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**GCSE**  
**MATHEMATICS**  
**8300/2H**

Higher Tier Paper 2 Calculator

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Mark scheme

Shadow paper based on November 2024

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Version: 1.0 Final

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

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

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

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

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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**

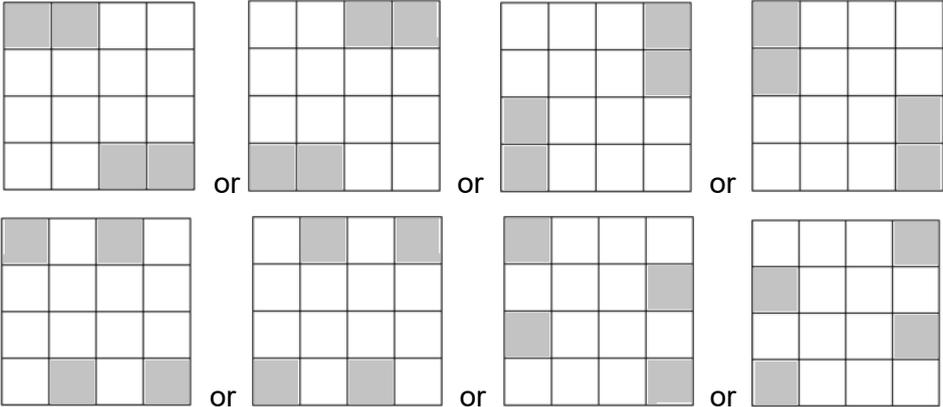
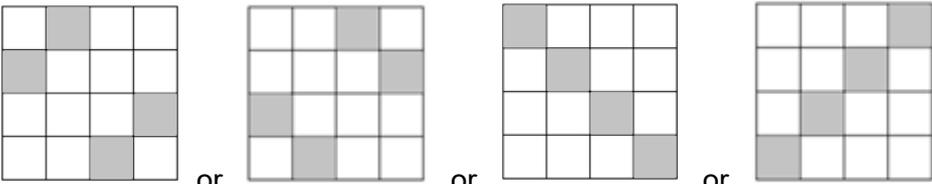
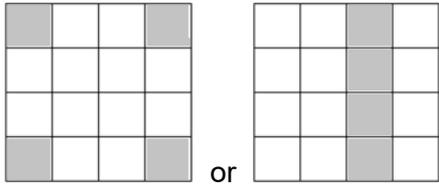
Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Q	Answer	Mark	Comments
1(a)	radius	B1	

Q	Answer	Mark	Comments
1(b)	sector	B1	

Q	Answer	Mark	Comments
1(c)	circumference	B1	

Q	Answer	Mark	Comments
2	Any two of $11 \times 5$ or 55 $17 \times 15$ or 255 $14 \times 25$ or 350 $18 \times 35$ or 630	M1	implied by 1290
	(their 55 + their 255 + their 350 + their 630) $\div$ 60	M1dep	oe must be sum of four numbers condone missing final bracket
	21.5 or $\frac{1290}{60}$	A1	oe value eg $21\frac{1}{2}$
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Ignore simplification or conversion attempt after correct answer seen		
	Answer 21 or 22 with 21.5 seen		M2A1
	21.5 in working with $20 < v \leq 30$ on answer line		M2A0
21.5 then answer doubled		M2A0	

Q	Answer	Mark	Comments	
	4 squares shaded so that the grid has exactly rotational symmetry of order 2 and no lines of symmetry	B2	B1 4 squares shaded so that the grid has rotational symmetry of order 2 and one or more lines of symmetry	
<b>3</b>	<b>Additional Guidance</b>			
			B2	
			B1	
			B0	
	Mark intention			
	Part squares shaded			B0

Q	Answer	Mark	Comments
4	<b>Alternative method 1</b>		
	$8 \times 6000 \div 100$ or 480	M2	oe M1 $8 \times 6000$ or 48 000 or $8 \div 100$ or 0.08 or $6000 \div 100$ or 60
	480 and No	A1	oe eg 20 less and No
	<b>Alternative method 2</b>		
	$500 \times 100 \div 6000$ or 8.3(3...)	M2	oe M1 $500 \times 100$ or 50000 or $500 \div 6000$ or 0.083(3...) or $100 \div 6000$ or 0.016(...) or 0.017
	8.3(3...) and No	A1	
	<b>Alternative method 3</b>		
	$500 \times 100 \div 8$ or 6250 or 4286	M2	oe M1 $500 \times 100$ or 50000 or $500 \div 8$ or 62.5 or $100 \div 8$ or 12.5
	6250 and No with M2 seen	A1	

Mark scheme and Additional Guidance continue on the next page

<b>4 cont</b>	<b>Alternative method 4</b>		
	$8 \times 6000$ or 48000	M1	oe
	$500 \times 100$ or 50000	M1	oe
	48000 and 50000 and No	A1	
	<b>Alternative method 5</b>		
	$500 \div 6000$ or 0.083(3...)	M1	oe
	$8 \div 100$ or 0.08	M1	oe
	0.083(3...) and 0.08 and No	A1	
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	No may be indicated by selecting the box or a statement in the working lines		
	No cannot be implied only by an inequality		
	A correct value is sufficient to show working eg 480 and No (except in alt 3)		M2A1
20 less in alt 1 implies M2			

Q	Answer	Mark	Comments
<b>5</b>	$A$ halves when $B$ doubles	B1	

Q	Answer	Mark	Comments
6	<b>Alternative method 1</b>		
	$1.5^2 - 1.2^2 = 0.81$ and $\sqrt{0.81} = 0.9$ or $2.25 - 1.44 = 0.81$ and $\sqrt{0.81} = 0.9$	B2	accept $0.9^2 = 0.81$ for $\sqrt{0.81} = 0.9$ accept $\sqrt{1.5^2 - 1.2^2} = 0.9$ for B2 accept $1.5^2 - 1.2^2 = 0.9^2$ for B2 B1 $1.5^2$ and $1.2^2$ oe
	<b>Alternative method 2</b>		
	$1.5^2 - 0.9^2 = 1.44$ and $\sqrt{1.44} = 1.2$ or $2.25 - 0.81 = 1.44$ and $\sqrt{1.44} = 1.2$	B2	accept $1.2^2 = 1.44$ for $\sqrt{1.44} = 1.2$ accept $\sqrt{1.5^2 - 0.9^2} = 1.2$ for B2 accept $1.5^2 - 0.9^2 = 1.2^2$ for B2 B1 $1.5^2$ and $0.9^2$ oe
	<b>Alternative method 3</b>		
	$0.9^2 + 1.2^2 = 2.25$ and $\sqrt{2.25} = 1.5$ or $0.81 + 1.44 = 2.25$ and $\sqrt{2.25} = 1.5$	B2	accept $1.5^2 = 2.25$ for $\sqrt{2.25} = 1.5$ accept $\sqrt{0.9^2 + 1.2^2} = 1.5$ for B2 accept $0.9^2 + 1.2^2 = 1.5^2$ for B2 B1 $0.9^2$ and $1.2^2$ oe
	<b>Additional Guidance</b>		
	B1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	$1.5^2 - 1.2^2 = 0.81$ $x^2 = 0.81$ $x = 0.9$		B2
	Max B1 if any incorrect statement seen eg $1.5^2 - 1.2^2 = \sqrt{0.81} = 0.9$		B1
Accept $1.5 \times 1.5$ for $1.5^2$ etc			
Condone eg $1.2 \text{ cm}^2$ and $1.5 \text{ cm}^2$ for $1.2^2$ and $1.5^2$ for B1 but must be recovered for B2			
$0.81 \div 0.9 = 0.9$ is equivalent to $\sqrt{0.81} = 0.9$			

Q	Answer	Mark	Comments
7(a)	75 × 0.44 or 33 or 90 × 0.4 or 36	M1	oe
	3	A1	
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	90 × 0.5 = 45		M0

Q	Answer	Mark	Comments
7(b)	No and valid reason involving the number of trials	B1	eg reasons she didn't do the most she did fewer spins Lewis did/span more they should use all 165 spins
	<b>Additional Guidance</b>		
	Ignore irrelevant or incorrect statements alongside a correct statement as long as not contradictory eg1 No and Lewis did most but he could have done more eg2 No and Lewis has more number of spins so there is a higher probability of landing on heads		B1 B1
	Allow 'he' to refer to Lewis eg No and Because he tried 95 times however Maya tried only 75 times		B1
	No and She did not do as many spins so her answer is less accurate than Lewis'		B1
	No and Lewis spun the wheel more times. Therefore his probability would be lower		B1
	No and Lewis spun more times so his final outcome will be higher		B1
	No and Lewis did 90 spins and Maya did 75 spins		B0
	No and Lewis did 90 spins so he has more chance of being accurate		B0

Q	Answer	Mark	Comments
8	digits 672 ÷ digits 960 or answer with only digit 7	M1	eg 672 ÷ 960 or 672 ÷ 960 000 or 672 ÷ 0.96 or 0.007 or 7000
	0.7 or $\frac{7}{10}$	A1	oe value eg $\frac{672}{960}$
	<b>Additional Guidance</b>		
	Ignore simplification or conversion attempt after correct answer seen		
	Condone eg 672 ÷ 960 000 <sup>3</sup> for M1 but must be recovered for A1		

Q	Answer	Mark	Comments
9	$16.5 \leq \text{temperature} < 17.5$	B2	oe B1 16.5 or 17.5 in correct position SC1 $17.5 \leq \text{temperature} < 16.5$
	<b>Additional Guidance</b>		
	Accept 17.49 for 17.5		
	Accept eg 16.50 for 16.5		

Q	Answer	Mark	Comments
10	1 + 0.3 or 1.3 or 100(%) + 30(%) or 130(%)	M1	oe eg $x + 0.2x$ implied by eg $20\% = 64\,000$ or $10\% = 32\,000$
	429 000 $\div$ 1.3 or 429 000 $\div$ 130 ( $\times$ 100) or 3300 ( $\times$ 100)	M1dep	oe eg $99\,000 \times \frac{10}{3}$ or $33\,000 \times 10$
	330 000	A1	
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	557 700 is M0 unless 1.3 oe seen		
	Correct answer followed by further work		M2A0

Q	Answer	Mark	Comments
11	$6x^3$	B1	
	$2xy^2$ or $2y^2x$	B1	
	$3x^2y^2$ or $3y^2x^2$	B1	
	<b>Additional Guidance</b>		
	Mark the answer lines unless blank		
Do not allow transcription errors			

Q	Answer	Mark	Comments
12	<b>Alternative method 1</b>		
	(violins =) $72 \div 2$ or 36	M1	oe
	their $36 \div (2 + 3 + 1)$ or 6	M1dep	oe
	$2 \times$ their 6	M1dep	oe $\frac{2}{2+3+1} \times 36$ is M3
	12	A1	
	<b>Alternative method 2</b>		
	$72 \div (2 + 3 + 1)$ or 12	M1	oe
	$2 \times$ their 12 or 24	M1dep	oe
	their $24 \div 2$	M1dep	oe
	12	A1	
	<b>Alternative method 3</b>		
	(violins =) $72 \div 2$ or 36	M1	oe
	$x + \frac{3}{2}x + \frac{1}{2}x =$ their 36	M1dep	oe equation with $x$ as number of keyboards
	$3x =$ their 36	M1dep	oe equation in form $ax = b$
	12	A1	
	<b>Additional Guidance</b>		
	Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Other algebraic approaches are possible eg (violins =) $72 \div 2$ or 36 M1 $2x + 3x + x =$ their 36 but does not score 2nd M1 until $(x = )$ their $36 \div (2 + 3 + 1)$		

Q	Answer	Mark	Comments
<b>13</b>	$\tan 43 = \frac{h}{17}$ or $\left(\frac{17}{\cos 43}\right)^2 - 17^2$ or [251.3, 251.31]	M1	oe eg $\tan (90 - 43) = \frac{17}{h}$ or $\frac{\sin 43}{h} = \frac{\sin 47}{17}$ any letter or phrase for $h$ eg opposite
	$17 \times \tan 43$ or $\sqrt{\left(\frac{17}{\cos 43}\right)^2 - 17^2}$ or [15.8, 15.85]	M1dep	oe eg $17 \div \tan (90 - 43)$ or $\frac{17 \sin 43}{\sin 47}$
	$\sin x = \frac{\text{their [15.8, 15.85]}}{18}$ or $\sin x = [0.877, 0.88]$	M1dep	oe eg $\sin x = \frac{\sin 90}{18} \times \text{their [15.8, 15.85]}$ implied by $\sin^{-1} [0.877, 0.88]$
	[61.2, 61.8]	A1	
	<b>Additional Guidance</b>		
Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts			

Q	Answer	Mark	Comments
14	No and valid explanation	B1	eg No and $0.7 \times 0.9 = 0.63$ or No and saves 37% or No and 10% is off a smaller amount
	<b>Additional Guidance</b>		
	A value may be used in an explanation eg $0.7 \times 0.9 \times 200 = 126$ and $0.6 \times 200 = 120$ so No		B1
	2nd discount is reducing an already reduced price so No		B1
	10% off reduced price is not 10% off original price and No		B1
	Cannot just add the percentages as they are of different amounts so No		B1
	10% of the already reduced price is not 10% on top of the 30% discount		B1
	No and 40% is too much		B0
Incorrect overall percentage saving stated eg No and saves 27%		B0	

Q	Answer	Mark	Comments
	22	B4	B3 correct equation eg $3x + 2x + 13 + 2x + 13 = 180$ or $2x + 13 = 90 - 1.5x$ or $3x + 90 - \frac{3}{2}x + 2x + 13 = 180$ or $2x + 13 = 167 - 5x$ B2 correct expressions for two angles or two different correct expressions for the same angle B1 correct expression for one angle
<b>Additional Guidance</b>			
15	Correct expressions for angles (which may be seen on the diagram) include angle $AQC = 3x$ angle $APQ = 2x + 13$ angle $AQP = 2x + 13$ angle $APQ = \frac{180 - 3x}{2}$ or $90 - \frac{3}{2}x$ angle $AQP = \frac{180 - 3x}{2}$ or $90 - \frac{3}{2}x$ angle $APQ = 180 - 3x - (2x + 13)$ or $167 - 5x$ angle $AQP = 180 - 3x - (2x + 13)$ or $167 - 5x$ angle $QPB = 180 - (2x + 13)$ or $167 - 2x$ angle $ZPB = 2x + 13$ (Z is the end of line $QP$ produced) angle $ZPA = 180 - (2x + 13)$ or $167 - 2x$ (Z is the end of line $QP$ )		
	B2 may be awarded for the same expression for two different angles eg angle $APQ = 2x + 13$ and angle $AQP = 2x + 13$		B2
	Accept eg $AQP$ for angle $AQP$		
	Do not accept eg (angle) $P$ for angle $APQ$ unless shown on the diagram		
	Ignore reasons		

Q	Answer	Mark	Comments
16	$x^2 + 5x - 12x - 60$ or $x^2 - 7x - 60$	M1	oe quadratic expression 4 terms with at least 3 correct (terms may be seen in a grid) implied by $x^2 - 7x + k$
	their $(x^2 + 5x - 12x - 60) - 4x (= 0)$ or their $(x^2 - 7x - 60) - 4x (= 0)$ or $x^2 - 11x - 60 (= 0)$	M1dep	accept eg $-x^2 + 11x + 60 (= 0)$ accept oe equations in the form $px^2 + qx = r$ eg $x^2 - 11x = 60$
	$(x + 4)(x - 15) (= 0)$ or $\frac{-11 \pm \sqrt{(-11)^2 - 4 \times 1 \times -60}}{2 \times 1}$ or $\frac{11 \pm 19}{2}$	M1	oe ft their 3-term quadratic which cannot be $x^2 - 7x - 60$
	-4 and 15	A1	must have both solutions
	<b>Additional Guidance</b>		
	-4 and 15 without working		M3A1
	In the quadratic formula $11^2$ is equivalent to $(-11)^2$ but do not accept $-11^2$ unless recovered		
	$x^2 - 7x - 60 = 4x$ $x^2 - 7x - 60 = 0$ $(x + 5)(x - 12) = 0$		M1 M0dep M1
If first M1 is awarded for 4 terms that are incorrectly simplified to 3 terms, the 2nd M1 can be awarded using the incorrect simplification eg $x^2 + 5x - 12x - 60 = x^2 - 17x - 60$ $x^2 - 17x - 60 - 4x (= 0)$			M1 M1dep

Q	Answer	Mark	Comments
17	(gradient $LM =$ ) 2 or (gradient $ST =$ ) $-\frac{1}{2}$	M1	oe do not allow inclusion of $x$ unless recovered
	Yes and valid reason	A1	valid reasons include $-\frac{1}{2}$ is the negative reciprocal of 2 $-\frac{1}{2} \times 2 = -1$ $-1 \div (-\frac{1}{2}) = 2$

Q	Answer	Mark	Comments
18(a)	3 15 46 84 100	B1	may be implied by plots
	Correct cf diagram with points joined with a smooth curve or lines	B2ft	$\pm \frac{1}{2}$ small square ft their cf values which must be increasing for B2 or B1 B1ft cf diagram with all points plotted at their heights but not at correct horizontal positions or cf diagram with all points plotted at correct horizontal positions with at least 4 of their heights correct or all points plotted correctly at their heights but cf diagram not drawn or drawn poorly
	<b>Additional Guidance</b>		
	Ignore diagram to the left of their (300, 3)		
	For B2ft the diagram must end at (1500, their 100) unless followed by a horizontal line		
	Histogram only	Max B1B0	
	Histogram and cf diagram	Mark the cf diagram	

Q	Answer	Mark	Comments	
18(b)	Correct median for their cumulative frequency diagram	B1ft	ft their diagram which must be increasing $\pm \frac{1}{2}$ small square	
	Correct comparison of their type X median with 910	B1ft	answers must be in context eg X lasts longer or X is better	
	Correct interquartile range for their cumulative frequency diagram	B1ft	ft their diagram which must be increasing $\pm \frac{1}{2}$ small square	
	Correct comparison of their type X interquartile range with 460	B1ft	answers must be in context eg X is more consistent or X is more reliable or Y is more varied	
	<b>Additional Guidance</b>			
	2nd and 4th marks - ignore irrelevant or incorrect statements alongside a correct statement as long as not contradictory eg (X median = 930) X lasts longer by 30 (error) minutes			2nd B1
	X's average is bigger			2nd B0
	X's median is greater			2nd B0
	X's spread is smaller			4th B0
	X's IQR is lower			4th B0
Y is more spread out			4th B0	
2nd and 4th marks can be awarded even if their diagram is not increasing				
2nd and 4th marks can be awarded even if the methods used for X's median and IQR are incorrect				

Q	Answer	Mark	Comments
<b>19</b>	<b>Alternative method 1 : starts by working out area of phone screen</b>		
	24 ÷ 10 or 2.4 or 10 ÷ 24 or 0.416(...) or 0.42 or 360 ÷ 24 or 15	M1	oe
	360 ÷ (24 ÷ 10) <sup>2</sup> or 360 × (10 ÷ 24) <sup>2</sup> or 360 ÷ 24 × (10 ÷ 24) × 10 or 62.5	M1dep	oe
	their 62.5 × $\frac{7560}{100^2}$	M2dep	oe M1dep their 62.5 ÷ 100 <sup>2</sup> or 0.00625 or their 62.5 × 7560 or 472500 M1 $\frac{7560}{100^2}$ or 0.756
	47.25	A1	SC3 digits 4725

**Mark scheme and Additional Guidance continue on the next page**

<b>Q19 cont</b>	<b>Alternative method 2 : starts by working out cost of tablet screen</b>		
	$360 \times \frac{7560}{100^2}$ or 272.16	M2	oe M1 $360 \div 100^2$ or 0.036 or $360 \times 7560$ or 2721600 or $\frac{7560}{100^2}$ or 0.756
	24 $\div$ 10 or 2.4 or 10 $\div$ 24 or 0.416(...) or 0.42	M1	oe
	their $272.16 \div (24 \div 10)^2$ or their $272.16 \times (10 \div 24)^2$	M1dep	oe dep on M3
	47.25	A1	SC3 digits 4725
	<b>Additional Guidance</b>		
	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
20	$10 = \frac{40}{u_1} + 5$	M1	oe eg $5 = \frac{40}{u_1}$ accept $u_1$ replaced by a different variable eg $x$
	$u_1 = 8$	A1	do not accept $x = 8$ in working with nothing on answer line for $u_1$
	$u_3 = 9$	B1	SC1 $u_1 = 9$ and $u_3 = 9\frac{4}{9}$ or $\frac{85}{9}$ or [9.4, 9.44] <b>or</b> $u_1 = 9$ and $u_3 = 9\frac{4}{17}$ or $\frac{157}{17}$ or [9.2, 9.235]
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Embedded $u_1$ eg $10 = \frac{40}{8} + 5$		M1

Q	Answer	Mark	Comments
21(a)	Draws a tangent at 2 seconds and [2.5, 3.5]	B2	B1 draws tangent at 4 seconds

Q	Answer	Mark	Comments	
21(b)	[370, 378]	B3	B2 (area under curve =) [76, 84] or (area under horizontal =) 224 and (area under diagonal =) 70 implied by 294 B1 (area under horizontal =) 224 or (area under diagonal =) 70	
	<b>Additional Guidance</b>			
	For B2 and B1 areas may be seen on the diagram			

Q	Answer	Mark	Comments
21(c)	Underestimate and valid reason involving area under the graph	B1ft	ft their area in (b)

Q	Answer	Mark	Comments	
22	$(n - 13)^2$	M1		
	$(n - 13)^2 - 13^2 + 181$ or $(n - 13)^2 - 169 + 181$ or $(n - 13)^2 + 12$	M1dep	may be embedded in or implied by an inequality or equation eg $(n - 13)^2 - 13^2 + 181 = 10$ $(n - 13)^2 - 13^2 + 181 > 10$ $(n - 13)^2 > -2$	
	Valid explanation with M1 seen	A1	eg M1 seen and all the terms must be 12 or more or $(n - 13)^2 \geq 0$ and 12 is added	
	<b>Additional Guidance</b>			
	Condone a different letter used eg $x$			
	M2 and all the terms must be greater than 12			M2A0
	M2 and the 13th term is the smallest			M2A0
	Least term is 12 with no working for completing the square			M0
	M2 and squaring a bracket always has two digits then adding 12 means it has at least two digits			M2A0
	$(n - 13)(n - 13)$ is equivalent to $(n - 13)^2$			
	$(n - 13n)^2$			M0
	Ignore incorrect work after M2 eg $(n - 13)^2 + 12 = 0$			M2
Condone $(n - 13)^2$ is positive and 12 is added			M2A1	

Q	Answer	Mark	Comments
23(a)	<b>Alternative method 1</b>		
	angle $ACB = 59$	M1	may be seen on diagram
	118	A1	
	<b>Alternative method 2</b>		
	angle $OAB = 90 - 59$ or 31 or angle $OBA = 90 - 59$ or 31	M1	may be seen on diagram
	118	A1	
	<b>Additional Guidance</b>		
	Accept eg $ACB$ for angle $ACB$		
	Accept (angle) $C$ for angle $ACB$		
	Do not accept eg (angle) $A$ for angle $OAB$ unless shown on the diagram		
Ignore reasons			

Q	Answer	Mark	Comments
23(b)	$g = 180 - 68$ or 112	M1	may be seen on diagram
	$f = \text{their } 112 \div 7 \times 4$ or 64	M1dep	oe may be seen on diagram
	$h = 180 - \text{their } 64$ or 116	M1dep	may be seen on diagram equivalent ratios to 16 : 29 implies M3
	16 : 29	A1	accept $1 : \frac{29}{16}$ or $\frac{16}{29} : 1$
	<b>Additional Guidance</b>		
	Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts		
	Ignore reasons		

Q	Answer	Mark	Comments
24	Response showing that $AE$ bisects angle $BED$ and all reasons	B4	<p>B3 response showing that angle <math>BEA = DEA</math></p> <p>B2 two correct expressions for two angles in terms of <math>y</math> (angles must be below <math>AD</math>) or two correct equal statements about a pair of angles (angle must be below <math>AD</math>)</p> <p>B1 correct expression for one angle in terms of <math>y</math> or one correct statement about a pair of angles</p>

**Additional Guidance is on the next page**

<b>Additional Guidance</b>	
<b>24 cont</b>	<p>Correct expressions for angles (which may be seen on the diagram) include</p> <p>angle <math>ABE = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p> <p>angle <math>AEB = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p> <p>angle <math>DAE = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p> <p>angle <math>DEA = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p> <p>angle <math>ADE = y</math></p> <p>angle <math>DEC = y</math></p> <p>angle <math>ECD = 180 - (y + 90 - \frac{y}{2})</math> or <math>90 + \frac{y}{2}</math></p> <p>angle <math>EDC = 180 - (y + 90 + \frac{y}{2})</math> or <math>90 - \frac{3y}{2}</math></p>
	<p>Correct statements about a pair of angles include</p> <p>angle <math>FAD = y</math></p> <p>angle <math>AFD = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p> <p>angle <math>FDA = \frac{180 - y}{2}</math> or <math>90 - \frac{y}{2}</math></p>
	Accept eg $ABE$ for angle $ABE$
	Do not accept a single upper case letter for an angle unless shown on the diagram
	<p>Reasons needed will depend on the approach used and will include some of</p> <p>alternate angles (are equal)</p> <p>(base) angles of isosceles triangle (are equal)</p> <p>angles in rectangle are 90</p> <p>angles of triangle (add up to 180)</p> <p>(adjacent) angles on a (straight) line (add to 180)</p>