<b>Additional Guidance</b>		
	36 is the number of possible 5-digit numbers ending in two even digits		
	24 is the number of possible 5-digit numbers ending in 2 or the number of possible 5-digit numbers ending in 4 or the number of possible 5-digit numbers ending in 6		
	48 is the number of possible 5-digit odd numbers		
	120 is the number of possible 5-digit numbers		
	Ignore any listing of possible numbers		



Q	Answer	Mark	Comments
<b>20</b>	<b>Alternative method 1 – finds K in terms of L and substitutes</b>		
	$2K = 3L$ or $K = L + 2M$	M1	oe correct equation eg $K = \frac{3L}{2}$ or $L = \frac{2K}{3}$ may be implied by values on diagram
	$1.5L = L + 2M$	M1dep	oe correct equation in L and M eg $3L = 2L + 4M$
	4	A1	condone 4M (= L)
	<b>Alternative method 2 – finds two variables in terms of the other variable</b>		
	Finds one variable in terms of one other eg L is $\frac{2}{3}$ of K	M1	oe fractions, decimals, percentages or ratio eg $K : L = 1 : \frac{2}{3}$ may be implied by values on diagram
	Finds two variables in terms of the other eg L is $\frac{2}{3}$ of K and M is $\frac{1}{6}$ of K	M1dep	oe fractions, decimals, percentages or ratio eg $K : L : M = 1 : \frac{2}{3} : \frac{1}{6}$ may be implied by values on diagram
	4	A1	condone 4M (= L)
	<b>Alternative method 3 – assumes a mass for one unknown</b>		
	Assumes a mass for one unknown and works out the mass of one other	M1	eg $K = 6$ kg and $L = 4$ kg
	Assumes a mass for one unknown and works out the masses of the other two	M1dep	eg $K = 6$ kg and $L = 4$ kg and $M = 1$ kg
	4	A1	condone 4M (= L)
	<b>Additional Guidance</b>		
	Condone 0.66 or better for $\frac{2}{3}$ and 0.0.16 or better for $\frac{1}{6}$ must be correct		
	$2K : 3L$ is not enough for M1		
	Ignore units		

Q	Answer	Mark	Comments
<b>21</b>	$(x - 4)^2 - 7$ or $a = 4$ and $b = 7$	B2	B1 $(x - 4)^2 \dots$ or $(x - 4)(x - 4) \dots$ or $a = 4$ (implied by 4, -24) or $x^2 - 2ax + a^2 - b$ or $-2a = -8$ or $2a = 8$ or $a^2 - b = 9$ or correct $b$ for their $a$
	<b>Additional Guidance</b>		
	$(x + 4)^2 - 7$ (7 is correct for $a = -4$ )	B1	
	$(x - 8)^2 - 55$ (55 is correct for $a = 8$ )	B1	
	$(x + 8)^2 - 55$ (55 is correct for $a = -8$ )	B1	

Q	Answer	Mark	Comments
	$a + b \rightarrow 3\sqrt{3}$ $ab \rightarrow 6$ $\frac{b}{a} \rightarrow 2$	B3	B1 each correct match
<b>Additional Guidance</b>			
<b>22</b>			<b>B3</b>
Two lines from a left-hand box is choice			<b>B0</b>

Q	Answer	Mark	Comments
23	<b>Alternative method 1 – subtracting powers of 10 algebraically</b>		
	Denotes the given recurring decimal by a letter and multiplies by one of 10, 100, etc	M1	eg $10x = 2.4242\dots$ or $100x = 24.2424\dots$
	Denotes the given recurring decimal by a letter and multiplies by one or two of 10, 100, etc and subtracts accordingly	M1dep	eg $100x - x = 24.24242\dots - 0.24242\dots$ or $99x = 24$ or $\frac{24}{99}$ or $10000x - 100x = 2424.2424\dots - 24.2424\dots$ or $9900x = 2400$ or $\frac{240}{990}$
	$\frac{8}{33}$	A1	
	<b>Alternative method 2 – subtracting powers of 10 numerically</b>		
	Multiplies the given decimal by one of 10, 100, etc	M1	eg $0.2\dot{4} \times 10 = 2.4\dot{2}$
	Multiplies the given decimal by one or two of 10, 100, etc and subtracts appropriately in fraction form	M1dep	eg $0.2\dot{4} \times 1000 = 242.4\dot{2}$ and $0.2\dot{4} \times 100 = 2.4\dot{2}$ and $\frac{242.42 - 2.42}{1000 - 10}$ or $\frac{240}{990}$
	$\frac{8}{33}$	A1	
	<b>Additional Guidance</b>		
	Condone decimals within fractions up to M2 eg $\frac{2.4}{9.9}$		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 $242.42 - 2.42 = 1000x - 10x$			

Q	Answer	Mark	Comments
24	<b>Alternative method 1 – using the equations of the lines</b>		
	$\frac{22-y}{6-0} = 3$ or $22 = 3 \times 6 + c$ or $(c =) 22 - 3 \times 6$ or $c = 4$ or $P$ is at $(0, 4)$ or $(PR =) y = 3x + 4$ or $y$ -coordinate of $P$ is 4 or $y$ -coordinate of $Q$ is 4	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
	$3m = -1$ or $(m =) -\frac{1}{3}$	M1	oe gradient of $RQ$
	$22 = \text{their } -\frac{1}{3} \times 6 + c$ or $22 = -2 + c$ or $c = 24$ or $(RQ =) y = -\frac{1}{3}x + 24$	M1dep	oe equation in $c$ dep on previous mark  oe equation of $RQ$
	their $\left(-\frac{1}{3}x + 24\right) = \text{their } 4$ or $x$ -coordinate of $Q$ is 60	M1dep	oe equation in $x$ where $x$ is the $x$ -coordinate of $Q$ dep on M3 $-\frac{1}{3} = \frac{22 - \text{their } 4}{6 - x}$ implies M4 if their 5 is correct or from correct working
(60, 4)	A1		

Question 24 continues on the next page

<b>24 cont</b>	<b>Alternative method 2 – using similar triangles</b>		
	Drops a perpendicular from $R$ to point $S$ on $PQ$ and uses $RS = 3PS = 18$ to work out that $P$ is at $(0, 4)$	M1	any or no letter  eg $22 - 3 \times 6$
	$3m = -1$ or $(m =) -\frac{1}{3}$ or  $\frac{RS}{SQ} = \frac{1}{3}$	M1	oe  gradient of $RQ$
	$18 \times 3$ or $54$	M1dep	length of $SQ$ may be seen on diagram dep on previous mark
	$6 +$ their $54$ or $x$ -coordinate of $Q$ is $60$	M1dep	
	$(60, 4)$	A1	
	<b>Additional Guidance</b>		
	Note that $60$ (for the $x$ -coordinate of $Q$ ) implies M3 (on alt 2) and implies M4 if $4$ is also seen (on alt 1)		

Q	Answer	Mark	Comments	
<b>25</b>	$\sin 60 = \frac{\sqrt{3}}{2}$ or $\tan 60 = \sqrt{3}$ or $\cos 30 = \frac{\sqrt{3}}{2}$	M1	oe eg $5 \sin 60 = \frac{5\sqrt{3}}{2}$ or $2 \tan 60 = 2\sqrt{3}$ implied by position in the expression may be seen in a table	
	substitution of all three correct values	M1dep	eg $\frac{5\sqrt{2}}{2} - \frac{\sqrt{2}}{2}$ or $\frac{4\sqrt{2}}{3}$ or $\frac{2\sqrt{3}}{2\sqrt{3}}$	
	1	M1dep		
	(1 =) $\tan 45$ or $x = 45$ with full working seen for M3	A1		
	<b>Additional Guidance</b>			
	Reference to $45^\circ$ being an acute angle is not required			

Q	Answer	Mark	Comments
26	<b>Alternative method 1</b>		
	$\sqrt{\frac{36\pi}{\pi}}$ or 6	M1	oe may be seen on diagram implied by diameter = 12
	$x^2 + x^2 = (\text{their } 6)^2$ or $2x^2 = 36$ or $x^2 = 18$ or their $6 \times \sin 45$ or their $6 \times \cos 45$ or their $6 \times \frac{1}{\sqrt{2}}$	M1	oe any letter (condone $a$ ) their 6 is their length OQ (the radius of the circle)
	$\sqrt{\text{their } 6^2 \div 2}$ or $\sqrt{18}$ or $3\sqrt{2}$ or $(\sqrt{18})^2$ or $(3\sqrt{2})^2$ or $(\text{their } 6 \times \sin 45)^2$ or $(\text{their } 6 \times \cos 45)^2$ or $\left(\text{their } 6 \times \frac{1}{\sqrt{2}}\right)^2$ or 18	M1dep	oe value for the length of one side of the square or the area of the square  dep on previous mark
	2 with full working seen for M3	A1	

Question 26 continues on the next page



<b>26 cont</b>	<b>Alternative method 2</b>		
	$\sqrt{\frac{36\pi}{\pi}}$ or 6or side length of square = $\frac{6}{\sqrt{a}}$	M1	oe may be seen on diagram implied by diameter = 12
	(Area of square = $\frac{36}{a}$ and) side length of square = $\frac{6}{\sqrt{a}}$ and $\left(\frac{6}{\sqrt{a}}\right)^2 + \left(\frac{6}{\sqrt{a}}\right)^2 = (\text{their } 6)^2$	M1	oe their 6 is their length OQ (the radius of the circle)  condone missing brackets if recovered
	$\frac{36}{a} + \frac{36}{a} = (\text{their } 6)^2$ or $\frac{72}{a} = 36$	M1dep	dep on M1M1
	2 with full working seen for M3	A1	
	<b>Additional Guidance</b>		
	2 with no working		MOMOM0A0
	$\frac{1}{2}$ on answer line (may score method marks)		A0
	Area of 18 from $\frac{1}{2}$ product of diagonals scores first 3 M marks		

Q	Answer	Mark	Comments		
<b>27</b>	(Total volume =) $\frac{200}{a} + \frac{300}{b}$	M1	oe eg $\frac{300a}{ab} + \frac{200b}{ab}$ or $\frac{300a + 200b}{ab}$		
	correct expression for total mass $\div$ total volume	M1dep	eg $(200 + 300) \div \left( \frac{300a}{ab} + \frac{200b}{ab} \right)$ or $500 \div \frac{300a + 200b}{ab}$ or $500 \times \frac{ab}{300a + 200b}$		
	$500 \times \frac{ab}{300a + 200b} = \frac{5ab}{3a + 2b}$	A1	condone $2b + 3a$ for $3a + 2b$		
	<b>Additional Guidance</b>				
	Students can gain M1M1 if they incorrectly simplify a correct expression for total volume before forming the division eg $\frac{200}{a} + \frac{300}{b} = \frac{500}{a+b}$ followed by $60 \div \frac{500}{a+b}$			M1M1A0	
Allow correct cancellation of 500, 300 and 200 at any stage of the working					