GCSE MATHEMATICS 8300/1H

Higher Tier Paper 1 Non-Calculator

Mark scheme

November 2025

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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

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

Further copies of this mark scheme are available from aqa.org.uk

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Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leqslant$ value $< b$
3.14 …	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Q	Answer	Mark	Comments
1(a)	8.34×10^5	B1	oe in standard form

Q	Answer	Mark	Comments
1(b)	0.079	B1	condone $\frac{79}{1000}$

Q	Answer	Mark	Comments
2	Circle with radius 4 units and centre (0,0)	B1	mark intention

Q	Answer	Mark	Comments
3(a)	$\times 6$ then $+11$ or $+\frac{11}{6}$ then $\times 6$	B1	

Q	Answer	Mark	Comments
3(b)	-3	B1	

Q	Answer	Mark	Comments
4	**Alternative method 1: finds the area of one face and takes the square root**		
	$54 \div 6$ or 9	M1	this is **not** implied by $9 \times 6 = 54$
	$\sqrt{\text{their } 9}$	M1dep	
	3	A1	
	Alternative method 2: trial and improvement		
	Trial of a total surface area of a cube with correct result of the trial	M1	eg $2 \times 2 \times 6 = 24$
	Trial of a total surface area of a cube with side length 3 with correct result of the trial	M1dep	eg $3 \times 3 \times 6 = 54$
	3	A1	
	Additional Guidance		
	Ignore any units given		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="6">5(a)</td><td>48 as the total for Group A
or
72 as the total for Group B</td><td>B1</td><td></td></tr>
<tr><td>32 and 16 in the correct position
or
45 and 27 in the correct position</td><td>B1ft</td><td>ft their 48

ft their 72</td></tr>
<tr><td>All values correct</td><td>B1</td><td></td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2"><table><tr><th></th><th>German</th><th>French</th><th>Total</th></tr><tr><td>Group A</td><td>32</td><td>16</td><td>48</td></tr><tr><td>Group B</td><td>45</td><td>27</td><td>72</td></tr><tr><td>Total</td><td>77</td><td>43</td><td>120</td></tr></table></td><td>B3</td></tr>
<tr><td colspan="2">ft can only be awarded for results in integer values for that row, but allow truncation or rounding to the nearest integer after division by 3 or 8
eg Total for group A is 40, with 27 in German and 13 in French</td><td>2nd B1</td></tr>
</table>

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="5">5(b)</td><td>$\frac{\text{their 27}}{\text{their 43}}$</td><td>B2ft</td><td>oe fraction, decimal or percentage
ft their values for French Group B and French total
B1ft
their 27 as a numerator
or their 43 as a denominator</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Decimal or percentage without fraction seen must be correct to 2sf or better</td><td></td></tr>
<tr><td colspan="2">Ignore an attempt to simplify a fraction scoring B2 or B1 or convert it to a decimal or percentage
eg $\frac{27}{120} = 21\%$ (incorrect, should be 23% to 2sf)</td><td>B1</td></tr>
<tr><td colspan="2">If their values result in a fraction or decimal $\geqslant 1$ or a percentage $\geqslant 100\%$ then a maximum of B1 can be awarded</td><td></td></tr>
</table>

Q	Answer	Mark	Comments
6(a)	Valid description	B1	eg As one increases, the other decreases or Population (density) is lower the further from the centre
	Additional Guidance		
	Ignore incorrect or irrelevant statements alongside correct statements, unless contradictory Ignore reference to strength or negative correlation Ignore comments about individual points		
	It is usually lower the further away it is		B1
	It is negative correlation because the density is lower the further from the centre		B1
	As people/km^2 goes down, km goes up		B1
	It is negative correlation		B0
	They are inversely proportional		B0

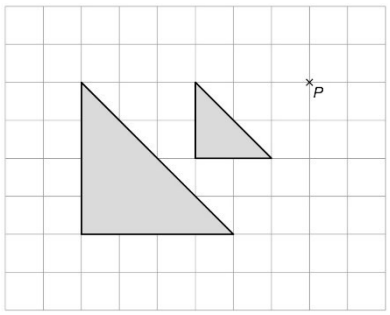
Q	Answer	Mark	Comments
6(b)	Line of best fit drawn through (1, [3600, 5000]) and (3, [1400, 2600])	B1	accept intention to draw a straight line ignore anything outside 1 to 3
	Correct reading of their line ± half a square	B1ft	ft their straight line with negative gradient ignore any working lines on their graph
	Additional Guidance		
	No line of best fit		B0B0

Q	Answer	Mark	Comments
7(a)	**Alternative method 1: converts to decimals and adds**		
	0.4 or 0.35	M1	
	0.75	A1	
	Alternative method 2: adds as fractions and then converts to a decimal		
	$\left(\frac{2}{5}=\right)\ \frac{8}{20}$ or $\left(\frac{7}{20}=\right)\ \frac{1.75}{5}$ or $\frac{40}{100}$ and $\frac{35}{100}$ or $\frac{75}{100}$ or 75%	M1	oe fractions with common denominator oe fraction or percentage
	0.75	A1	
	Additional Guidance		
	Alt 2, for M1 accept fractions which include decimals		M1

Q	Answer	Mark	Comments
7(b)	No and valid fraction and terminating decimal	B1	eg No and $\frac{1}{4}=0.25$ or No and ($x=$) 4 and 0.25 or No and $\frac{1}{8}=0.125$ or No and ($x=$) 8 and 0.125 or No and $\frac{1}{100}=0.01$ or No and ($x=$) 100 and 0.01
	Additional Guidance		
	No with one counter-example, even if amongst multiple examples		B1
	Reasons involving recurring decimals		B0

Q	Answer	Mark	Comments
8(a)	2 and 1.5	B2	oe B1 2 or 1.5 oe

Q	Answer	Mark	Comments
8(b)	At least three points from the table in part (a) plotted or At least three correct points	M1	implied by a graph passing through the three points
	Straight line from (–2, 2.5) to (2, 0.5)	A1	ignore any working beyond (–2, 2.5) and (2, 0.5)
	Additional Guidance		
	Half a square tolerance throughout		

Q	Answer	Mark	Comments
9	Fully correct triangle	B3	B2 correct size triangle in the correct orientation but not in the correct position or all vertices plotted in the correct positions but not joined B1 correct size triangle not in the correct orientation
	Additional Guidance		
			
	Mark intention		

Q	Answer	Mark	Comments
10(a)	11 : 15 : 20 or $\frac{11}{20} : \frac{3}{4} : 1$ or $\frac{11}{15} : 1 : \frac{4}{3}$ or $1 : \frac{15}{11} : \frac{20}{11}$	B2	B1 55 : 75 : 100 oe unsimplified ratio or two of the three correct values in the correct positions in a 3-value ratio eg 11 : 15 : 10 or $\frac{11}{20} : \frac{3}{5} : 1$ or three correct values in a 3-value ratio but not in the correct order or their incorrect 3-value ratio fully simplified
	Additional Guidance		
	Accept decimals to 2dp or better Accept mixed numbers		
	Ignore units for B1 only		

Q	Answer	Mark	Comments	
10(b)	**Alternative method 1: working with 1°**			
	$390 \times \frac{55}{130}$	M2	oe M1 for a correct first step using one operator eg $\frac{130}{55}$	
	165	A1	SC1 225 or 300 or 1080	
	Alternative method 2: build-up method			
	Correct amount of money for a multiple of 5°, up to 50°, or the correct method to work it out	M1	value must be assigned to an angle eg 5° (=) 15 390 ÷ 13 and 10°	
	Correct method to calculate the amount of money for 55°	M1dep	eg 5° = 15 and 15 × 11	
	165	A1	SC1 225 or 300 or 1080	
	Additional Guidance			
	Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts			
	SC1 for amount spent on Other (225), Food (300) or total (1080)			
	Condone missing degrees symbols			
	165°			M2A0

Q	Answer	Mark	Comments
11	(radius =) $\frac{4 \times 6}{2}$ or $\frac{24}{2}$ or 12	M1	may be implied by 144
	$\pi \times$ (their 12)$^2 \div 4$	M1	oe their 12 can be any positive number [113.04, 113.112] implies M2
	36π	A1	
	Additional Guidance		
	For the award of M1M1 their 12 must not be from incorrect working		
	Condone eg $\pi 36$ for 36π		
	Accept [3.14, 3.142] or pi for π for up to M2		

	Answer	Mark	Comments
12(a)	All 6 points plotted using upper class boundaries and cf values	B1	± half a small square implied by correct graph
	Polygon or smooth curve through (10, 3), (20, 9), (30, 16), (40, 20), (50, 27) and (60, 30)	B1	± half a small square ignore any bars drawn
	Additional Guidance		
	For B1B1 the graph must start at (0, 0) or (10, 3) and end at (60, 30), unless followed by a horizontal line		

Q	Answer	Mark	Comments
12(b)	Horizontal line drawn from 7.5 to curve or polygon or horizontal line drawn from 22.5 to curve or polygon	M1	implied by correct reading for their increasing curve, polygon or straight line or mark at correct place on their increasing curve, polygon or straight line ± half a small square
	Correct evaluation of correct reading from their graph at 22.5 − correct reading from their graph at 7.5	A1ft	ft their increasing curve, polygon or straight line

Q	Answer	Mark	Comments
13	$5 \times 3 : 7 \times 3$ or $15 : 21$ and $3 \times 7 : 2 \times 7$ or $21 : 14$ **or** $15 : 21 : 14$	M1	oe 3-way ratio eg $5 : 7 : \frac{14}{3}$ or $\frac{15}{3} : \frac{21}{3} : \frac{14}{3}$ or $\frac{15}{7} : 3 : 2$ or $\frac{15}{7} : \frac{21}{7} : \frac{14}{7}$
	their 15 + their 21 + their 14 or 50	M1dep	oe $\frac{21}{50}$ oe implies M2
	42	A1	

Q	Answer	Mark	Comments
14	$5^2 + 8^2$ or 89 or $9^2 + 3^2$ or 90	M1	oe eg $(-5)^2 + 8^2$ or $9^2 + (-3)^2$ missing brackets must be recovered
	$5^2 + 8^2$ or 89 and $9^2 + 3^2$ or 90 **or** $\sqrt{5^2 + 8^2}$ or $\sqrt{89}$ and $\sqrt{9^2 + 3^2}$ or $\sqrt{90}$	M1dep	oe
	89 and 90 and No or $\sqrt{89}$ and $\sqrt{90}$ and No	A1	
	Additional Guidance		
	No may be implied eg $89 < 90$		M1M1A1

Q	Answer	Mark	Comments
15(a)	5 parts = 300 or 300 ÷ (7 – 2) or 60	M1	implied by 120 (small), 420 (medium), 180 (large) or 720 (total)
	$\frac{3}{5}$ × 3 × their 60	M1dep	oe eg $\frac{3}{5} \times \frac{3}{12} \times 720$
	108	A1	allow 100 or 110 if 108 seen

Q	Answer	Mark	Comments
15(b)	Correct statement	B1	eg 2 : 7 : 3 is for the total number of coffees sold, not for the takeaway coffees $\frac{3}{5}$ is for all the coffees, but might not be the same for the large coffees
	Additional Guidance		
	The ratio for takeaway coffee might be different	B1	
	Don't know the takeaway ratio	B1	
	Have assumed the ratio stays the same	B1	
	People who buy large might be more likely to buy takeaway	B1	
	The fraction for large coffee might be different	B1	
	Condone words other than ratio and fraction so long as the meaning is clear eg I assumed the relationship stays the same	B1	
	The ratio may not be accurate	B0	
	$\frac{3}{5}$ may not be accurate	B0	
	Some people who ordered takeaway may have drunk it in the shop	B0	
	They don't know the exact numbers	B0	
	There isn't enough information	B0	

Q	Answer	Mark	Comments	
16	One correct equation eg $4a + 3b = 2$ or $3a + 5b = 1.94$ or $7a + 8b = 3.94$	M1	any letters eg $4a + 3b = 200$ or $3x + 5y = 194$ or $7w + 8z = 394$	
	Equates coefficients or makes a the subject in one equation or makes b the subject in one equation	M1dep	eg $20a + 15b = 10$ and $9a + 15b = 5.82$ or $12a + 9b = 6$ and $12a + 20b = 7.76$ eg $a = \frac{2-3b}{4}$ or $a = \frac{1.94-5b}{3}$ eg $b = \frac{2-4a}{3}$ or $b = \frac{1.94-3a}{5}$	
	Correct elimination of one unknown	M1dep	eg $11a = 4.18$ or $a = 0.38$ or $a = 38$ **or** $11b = 1.76$ or $b = 0.16$ or $b = 16$	
	38p or £0.38	A1	must include correct unit condone £0.38p	
	Additional Guidance			
	Condone units within equations, but do not allow mixed units unless recovered			
	Correct answer from trial			M3A1

Q	Answer	Mark	Comments
17	Any two of 10, 30 and 60	B1	may be on the diagram rounding to 60 is implied by use of 0.5 for cos 61
	Correct rhs of cosine rule equation with rounded or unrounded values	M1	eg $10.7^2 + 29.4^2 - 2 \times 10.7 \times 29.4 \times$ cos 61 or $10^2 + 30^2 - 2 \times 10 \times 30 \times \cos 60$ condone use of 11 and 29 for this mark
	$\sqrt{10^2 + 30^2 - 2 \times 10 \times 30 \times \cos 60}$ or $\sqrt{100 + 900 - 600 \cos 60}$ or $\sqrt{100 + 900 - 300}$	M1dep	oe
	$\sqrt{700}$ or $10\sqrt{7}$ with 10, 30 and 60 seen	A1	condone $10\sqrt{7}$ with 10, 30 and 60 seen SC3 $\sqrt{691}$ with 11, 30 and 60 seen or $\sqrt{651}$ with 10, 29 and 60 seen SC2 $\sqrt{643}$ with 11, 29 and 60 seen
	Additional Guidance		
	Ignore any attempt to simplify the surd or convert to decimal form after $\sqrt{700}$ or $10\sqrt{7}$ seen (apply also to SC values)		B1M1M1A1

Q	Answer	Mark	Comments
18	**Alternative method 1: using the quadratic formula**		
	$5x^2 + 4x - 28\ (= 0)$ or $-5x^2 - 4x + 28\ (= 0)$	B1	oe 3-term quadratic (equated to 0) implied by M1 awarded
	$\frac{-4 \pm \sqrt{4^2 - 4(5)(-28)}}{2(5)}$	M1	ft their 3-term quadratic missing brackets must be recovered
	$\frac{-4 \pm \sqrt{576}}{10}$ or $\frac{-4 \pm 24}{10}$	M1dep	ft their 3-term quadratic with evaluations completed as far as shown
	$-\frac{14}{5}$ and 2	A1	oe
	Alternative method 2: using factorisation		
	$5x^2 + 4x - 28\ (= 0)$ or $-5x^2 - 4x + 28\ (= 0)$	B1	oe 3-term quadratic (equated to 0) implied by M1M1 awarded
	$(5x + p)(x + q)$ where $pq = -28$ or $5q + p = 4$ or $(5x + r)(5x + s)$ where $rs = -140$ or $r + s = 4$	M1	ft their 3-term quadratic
	$(5x + 14)(x - 2)\ (= 0)$	M1dep	fully correct factorisation of their 3-term quadratic if it factorises
	$-\frac{14}{5}$ and 2	A1	oe

The mark scheme for question 18 continues on the next page

18cont	**Alternative method 3: using completing the square**		
	$5x^2 + 4x - 28$ (= 0) or $-5x^2 - 4x + 28$ (= 0) **or** $5\left(x^2 + \frac{4}{5}\right) = 28$ or $x^2 + \frac{4}{5}x = \frac{28}{5}$ or $5\left(x^2 + \frac{4}{5}x - \frac{28}{5}\right)$ (= 0) or $x^2 + \frac{4}{5}x - \frac{28}{5}$ (= 0)	B1	oe 3-term quadratic (equated to 0) implied by M1 awarded
	$5\left[\left(x^2 + \frac{2}{5}\right)^2 - \left(\frac{2}{5}\right)^2 - \frac{28}{5}\right]$ (= 0) or $\left[\left(x^2 + \frac{2}{5}\right)^2 - \left(\frac{2}{5}\right)^2 - \frac{28}{5}\right]$ (= 0) or $5\left[\left(x^2 + \frac{2}{5}\right)^2 - \left(\frac{2}{5}\right)^2\right] = 28$ or $\left[\left(x^2 + \frac{2}{5}\right)^2 - \left(\frac{2}{5}\right)^2\right] = \frac{28}{5}$	M1	ft their 3-term quadratic
	$-\frac{2}{5} \pm \sqrt{\left(\frac{2}{5}\right)^2 + \frac{28}{5}}$ or $-\frac{2}{5} \pm \sqrt{\frac{144}{25}}$	M1dep	fully correct ft their 3-term quadratic (equation) seen
	$-\frac{14}{5}$ and 2	A1	
	Additional Guidance		
	$-\frac{14}{5}$ and 2 with no working or from T & I		4 marks

Q	Answer	Mark	Comments
19(a)	$0.49\dot{2}$	B1	oe eg $\frac{443}{900}$ accept a bar or arc above the 2 or 0.4922.. (at least two 2s and at least two dots)

Q	Answer	Mark	Comments
19(b)	**Alternative method 1: using $x = 0.074\ldots$**		
	Multiplication by a power of 10 with correct result	M1	eg $10x = 0.744\ldots$ or $100x = 7.44\ldots$ or $1000x = 74.4\ldots$ any or no letter
	Correct equation formed from subtraction of two equations to eliminate recurring digits or correct fraction with a decimal numerator	M1dep	eg $9x = 0.67$ or $90x = 6.7$ or $990x = 73.7$ eg $\frac{0.67}{9}$
	$\frac{67}{900}$	A1	oe fraction eg $\frac{737}{9900}$
	Alternative method 2: using $x = 0.004\ldots$		
	Correct equation formed from subtraction of two equations to eliminate recurring digits or correct fraction, which may include a decimal numerator	M1	eg $9x = 0.04$ or $90x = 0.4$ or $99x = 0.44$ eg $\frac{4}{900}$ or $\frac{4.4}{990}$ or $\frac{44}{9900}$
	$\frac{7}{100}$ + their correct fraction, which may include a decimal numerator	M1dep	eg $\frac{7}{100} + \frac{4}{900}$
	$\frac{67}{900}$	A1	oe fraction eg $\frac{737}{9900}$
	Additional Guidance		
	Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Ignore incorrect simplifying if correct fraction seen		
	Unless recovered, recurring decimals must be denoted by a dot or bar or arc above the 4 or at least two 4s and at least two dots		

Q	Answer	Mark	Comments
20	**Alternative method 1: eliminates y**		
	$x^2 + 2x + 5 = 12 - 4x$	M1	oe implied by $x^2 + 6x - 7\ (= 0)$
	$x^2 + 6x - 7\ (= 0)$	M1dep	oe 3-term quadratic
	$(x - 1)(x + 7)$ or $\frac{-6 \pm \sqrt{6^2 - 4 \times 1 \times -7}}{2 \times 1}$ or $(x + 3)^2 = 16$	M1	oe correct method to solve their 3-term quadratic, but not $x^2 + 2x + 5 = 0$
	$x = 1$ and $x = -7$ or $x = 1$ and $y = 8$ or $x = -7$ and $y = 40$ with M3 awarded	A1	
	$x = 1$ and $y = 8$ and $x = -7$ and $y = 40$ with M3 awarded	A1	

The mark scheme for question 20 continues on the next page

20cont	**Alternative method 2: eliminates x**		
	$y = \left(\frac{12-y}{4}\right)^2 + 2\left(\frac{12-y}{4}\right) + 5$	M1	oe implied by $y^2 - 48y + 320\ (= 0)$
	$y^2 - 48y + 320\ (= 0)$	M1	oe 3-term quadratic
	$(y-8)(y-40)$ or $\frac{-(-48) \pm \sqrt{48^2 - 4\times1\times320}}{2\times1}$ or $(y-24)^2 = 256$	M1	oe correct method to solve their 3-term quadratic, but not $x^2 + 2x + 5 = 0$
	$y = 8$ and $y = 40$ or $y = 8$ and $x = 1$ or $y = 40$ and $x = -7$ with M3 awarded	A1	
	$x = 1$ and $y = 8$ and $x = -7$ and $y = 40$ with M3 awarded	A1	
	Additional Guidance		
	Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comments
21(a)	$\frac{4}{3\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$ or $\frac{4}{3\sqrt{6}} \times \frac{3\sqrt{6}}{3\sqrt{6}}$	M1	oe may be seen as separate calculations
	$\frac{4\sqrt{6}}{3\times 6}$ or $\frac{4\sqrt{6}}{18}$ or $\frac{4\times 3\times\sqrt{6}}{3\times 3\times 6}$ or $\frac{12\sqrt{6}}{54}$	M1dep	
	$\frac{2\sqrt{6}}{9}$	A1	accept $\frac{2\times\sqrt{6}}{9}$

Q	Answer	Mark	Comments
21(b)	1 : 16	B4	B3 128 B2 18 and 30 and 30 and 50 or 18 and 60 and 50 **or** $\left(8\sqrt{2}\right)^2$ B1 18 or 50 or $30 + 30$ or 60 **or** $5\sqrt{2}$ or $8\sqrt{2}$
	Additional Guidance		
	Up to B2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Terms may be in a grid for B1 or B2		

Q	Answer	Mark	Comments
22	**Alternative method 1: factorisation and cancelling $n + 1$**		
	$(n + 5)(n + 1)$	M1	oe factorisation
	$\frac{1}{n+5}$	A1	
	$\frac{1}{6} + \frac{1}{7}$	M1	accept $\frac{2}{12} + \frac{3}{21}$
	$\frac{1}{n+5}$ and $\frac{1}{6} + \frac{1}{7} = \frac{13}{42}$ and a correct explanation that the first two terms are the greatest	A1	oe explanation eg the terms decrease
	Alternative method 2: substituting $n + 1$ for n for the second term		
	$\frac{n+1}{n^2+6n+5} + \frac{n+2}{n^2+8n+12}$	M1	2nd term must be expanded and simplified to this point
	$\frac{1}{n+5}\ (+\ \frac{1}{n+6})$	A1	
	$\frac{1}{6} + \frac{1}{7}$	M1	accept $\frac{2}{12} + \frac{3}{21}$
	$\frac{1}{n+5} + \frac{1}{n+6}$ and $\frac{1}{6} + \frac{1}{7} = \frac{13}{42}$ and a correct explanation that the first two terms are the greatest	A1	oe explanation eg the terms decrease

The mark scheme for question 22 continues on the next page

<table>
<tr><td rowspan="5">22cont</td><td colspan="3">Alternative method 3: uses linear ÷ quadratic must be decreasing</td></tr>
<tr><td>Correct explanation that a linear function divided by a quadratic function is decreasing
and
substitutes 1 and 2 into the given expression to get $\frac{1}{6} + \frac{1}{7}$ oe fractions
and
shows that the two fractions sum to $\frac{13}{42}$</td><td>B4</td><td>part marks are not available on this scheme</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="2">Up to M1A1M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts</td><td></td></tr>
<tr><td colspan="2">Substitution of 1 and 2 to get $\frac{2}{12} + \frac{3}{21}$ (or $\frac{1}{6} + \frac{1}{7}$) without working for other marks</td><td>M0A0M1A0</td></tr>
</table>