



GCSE MATHEMATICS 8300/2H

Higher Tier

Paper 2 Calculator

Shadow paper based on June 2022 paper

Mark scheme

June 2022

Version: 1.1

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.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
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	Comment
1	$\frac{1}{40}$	B1	

Q	Answer	Mark	Comment
2	$P(A' \cap B)$	B1	

Q	Answer	Mark	Comment
3	21	B1	

Q	Answer	Mark	Comment
4	$-4 \leq x < 2$	B1	

Q	Answer	Mark	Comments
5	Alternative method 1		
	$8x - 4$	M1	may be seen in a grid
	their $8x - 6x = 5 +$ their 4 or $2x = 9$ or $9 \div 2$	M1	oe eg their $-4 - 5 = 6x -$ their $8x$ or $2x - 9 = 0$ collecting two terms in x and two constant terms correctly
	$\frac{9}{2}$ or $4\frac{1}{2}$ or 4.5	A1ft	oe ft M1M0 or M0M1 with exactly one error
	Alternative method 2		
	$\frac{6x}{2} + \frac{5}{2}$	M1	oe two terms eg $3x + 2.5$
	$4x -$ their $\frac{6x}{2} =$ their $\frac{5}{2} + 2$ or $\frac{2x}{2} = \frac{9}{2}$	M1	oe eg $-2 -$ their $\frac{5}{2} =$ their $\frac{6x}{2} - 2x$ or $\frac{2x}{2} - \frac{9}{2} = 0$ collecting two terms in x and two constant terms correctly
$\frac{9}{2}$ or $4\frac{1}{2}$ or 4.5	A1ft	oe ft M1M0 or M0M1 with exactly one error	

Additional Guidance is on the next page

Additional Guidance		
5 cont	Ignore simplification or conversion if correct answer seen	
	Correct answer from trial and improvement	M1M1A1
	Correct equation with terms collected or division with no or incorrect answer	M1M1A0
	Embedded 4.5 with no or incorrect answer	M1M1A0
	$8x - 4 = 6x + 5$ $8x - 6x = 5 - 4$ $x = 0.5$ (exactly one error in line 2)	M1 M0 A1ft
	$6x - 4 = 6x + 5$ $6x - 6x = 5 + 4$ $0 = 9$ (exactly one error in line 1 but no answer)	M0 M1 A0ft
	$8x - 4 = 6x + 5$ $8x + 6x = 5 - 4$ $x = \frac{1}{14}$ (two errors in line 2)	M1 M0 A0ft
	$8x - 2 = 6x + 5$ $8x - 6x = 5 + 2$ $x = 7$ (exactly one error in line 1 but answer does not ft)	M0 M1 A0ft
	Any ft answer must be rounded or truncated to 1 dp or better	
	The last two marks can be implied without the collection of terms seen eg $8x - 2 = 6x + 5$ and $x = 4.5$	M0M1A1ft
	Collecting terms before the bracket has been expanded	M0M0A0ft

Q	Answer	Mark	Comments
	64 and 19 or 4^3 and 19 or 4 and 4 and 4 and 19	B2	together in any order eg 64×19 or 19×4^3 or 4, 4, 4, 19 or $1216 \div 19 = 64$ or $1216 \div 64 = 19$ B1 at least three of 8, 27, 64, 125, 216, 343, 512, 729, 1000, 1331, 1728, 2197 etc (allow 2^3 , 3^3 , 4^3 etc) or all four of 11, 13, 17, 19 (ignore any numbers not between 10 and 20) or (cube number > 1) \times (prime number between 10 and 20) or $1216 \div$ (cube number > 1) or $1216 \div$ (prime number between 10 and 20)
6	Additional Guidance		
	B1 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts		
	B2 responses may be seen on a factor tree		
	B1 for three cube numbers given in index form – evaluations can be ignored eg 4^3 5^3 6^3 scores B1 with no evaluations or with incorrect evaluations		
	B1 for multiplications or divisions – evaluation can be ignored eg1 $2^3 \times 13$ scores B1 with no evaluation or evaluated incorrectly eg2 $1216 \div 27$ scores B1 with no evaluation or evaluated incorrectly eg3 $1216 \div 11$ scores B1 with no evaluation or evaluated incorrectly		
	64 and 19 seen in multiple attempts is B2 if 1216 included eg $64 \times 19 = 1216$ or $1216 \div 19 = 64$ or $1216 \div 64 = 19$ seen amongst multiple attempts	B2	
	64 and 19 seen in multiple attempts is B1 if 1216 not included eg 64×19 seen amongst multiple attempts	B1	
	11 13 15 17 19 does not score B1 unless 11 13 17 19 selected		
Incomplete list eg 11 13 19 does not score B1			

Q	Answer	Mark	Comments
7	Alternative method 1 Computer chips per minute or computer chips per second		
	520 ÷ 12 or 43.3333	M1	oe eg 520 ÷ (12 × 60) or 520 ÷ 720 or $\frac{13}{18}$ or [0.72, 0.73] or 0.72
	2366 ÷ their 43.3333 or (2366 – 520) ÷ their 43.333.. + 12 or 54.6	M1dep	oe eg 2366 ÷ their [0.72, 0.73] or (2366 – 520) ÷ their [0.72, 0.73] + 12 × 60 or 3276
	54 minutes 36 seconds	A1	SC2 54 minutes 60 seconds or 55 minutes 0 seconds
	Alternative method 2 Minutes per computer chip or seconds per computer chip		
	12 ÷ 520 or $\frac{3}{130}$ or [0.023, 0.0231] or 0.02	M1	oe eg 12 × 60 ÷ 520 or 720 ÷ 520 or $\frac{18}{13}$ or [1.38, 1.39] or 1.4
	2366 × their [0.023, 0.0231] or (2366 – 520) × their [0.023, 0.0231] + 12 or 54.6	M1dep	oe eg 2366 × their [1.38, 1.39] or (2366 – 520) × their [1.38, 1.39] + 12 × 60 or 3276
	54 minutes 36 seconds	A1	SC2 54 minutes 60 seconds or 55 minutes 0 seconds

Mark scheme and Additional Guidance continue on the next page

7 cont	Alternative method 3		
	2366 ÷ 520 or 4.55 or $4\frac{11}{20}$ or (2366 – 520) ÷ 520 or 3.55 or $3\frac{11}{20}$	M1	oe
	12 × their 4.55 or 12 × their 3.55 + 12 or 54.6	M1dep	oe eg 12 × 60 × their 4.55 or 12 × 60 × their 3.55 + 12 × 60 or 3267
	54 minutes 36 seconds	A1	SC2 54 minutes 60 seconds or 55 minutes 0 seconds
	Additional Guidance		
	M1 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts		
	Answer 54.6 minutes 3276 seconds		M1M1A0
	Build-up method must be a fully correct method that would lead to 54.6		

Q	Answer	Mark	Comments
8	Alternative method 1		
	105×5 or 525 or $\frac{92 + 98 + 103 + 112 + x}{5}$ or $\frac{405 + x}{5}$	M1	oe any letter or symbol
	$105 \times 5 - 92 - 98 - 103 - 112$ or $105 \times 5 - 405$ or $92 + 98 + 103 + 112 + x = 105 \times 5$ or $405 + x = 105 \times 5$	M1dep	oe any letter or symbol equations must have fraction eliminated
	120	A1	
	Alternative method 2		
	Trial of any value with mean correctly evaluated	M1	also allow if given to the next or previous integer eg1 trial of 100 $\frac{92 + 98 + 103 + 112 + 100}{5} = 101$ eg2 trial of 75 $\frac{405 + 75}{5} = 96$ ignore trials with mean not evaluated or incorrectly evaluated
	Trial of 120 with mean evaluated to 105	M1dep	eg $\frac{92 + 98 + 103 + 112 + 120}{5} = 105$ this mark implies M1M1
	120	A1	

Mark scheme and Additional Guidance continue on the next page

8 cont	Alternative method 3		
	$\frac{92 + 98 + 103 + 112}{4}$ or $\frac{405}{4}$ or 101.25	M1	oe
	their 101.25 + 5 × (105 – their 101.25) or their 101.25 + 5 × 3.75 or their 101.25 + 18.75	M1dep	oe 105 + 4 × (105 – their 101.25)
	120	A1	
	Alternative method 4		
	$\frac{92 + 98 + 103 + 112}{5}$ or $\frac{405}{5}$ or 81	M1	oe
	5 × (105 – their 81) or 5 × 24	M1dep	oe
	120	A1	
	Alternative method 5		
	(105 – 92) + (105 – 98) + (105 – 103) + (105 – 112) or 13 + 7 + 2 – 7 or 15	M1	oe eg (92 – 105) + (98 – 105) + (103 – 105) + (112 – 105) or 105 × 4 – 92 – 98 – 103 – 112 or –13 – 7 – 2 + 7 or –15
	105 + their 15	M1dep	oe eg 105 – their –15
	120	A1	
	Additional Guidance		
	M1 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts		
	Embedded 120 scores M1M1A0 using Alt 2 (even if a different answer is given)		
	Condone eg Alt 3 $92 + 98 + 103 + 112 \div 4$ No further marks unless recovered		M1
	Alt 5 1st M1 Subtractions must be consistent		
Condone 120% for 120			

Q	Answer	Mark	Comments
9(a)	$\frac{192}{240}$ or $\frac{96}{120}$ or $\frac{80}{100}$ or 0.8 or 80%	B1	oe fraction, decimal or percentage
	Additional Guidance		
	Correct answer seen with an answer of 192	B0	
	Ignore simplification or conversion if correct answer seen eg1 $\frac{96}{120}$ seen Answer $\frac{9}{10}$ eg2 0.8 seen Answer 0.8 eg3 $\frac{32}{40}$ seen Answer 75	B1 B1 B1	
	Ignore words if correct answer seen eg1 $\frac{192}{240}$ seen Answer 32 out of 40 eg2 $\frac{192}{240}$, likely	B1 B1	
	Answer given as ratio (even if correct answer also seen) eg 192 : 240	B0	
	Answer only in words eg 192 out of 20	B0	
	Only 80 (without %)	B0	

Q	Answer	Mark	Comments	
9(b)	$\frac{28}{240} \times 900$ or 3.75×28 or or 4×28 or 112 or $105 : 900$ or $\frac{105}{900}$	M1	oe eg $0.11666... \times 900$	
	105	A1		
	Additional Guidance			
	Working and value may be seen by table			
	25200 = 240, Answer 105			M1A1
	Embedded but not selected as answer eg $720 + 75 + 105 = 900$			M1A0
	Working for Answered and fully resolved or Answered and not resolved is not choice eg ignore 720 and 75 seen			
	105 followed by answer 77			M1A0
If rounded or truncated values are used, the final answer must be exactly 105 eg1 $900 \div 240 = 3.75, 3.8 \times 28$ Answer 105 (may have kept full value on calculator) eg2 $900 \div 240 = 3.75, 3.8 \times 28$ Answer 106 (comes from further rounding)			M1 A1 M1 A0	

Q	Answer	Mark	Comments
10	160 × 0.9 or 144 or 35 × 1.4 or 49 or 160 × 0.1 and 35 × 0.4 or 16 and 14 or –16 and 14	M1	oe eg 60 × (1 – 0.1) or 35 + 35 × 0.4 or 35 + 14 implied by 193 or 2 or –2
	No and correct valid amount(s)	A1	eg no and 195 and 193 or no and 2 or no and –2 or no and 16 and 14 or no and –16 and 14
Additional Guidance			
If neither box is ticked, No may be implied eg neither box is ticked and Eloise paid 2 less			M1A1
Working and values may be seen by the table			
No and 195 with M1 not seen			M0A0
No and 16 with M1 not seen			M0A0
No and 14 with M1 not seen			M0A0
Condone No and 14 and 16 with arithmetic error(s) seen eg 144 so 16 less 49 so 14 more 192 and 195 No (arithmetic error in calculating Eloise's total)			M1A1
Do not condone No and 16 and 14 with process error(s) seen eg 160 – 16 = 144 35 – 14 = 21 (process error, should be 35 + 14) 165 and 195 No			M1A0

Q	Answer	Mark	Comments
11	Alternative method 1		
	7 ² or 49 and 24 ² or 576	M1	oe implied by 625
	$\sqrt{7^2 + 24^2}$ or $\sqrt{49 + 576}$ or $\sqrt{625}$ or 25	M1dep	oe eg $\sqrt{7^2 + 24^2 - 2 \times 7 \times 24 \times \cos 90}$
	37 × their 25 or 925	M1dep	oe if M1M0 their 25 can be any value other than 7, 24 or 37 dep on 1st M
	0.5 × 24 × 7 or 84	M1	oe eg 0.5 × 24 × 7 × sin 90
	1009	A1	SC3 1093
	Alternative method 2		
	$\tan^{-1} \frac{7}{24}$ or [16.2, 16.3] or $\tan^{-1} \frac{24}{7}$ or [73.7, 73.8]	M1	oe may be on diagram
	$\frac{24}{\cos(\text{their } [16.2, 16.3])}$ or $\frac{7}{\cos(\text{their } [73.7, 73.8])}$ or 25	M1dep	oe eg $\frac{7}{\sin(\text{their } [16.2, 16.3])}$ or 24 cos (their [16.2, 16.3]) + 7 cos (their [73.7, 73.8])
	37 × their 25 or 925	M1dep	oe if M1M0 their 25 can be any value other than 7, 24 or 37 dep on 1st M
	0.5 × 24 × 7 or 84	M1	oe eg 0.5 × 24 × 7 × sin 90
	1009	A1	SC3 1093

Additional Guidance is on the next page

Additional Guidance	
11 cont	Up to M4 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts
	The 4th mark in Alts 1 and 2 is not dependent on any other marks
	25 or 925 or 84 may be on the diagram
	SC3 is for using 24×7 for the area of the triangle
	Ignore units

Q	Answer	Mark	Comments
12	y is 80% of x	B1	

Q	Answer	Mark	Comments
13(a)	$\frac{1}{3} \times \pi \times 21^2 \times 105$ or $\frac{2}{3} \times \pi \times 21^3$	M1	oe eg $\frac{1}{3} \pi \times 441 \times 105$ or $\frac{2}{3} \pi \times 9261$
	15435 π or [48 466, 48 497] or 6174 π or [19 386, 19 399]	A1	may be seen in a sum implied by final A1
	$\frac{1}{3} \times \pi \times 21^2 \times 105 + \frac{2}{3} \times \pi \times 21^3$ or 15 435 π + 6174 π or [48 466, 48 497] + [19 386, 19 399]	M1dep	oe
	21 609 π or [67 852, 67 896]	A1	
	Additional Guidance		
	π may be seen as any value in the interval [3.14, 3.142]		
	Do not allow any misreads of formulae unless recovered eg $\pi \times 21^2 \times 105$ and $\frac{2}{3} \times \pi \times 21^2$		M0
	Allow dots for multiplication		
	For A marks allow eg 15 435 $\times \pi$ or $\pi \times 21 609$		
	21 609 π followed by incorrect evaluation attempt		M1A1M1A1
21 609 π followed by further work		M1A1M1A0	
21 609 only		M0A0M0A0	
$\frac{1}{3} \times \pi \times 21^2 \times 105 = 3245$ $\frac{2}{3} \times \pi \times 21^3 = 28952$ 3245 + 28952 (even though 3245 is wrong the method for $\frac{1}{3} \times \pi \times 21^2 \times 105$ is seen)		M1A1 M1	

Q	Answer	Mark	Comments
13(b)	Alternative method 1 Uses volume scale factor		
	21 ÷ 3 or 7	M1	oe eg 7 × 3 = 21
	(their 7) ³	M1dep	oe eg 21 ³ ÷ 3 ³ or 9261 ÷ 27
	343	A1	condone 1 : 343 or 343 : 1 SC2 $\frac{1}{343}$
	Alternative method 2 Compares volumes of cornets (ie compares total volumes)		
	21 ÷ 3 or 7	M1	oe eg 7 × 3 = 21 may be implied eg (height of cone) 15 or (volume of cone) 45π or (volume of cone) [141.3, 141.5] or (total volume) 63π or [197.82, 197.95]
	their (a) ÷ $(\frac{1}{3}\pi \times 3^2 \times \frac{105}{\text{their } 7} + \frac{2}{3}\pi \times 3^3)$	M1dep	oe eg their (a) ÷ [197.82, 197.95]
	343	A1	condone 1 : 343 or 343 : 1 SC2 $\frac{1}{343}$

Mark scheme and Additional Guidance continue on the next two pages

13(b) cont	Alternative method 3 Compares volumes of cones		
	$21 \div 3$ or 7	M1	oe eg $7 \times 3 = 21$ may be implied eg (height of cone) 15 or (volume of cone) 45π or (volume of cone) [141.3, 141.5] or (total volume) 63π or [197.82, 197.95]
	their volume of cone from (a) $\div \left(\frac{1}{3} \pi \times 3^2 \times \frac{105}{\text{their } 7} \right)$	M1dep	oe eg their volume of cone from (a) \div [141.3, 141.5]
	343	A1	condone 1 : 343 or 343 : 1 SC2 $\frac{1}{343}$
	Alternative method 4 Compares volumes of hemispheres		
	their volume of hemisphere from (a) $\div \left(\frac{2}{3} \pi \times 3^3 \right)$	M2	oe eg their volume of hemisphere from (a) \div [56.52, 56.56]
	343	A1	condone 1 : 343 or 343 : 1 SC2 $\frac{1}{343}$

Additional Guidance is on the next page

		Additional Guidance	
13(b) cont		π may be seen as any value in the interval [3.14, 3.142]	
		Answer $\times 343$ or $343 \times$	M1M1A1
		Answer 7	M1M0A0
		Answer 7^3 with 343 seen	M1M1A1
		Answer 7^3 without 343 seen	M1M1A0
		Alts 2, 3 and 4 Allow if an incorrect volume formula from (a) is used in (b) eg Alt 4 (a) $\frac{1}{2} \times \frac{2}{3} \times \pi \times 21^3 = 3087\pi$ (b) $\frac{1}{2} \times \frac{2}{3} \times \pi \times 3^3 = 9\pi$ $3087\pi \div 9\pi$ 343	M2 A1
		Alts 2 and 3 2nd M1 – allow consistent omission of π	
		Alt 4 M2 – allow consistent omission of π	
		Alts 2, 3 and 4 Answer 343 is M1M1A1 unless it comes from rounding or truncating eg1 Alt 2 $67\,886.661 \div 197.920 = 343$ eg2 Alt 2 $67\,886.661 \div 197.920 = 343.00051$ Answer 343	M1M1A1 M1M1A0

Q	Answer	Mark	Comments
14(a)	Alternative method 1		
	375 + 400 + 1475 or 2250 or $\frac{10}{60}$ seen	M1	oe for 375 allow 350 or 370 or 380 or 400 for 1475 allow 1450 or 1470 or 1480 or 1500 eg 400 + 400 + 1500 any estimated values must be seen eg only seeing 2300 is M0
	$\frac{375}{375 + 400 + 1475} \times 87\,192$ or [0.16, 0.17] × 87 192 or [13950, 14823]	M1dep	oe for 375 allow 350 or 370 or 380 or 400 for 1475 allow 1450 or 1470 or 1480 or 1500 for 87 192 allow 87 000 or 87 100 or 87 200 or 90 000
	14 532	A1	
	Alternative method 2		
	60 [57, 62]	M1	may be on the diagram
	$\frac{\text{their [57, 60]}}{360} \times 87\,192$ or their [57, 62] × 242.2 or [13 805, 15 016]	M1dep	oe for 87 192 allow 87 000 or 87 100 or 87 200 or 90 000
	14 532	A1	
	Additional Guidance		
	375 + 400 + 1475 = 2250 If they subsequently estimate 2250 no further marks can be scored		M1
Alt 2 if their angle is outside the range [57, 62]		M0M0A0	

Q	Answer	Mark	Comment
14(b)	It is larger than the answer to part (a)	B1	

Q	Answer	Mark	Comment									
15	<table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 33.33%;">3</td> <td style="width: 33.33%; background-color: #cccccc;">3</td> <td style="width: 33.33%; background-color: #cccccc;">$\frac{1}{9}$</td> </tr> <tr> <td>$\frac{1}{27}$</td> <td>1</td> <td>27</td> </tr> <tr> <td>9</td> <td style="background-color: #cccccc;">$\frac{1}{3}$</td> <td style="background-color: #cccccc;">$\frac{1}{3}$</td> </tr> </table>	3	3	$\frac{1}{9}$	$\frac{1}{27}$	1	27	9	$\frac{1}{3}$	$\frac{1}{3}$	B2	<p>oe values eg 0.111... for $\frac{1}{9}$</p> <p>condone unprocessed values eg for 3 allow $\frac{9}{3}$ or $\frac{3}{1}$</p> <p>B1 at least three of the eight rows, columns and diagonals have a product of 1</p> <p>do not count rows, columns or diagonals that only have ones</p> <p>do not count incomplete rows, columns or diagonals</p>
	3	3	$\frac{1}{9}$									
	$\frac{1}{27}$	1	27									
	9	$\frac{1}{3}$	$\frac{1}{3}$									
Additional Guidance												
The given values in the grid cannot be changed												
<p>B1 can be awarded with an incomplete grid eg</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 33.33%;">3</td> <td style="width: 33.33%; background-color: #cccccc;">3</td> <td style="width: 33.33%; background-color: #cccccc;">$\frac{1}{9}$</td> </tr> <tr> <td></td> <td>1</td> <td>27</td> </tr> <tr> <td></td> <td style="background-color: #cccccc;">$\frac{1}{3}$</td> <td style="background-color: #cccccc;">$\frac{1}{3}$</td> </tr> </table>			3	3	$\frac{1}{9}$		1	27		$\frac{1}{3}$	$\frac{1}{3}$	B1
3	3	$\frac{1}{9}$										
	1	27										
	$\frac{1}{3}$	$\frac{1}{3}$										
<table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 33.33%;">1</td> <td style="width: 33.33%; background-color: #cccccc;">3</td> <td style="width: 33.33%; background-color: #cccccc;">$\frac{1}{9}$</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td style="background-color: #cccccc;">$\frac{1}{3}$</td> <td style="background-color: #cccccc;">$\frac{1}{9}$</td> </tr> </table>			1	3	$\frac{1}{9}$	1	1	1	1	$\frac{1}{3}$	$\frac{1}{9}$	<p>Three products of 1 but two are not counted as they only have ones</p> <p style="text-align: center; vertical-align: middle;">B0</p>
1	3	$\frac{1}{9}$										
1	1	1										
1	$\frac{1}{3}$	$\frac{1}{9}$										

Q	Answer	Mark	Comments
16(a)	Valid criticism of method indicating or implying that 30 is incorrect	B1	eg the shop was open for fewer than 30 days
	Additional Guidance		
	Valid criticism with non-contradictory statements	B1	
	Contradictory statements	B0	
	30 should be 22	B1	
	The answer is 68 (allow 68.18 or 68.2 or 70)	B1	
	30 should be 20	B1	
	The answer is 75	B1	
	The answer is more than 50	B1	
	The stall wasn't open for 30 days	B1	
	He didn't work every day in November	B1	
	The stall was shut on Sundays and Mondays	B1	
	He is open 5 days a week	B1	
	The stall isn't open every day	B1	
	He should divide by 31	B0	
	He doesn't work weekends	B0	
	There aren't 30 days in November	B0	
	Not every month has 30 days	B0	
	30 should be 27	B0	
	The answer is less than 50	B0	

Q	Answer	Mark	Comments
16(b)	Alternative method 1		
	$1500 \div (13 + 3 + 9)$ or $1500 \div 25$ or 60	M1	oe implied by 780 or 180 or 540 or 359.4(0) or 286.2(0)
	13×5.99 or 77.87 or 9×4.77 or 42.93 or 120.80	M1	oe may be embedded or implied eg $13 \times 5.99 \times \text{their } 60$ or $9 \times 4.77 \times \text{their } 60$ their 60 can be any number $4672.2(0)$ or $2575.8(0)$ or 7248 score M1M1
	$(8058 - 13 \times 5.39 \times \text{their } 60 - 9 \times 4.77 \times \text{their } 60) \div (3 \times \text{their } 60)$ or $(8058 - 4672.2(0) - 2575.8(0)) \div 180$ or $(8058 - 7248) \div 180$ or $810 \div 180$	M1dep	oe eg $(8058 - 13 \times 5.99 \times \text{their } 60 - 9 \times 4.77 \times \text{their } 60) \div (1500 - 13 \times \text{their } 60 - 9 \times \text{their } 60)$ or $\frac{810}{180}$ dep on M1M1 their 60 must be from 1st M1
	$4.5(0)$	A1	

Mark scheme and Additional Guidance continue on the next page

16(b) cont	Alternative method 2		
	1500 ÷ (13 + 3 + 9) or 1500 ÷ 25 or 60	M1	oe implied by 780 or 180 or 540 or 359.4(0) or 286.2(0)
	13 × 5.99 or 77.87 or 9 × 4.77 or 42.93 or 120.80	M1	oe may be embedded or implied eg 13 × 5.99 × their 60 or 9 × 4.77 × their 60 their 60 can be any number 4672.2(0) or 2575.8(0) or 7248 score M1M1
	$\left(\frac{8058}{\text{their } 60} - 13 \times 5.99 - 9 \times 4.77 \right) \div 3$ or (134.3(0) – 77.87 – 42.93) ÷ 3 or 13.50 ÷ 3	M1dep	oe eg (134.3(0) – 120.80) ÷ 3 or $\frac{810}{180}$ dep on M1M1 their 60 must be from 1st M1
	4.5(0)	A1	
	Additional Guidance		
Up to M1M1 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts			

Q	Answer	Mark	Comment
17	cylinder	B1	

Q	Answer	Mark	Comments
18	$\frac{-5 \pm \sqrt{5^2 - 4 \times 1 \times -13}}{2 \times 1}$ or $-\frac{5}{2} \pm \sqrt{\frac{77}{4}}$	M1	oe eg $\frac{-5 \pm \sqrt{25 + 52}}{2}$ or $\frac{-5 \pm \sqrt{77}}{2}$
	1.88(748...) and -6.88(748...)	A1	
	Additional Guidance		
	$-2.5 \pm \sqrt{25 + 52} \text{ or } -2.5 \pm \sqrt{77}$		M1
	For M1 allow solutions given separately eg $\frac{-5 + \sqrt{77}}{2}$ and $\frac{-5 - \sqrt{77}}{2}$		M1
	Both solutions correct		M1A1
	One solution correct does not imply M1		
	Not using \pm is M0 unless recovered eg1 $\frac{-5 + \sqrt{5^2 - 4 \times 1 \times -13}}{2 \times 1}$ followed by 1.88 eg2 $\frac{-5 + \sqrt{5^2 - 4 \times 1 \times -13}}{2 \times 1}$ followed by 1.88... and -6.88...		M0A0 M1A1
	A short dividing line or a short square root symbol is M0 unless recovered eg by a correct solution		
	Condone if their square root symbol is above any part of -13		
$\sqrt{5^2 - 4 \times 1 \times -13}$ is correct for $\sqrt{5^2 - 4 \times 1 \times -13}$			
Both decimal solutions seen in working but only one on answer line		M1A0	

Q	Answer	Mark	Comments
19	(35, 6)	B3	B2 $E(35, \dots)$ or $E(\dots, 6)$ B1 $C(17, 18)$ or $D(23, 14)$ SC1 $C(a, b)$ and $D(a + 6, b - 4)$
	Additional Guidance		
	Mark the answer line for B3 and B2 (if blank check working lines and diagram)		
	B1 or SC1 is likely to be seen in working lines or on the diagram		
	Condone missing brackets eg $C 17, 18$	B1	
	Coordinates can be implied eg $D x = 23 y = 14$	B1	
	Condone answers given as vectors for B2, B1 or SC1 eg $C \begin{pmatrix} 17 \\ 18 \end{pmatrix}$	B1	
SC1 C cannot be $(5, 26)$ or $(11, 22)$ and coordinates of D must be evaluated eg $C(15, 17)$ and $D(21, 13)$	SC1		

Q	Answer	Mark	Comments
20	Alternative method 1		
	6.46 ÷ 1.52 or 4.25 or 1.52 ÷ 6.46 or [0.235, 0.24] or 6.46 ÷ 5.95 or [1.08, 1.09]	M1	oe eg $\frac{17}{4}$ or $\frac{35}{38}$ or $5.95 \times [1.08, 1.09] = 6.46$
	5.95 ÷ (6.46 ÷ 1.52) or 5.95 × (1.52 ÷ 6.46) or 1.52 ÷ (6.46 ÷ 5.95) or 1.4	M1dep	oe eg 5.95 ÷ 4.25 or 5.95 × [0.235, 0.24] or 1.52 ÷ [1.08, 1.09]
	their 1.4 ÷ 1.52 or [0.921, 0.922] or 1 – their 1.4 ÷ 1.52 or 1 – [0.921, 0.922] or [0.078, 0.079]	M1dep	oe eg $\frac{35}{38}$ or $1 - \frac{35}{38}$ or $\frac{3}{38}$ 5.95 ÷ 6.46 oe scores M3 1 – 5.95 ÷ 6.46 oe scores M3
	7.9	A1	
	Alternative method 2		
	6.46 ÷ 5.95 or [1.08, 1.09]	M1	oe eg $\frac{646}{595}$
	1 ÷ their [1.08, 1.09]	M1dep	oe eg $1 \div \frac{646}{595}$
	[0.921, 0.922] or 1 – [0.921, 0.922] or [0.079, 0.078]	M1dep	oe eg $\frac{595}{646}$ or $1 - \frac{595}{646}$ or $\frac{51}{646}$ 5.95 ÷ 6.46 oe scores M3 1 – 5.95 ÷ 6.46 oe scores M3
	7.9	A1	

Additional Guidance is on the next page

Additional Guidance		
20 cont	Up to M3 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts	
	$\frac{0.51}{5.95} = [0.085, 0.086]$ is M0 unless $[1.085, 1.086]$ subsequently used	
	$5.95 \div 1.52$ with no further correct working	M0
	Note that 1.4 seen may be from an incorrect method eg $1.52 \times 0.92 = 1.4$ does not score because 1.52×0.92 is an incorrect method and the actual value of 1.52×0.92 is 1.3984	
	Any single calculation or set of calculations that lead to $\frac{35}{38}$ or $\frac{3}{38}$	M3
	Some common oes for $1 - 5.95 \div 6.46$ are $\frac{6.46 - 5.95}{6.46}$ or $\frac{0.51}{6.46}$ and $\frac{1.52 - 1.6}{1.52}$ or $\frac{0.08}{1.52}$	M3
	3rd M1 oes include [0.921, 0.922] \times 100 or [92.1, 92.2]% 100% – [0.921, 0.922] \times 100 [0.079, 0.78] \times 100 or (7.9, 7.8)%	
	Values that score marks may be seen in ratios eg 6.46 : 1.52 (does not score at this stage) 4.25 : 1	M1
	Allow working in pence eg $646 \div 1.52$ or 425	M1
	Allow working in grams eg $6.46 \div 1520$ or 0.00425	M1

Q	Answer	Mark	Comment
21	$y = x^2 - 16$	B1	

Q	Answer	Mark	Comment
22	3^{-4}	B1	

Q	Answer	Mark	Comments
23	$(3x - 5)(x + 2)$	B2	B1 $(3x + a)(x + b)$ where $ab = -10$ or $a + 3b = 1$ a and b must be integers SC1 $(-3x + 5)(-2 - x)$
	Additional Guidance		
	Brackets in either order for B2 and B1 and SC1		
	$(3x + 2)(x - 5)$		B1
	$(3x + 10)(x - 1)$ or $(3x + 2)(x - 5)$ or $(3x - 10)(x + 1)$ or $(x + 10)(3x - 1)$		B1
	Do not allow answers involving fractions		B0
	Some examples of B1 with $a + 3b = 1$ $(3x + 7)(x - 2)$ $(3x + 16)(x - 5)$ $(3x + 4)(x - 1)$ $(3x + 10)(x - 3)$		
	$(-5 + 3x)$ is equivalent to $(3x - 5)$ etc		
	Condone use of multiplication signs in B2 or B1 responses eg $(3x - 5) \times (x + 2)$		B2
	Condone missing closing bracket in B2 or B1 responses eg $(3x - 5)(x + 2$		B2
Ignore any attempt to 'solve' after B2 or B1 seen			

Q	Answer	Mark	Comments
24	$\frac{13-6}{6-1}$ or $\frac{7}{5}$	M1	oe eg $\frac{6-13}{1-6}$ or 1.4 may be embedded in an attempt at equation of line eg $y = \frac{7}{5}x \dots$ may be implied
	$-1 \div \text{their } \frac{7}{5}$ or $-\frac{5}{7}$ or $\frac{17-2}{x-0} \times \text{their } \frac{7}{5} = -1$	M1	oe allow $[-0.57143, -0.57]$ may be embedded in an attempt at equation of a line eg $y = \text{their } -\frac{5}{7}x \dots$
	$17 - 2 = \text{their } -\frac{5}{7}x$ or $-5x = 105$ or $105 \div -5$	M1dep	oe equation must be of the form $ax = b$ (b can be unprocessed) dep on 2nd M1
	-21	A1	

Additional Guidance is on the next page

		Additional Guidance	
24 cont	The second mark is not dependent on the first – see examples below		
	(gradient of line through given points =) $\frac{6-1}{13-6} = \frac{5}{7}$		M0
	(gradient of perpendicular line =) $-\frac{7}{5}$		M1
	$17-2 = -\frac{7}{5}x$		M1
	(gradient of line through given points =) $-\frac{7}{5}$		M0
	$\frac{17-2}{x} \times -\frac{7}{5} = -1$		M1
	$-105 = -5x$		M1
	(gradient of line through given points =) $\frac{7}{5}$		M1
(gradient of perpendicular line =) $\frac{5}{7}$		M0M0	
Condone use of letters for gradients eg $x = 1.4$			M1
For the first two marks, condone inclusion of x in their gradients			
Answer -21 that comes from rounding or truncating cannot score A1			
eg1 (perp grad =) -0.71 $15 = -0.71x$ Answer -21			M3A1
eg2 (perp grad =) -0.71 $15 = -0.71x = -21.12$ Answer -21			M3A0

Q	Answer	Mark	Comments
25	$x = 3y + 4$ or $x - 4 = 3y$ or $y - 4 = 3x$ or $\frac{y-4}{3}$	M1	oe eg $x = 3f^{-1} + 4$ or $f(x) - 4 = 3x$
	$\frac{x-4}{3}$	A1	oe eg $\frac{x}{3} - \frac{4}{3}$ may be implied eg by $18f^{-1}(x) = 6(x - 4)$ implied by $\frac{y-4}{3}$ if $\frac{x-4}{3}$ used in subsequent working
	Correctly expands $2(3x + 4) - 18 \times$ their $\frac{x-4}{3}$ to a linear expression	M1	$6x + 15 - 6x + 30$ if M1A1 their $\frac{x-4}{3}$ must be a function of x their $\frac{x-4}{3}$ cannot be $3x + 4$ implied by a correct linear expression or value for $2(3x + 4) - 18 \times$ their $\frac{x-4}{3}$
	$\frac{x-4}{3}$ and 32	A1	
	Additional Guidance		
	32 with no working		Zero
	32 from wrong working does not score 4 marks – mark the working seen		
	First A1 Condone $y = \frac{x-4}{3}$ or $f = \frac{x-4}{3}$ or $f(x) = \frac{x-4}{3}$ or $x = \frac{x-4}{3}$		
	For $6x + 8 - 6x + 24$ allow $\frac{18x + 24 - 18x + 72}{3}$ but not $6x + 8 - \frac{18x - 72}{3}$		
	$x = 3y + 4$ $\frac{x+4}{3}$ $6x + 8 - \frac{18x}{3} - \frac{72}{3}$ (implied by -16)		M1A0 M1A0
$-3x - 4$ $6x + 8 + 18x + 72$ (implied by $24x + 80$)		M0A0 M1A0	

Q	Answer	Mark	Comments	
26	$11.2 \div 0.35$ or 32	M1	oe	
	their $32 \div 8 \times 9$ or 36	M1dep	oe eg $\frac{9}{8} \times$ their 32 or $1.125 \times$ their 32	
	$0.35 \div 7 \times 5$ or 0.25	M1	oe eg $\frac{5}{7} \times 0.35$ or $[0.71, 0.72] \times 0.35$ $\frac{9}{8} \times \frac{5}{7} \times 11.2$ oe scores M3	
	9	A1		
	Additional Guidance			
	Up to M3 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts			
	Any single calculation or set of calculations that are a correct method and lead to 9			M3
	Note that the single calculation $\frac{9}{8} \times \frac{5}{7} \times 11.2$ does not use 0.35			M3
	An oe for $\frac{9}{8} \times \frac{5}{7} \times 11.2$ is $\frac{9}{8} \times \frac{11.2}{0.35} \times \frac{5}{7} \times 0.35$			M3
Values may be seen in ratios eg 32 : 36			M1M1	

Q	Answer	Mark	Comment
27	Alternative method 1		
	Sight of at least one of 9.75 or 9.85 or 8.85 or 8.95	M1	allow 9.849 for 9.85 and 8.949 for 8.95
	their $9.85 \times$ their 8.95	M1	$9.8 \leq$ their 9.85 < 9.9 $9.0 \leq$ their 8.95 < 8.9
	9.85 \times 8.95 selected and 88.1(575)	A1	accept 88.1(6) or 88.158 with 9.85 \times 8.95 selected
	Alternative method 2		
	Sight of at least one of 9.75 or 9.85 or 8.85 or 8.95	M1	allow 9.849 for 9.85 and 8.949 for 8.95
	88.2 \div their 9.85 or 88.2 \div their 8.95	M1	$9.8 \leq$ their 9.85 < 9.9 $9.0 \leq$ their 8.95 < 8.9
	88.2 \div 9.85 and 8.9543... and 8.95 or 88.2 \div 8.95 and 9.8547... and 9.85	A1	

Additional Guidance	
<p>Alt 1 9.85×8.95 amongst other calculations eg 9.75×8.85 and/or 9.85×8.85 can still score the second M1 but it must be clear that they are considering $9.85 \times 8.95 = 88.1(575)$ to show that the room cannot be hired</p> <p>eg1 $9.85 \times 8.95 = 88.1575$ $9.75 \times 8.85 = 86.2875$</p> <p>eg2 $9.85 \times 8.95 = 88.1575$ $9.75 \times 8.85 = 86.2875$</p> <p>$9.85 \times 8.85 = 87.1725$ The upper bounds show it cannot be hired</p>	<p>M1M1A0</p> <p>M1M1A1</p>
Ignore the calculation 9.8×8.9 throughout	
Alt 1 $88.1(575)$ or 88.2 or 88.158 without 9.85×8.95 selected	A0
88.1575 only	M0M0A0
Alt 2 $8.9543\dots$ without $88.2 \div 9.85$ and 8.95 seen	A0
Alt 2 $9.8548\dots$ without $88.2 \div 8.95$ and 9.85 seen	A0

Q	Answer	Mark	Comments
	interior angle = 150 or exterior angle = 30 or angle $BCA = 15$ or angle $BCN = 120$ or angle $ACD = 135$ or angle $NCM = 45$ or angle $DCM = 45$	B1	method not required may be seen on diagram
28	interior angle = 150 with a valid method shown or exterior angle = 30 with a valid method shown or angle $BCA = 15$ with a valid method shown or angle $BCN = 120$ with a valid method shown or angle $ACD = 135$ with a valid method shown or angle $NCM = 45$ with a valid method shown or angle $DCM = 45$ with a valid method shown	B1dep	angles may be seen on diagram but methods will be in working lines eg $180 - \frac{360}{12} = 150$ or $\frac{1800}{12} = 150$ or $360 - 120 - 90 = 150$ or $\frac{360}{12} = 30$ or $\frac{180 - 120}{2} = 30$ or $180 - 150 = 30$ or $360 - 150 - 90 = 120$ or $360 - 240 = 120$ or $180 - 2 \times 30 = 120$ or $150 - 15 = 135$ or $\frac{180 - 90}{2} = 45$ or $90 - 45 = 45$
	interior angle = 150 with a valid method shown and exterior angle = 30 with a valid method shown and angle $BCA = 15$ with a valid method shown and angle $BCN = 120$ with a valid method shown and angle $ACD = 135$ with a valid method shown and angle $NCM = 45$ with a valid method shown and angle $DCM = 45$ with a valid method shown	B1dep	angles may be seen on diagram but methods will be in working lines eg $\frac{1800}{12} = 150$ and $\frac{180 - 120}{2} = 30$ and $360 - 240 = 120$ and $150 - 15 = 135$ and $\frac{180 - 90}{2} = 45$ and $90 - 45 = 45$ angles worked out in any order

<p>28 cont</p>	<p>Fully correct working that must show correct progression and show all valid methods</p> <p>Valid methods shown must be appropriate for the approach used</p> <p>A reason must be included in the final step</p>	<p>B1dep</p>	<p>examples of the final step are</p> <p>(i) angle $ACD + \text{angle } DCM = 180$</p> <p>(ii) angle $ACB + BCN + NCM = 180$</p> <p>(ii) interior angle = 150 in two different ways</p> <p>(iii) exterior angle = 30 in two different ways</p> <p>(iv) angle $BCN = 120$ in two different ways</p> <p>(v) sum of angles on a straight line ACM at $C = 135 + 45$ and $15 + 120 + 45$</p>
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Additional Guidance is on the next page

		Additional Guidance	
28 cont		Condone incorrect use of equals signs throughout eg interior angle = $12 - 2 = 10 \times 180 = 1800 \div 12 = 150$	B1B1
		interior angle may be seen as angle <i>ABC</i> or angle <i>BCD</i> exterior angle may be seen as angle <i>CBN</i>	
		It must be clear which angle they are working out eg1 Do not accept 150 if it is not correctly identified or not in the correct position on diagram eg2 Do accept 150 if it is identified as an interior angle or angle <i>ABC</i> or is in the correct position on the diagram	
		Do not accept incorrect statements eg1 exterior angle = 150 (even if 150 in correct position on the diagram) eg2 angle <i>ACB</i> = 150 (even if 150 in correct position on the diagram)	
		Ignore reasons for the first three marks	
		Angles on the diagram with no valid methods can score a maximum of B1B0B0B0	
		For the 2nd and 3rd marks the methods shown do not have to show progression	
		Example of fully correct working for (i) interior angle = $\frac{1800}{12} = 150$ angle <i>BCN</i> = $360 - 150 - 90 = 120$ angle <i>CBN</i> = $\frac{180 - 120}{2} = 30$ 150 + 30 = 180 angles on a (straight) line	B1B1 B1 B1
		Example of fully correct working for (ii) exterior angle = $\frac{360}{12} = 30$ angle <i>BCN</i> = $180 - 2 \times 30 = 120$ interior angle = $360 - 120 - 90 = 150$ interior angle = $\frac{1800}{12} = 150$ (interior) angle of polygon	B1B1 B1 B1

Q	Answer	Mark	Comments									
29	$(x - 7)^2 \dots$	M1	allow $\left(x - \frac{14}{2}\right)^2 \dots$ may be implied by a grid for $(x - 7)^2$									
	$(x - 7)^2 - 7^2 + 44$ or $(x - 7)^2 - 49 + 44$ or $(x - 7)^2 - 5$	M1dep	oe completing the square eg $\left(x - \frac{14}{2}\right)^2 - \left(\frac{14}{2}\right)^2 + 44$									
	(7, -5) with correct completing the square seen	A1	eg (7, -5) with $(x - 7)^2 - 7^2 + 44$ seen SC1 (7, -5) with correct completing the square not seen									
	Additional Guidance											
	Allow $(x - 7)^2$ to be $(7 - x)^2$ throughout											
	Allow $(x - 7)^2$ to be $(x - 7)(x - 7)$ throughout											
	Condone expression = 0 throughout											
	$(x - 7)^2 = 5$ with $(x - 7)^2 - 5 (= 0)$ also seen scores M1M1 Also scores A1 if answer correct											
	$(x - 7)^2 = 5$ without $(x - 7)^2 - 5 (= 0)$ also seen Answer correct would still mean M1M0 (or SC1)			M1M0								
	Allow as a slip if completing the square seen but the squared is omitted in a subsequent line eg $(x - 7)^2 - 49 + 44 = (x - 7) - 5$ Answer (7, -5)			M1M1 A1								
	$(x - 7) - 5$ and answer (7, -5)			SC1								
	$(x - 7) - 5$ and answer not (7, -5)			M0M0A0								
(7, -5) with no method or from a different method eg calculus			SC1									
<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td></td> <td>x</td> <td>-7</td> </tr> <tr> <td>x</td> <td>x^2</td> <td>$-7x$</td> </tr> <tr> <td>-7</td> <td>$-7x$</td> <td>49</td> </tr> </table> Condone one of the products missing or incorrect				x	-7	x	x^2	$-7x$	-7	$-7x$	49	M1
	x	-7										
x	x^2	$-7x$										
-7	$-7x$	49										