

**OXFORD**

INTERNATIONAL  
AQA EXAMINATIONS

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# INTERNATIONAL GCSE MATHEMATICS

## 9260/2E

Paper 2E Extension Tier

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Mark scheme

June 2022

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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.

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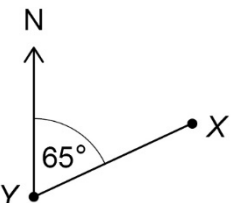
**Key to mark types and abbreviations**

<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.

Q	Answer	Mark	Comments
1	2	B1	

Q	Answer	Mark	Comments
2	5.00006	B1	

Q	Answer	Mark	Comments
3	$\frac{nx}{4}$	B1	

Q	Answer	Mark	Comments
4		B1	

Q	Answer	Mark	Comments
<b>5</b>	$5xy(x - 7y)$ or $-5xy(7y - x)$	<b>B2</b>	B1 $xy(5x - 35y)$ or $5x(xy - 7y^2)$ or $5y(x^2 - 7xy)$ or $5(x^2y - 7xy^2)$ or $x(5xy - 35y^2)$ or $y(5x^2 - 35xy)$ or fully factorised expression with one error in the bracket
	<b>Additional Guidance</b>		
	Condone multiplication signs for B2 and B1 eg1 $5xy \times (x - 7y)$ eg2 $x \times y \times (5x - 35y)$		B2 B1
	Further work following a B2 answer		B1
	Further work following a B1 answer		B1
	$5xy(x + 7y)$ fully factorised with one error in the bracket		B1
	$5xy(x - 6y)$ fully factorised with one error in the bracket		B1
	Condone missing final bracket eg1 $5xy(x - 7y$ eg2 $5x(xy - 7y^2$		B2 B1
	Allow equivalent factorised expressions eg $-5x(7y^2 - xy)$		B1
	$xy(5x + 35y)$ one error in the bracket but not fully factorised		B0

Q	Answer	Mark	Comments
6	<b>Alternative method 1</b>		
	A pair of arcs, centre Y, equal radius ( $\pm 2$ mm), intersecting YX and YZ or a single arc, centre Y, intersecting YX and YZ	M1	oe eg a single arc, centre Y, radius YX intersecting YZ
	Two intersecting arcs, equal radius ( $\pm 2$ mm), with centres at the intersections on YX and YZ	M1dep	if a single arc, centre Y, radius YX intersecting YZ has been drawn the centres will be at X and the intersection on YZ
	Fully correct method of construction of angle bisector and P marked 6 cm from Y in a position where YP bisects the angle XYZ	A1	$\pm 2$ mm
	<b>Alternative method 2</b>		
	A pair of arcs, centre Y, equal radius ( $\pm 2$ mm), intersecting YX and YZ or a single arc, centre Y, intersecting YX and YZ	M1	oe eg a single arc, centre Y, radius YX intersecting YZ
	Two further arcs, centre Y, equal radius ( $\pm 2$ mm), intersecting YX and YZ or a further single arc, centre Y, intersecting YX and YZ and two lines from the YX intersection of one arc to the YZ intersection of the other arc	M1dep	if a single arc, centre Y, radius YX, intersecting YZ has been drawn, one line will join X to the intersection on YZ
	Fully correct method of construction of angle bisector and P marked 6 cm from Y in a position where YP bisects the angle XYZ	A1	$\pm 2$ mm

Additional guidance is on the next page

		<b>Additional Guidance</b>	
<b>6 cont.</b>		The angle bisector need not be drawn	
		Ignore incorrect arc(s)	
		Condone $P$ not labelled if clearly indicated eg by a cross or dot	
		If $P$ is not labelled or clearly indicated by a cross or dot, take the end of the angle bisector as the position of $P$	
		The angle bisector need not pass through the intersection of the second pair of arcs but must do so if it were extended	
		Accept an arc touching $YX$ and/or $YZ$	
		No arc, centre $Y$ , seen on $YZ$	M0
		Method for alt 2  <div style="text-align: center;"> </div>	M2

Q	Answer	Mark	Comments												
7(a)	<table border="1"> <tr> <td>x</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> </tr> <tr> <td>y</td> <td>-6</td> <td>1</td> <td>2</td> <td>3</td> <td>10</td> </tr> </table>	x	-2	-1	0	1	2	y	-6	1	2	3	10	B2	B1 one value in the correct position
	x	-2	-1	0	1	2									
	y	-6	1	2	3	10									
<b>Additional Guidance</b>															
If table contains blanks, values may be implied from the graph or points plotted in part (b)															

Q	Answer	Mark	Comments
7(b)	4 or 5 points plotted correctly	M1	correct or ft their table in (a) $\pm \frac{1}{2}$ small square points may be implied by curve passing through them
	Fully correct smooth cubic curve		A1 $\pm \frac{1}{2}$ small square for each point
	<b>Additional Guidance</b>		
	Correct graph drawn		M1A1
	If two points are plotted for an $x$ -value, then this is choice for that $x$ -value unless their graph passes through one of the points eg $(-2, -6)$ and $(-2, 6)$ plotted is choice unless their graph passes through one of the points		
	Curve must have a decreasing positive gradient to the left of $(0, 2)$ and an increasing positive gradient to the right of $(0, 2)$		
	Condone a positive gradient at $(0, 2)$		
	Condone an infinite gradient at $(-2, -6)$ and/or $(2, 10)$		
Ignore the curve extended beyond their plots for $(-2, -6)$ and $(2, 10)$			

Q	Answer	Mark	Comments
8	<b>Alternative method 1</b>		
	$6^2$ and $4.5^2$ or 36 and 20.25 or 56.25	M1	oe
	$\sqrt{6^2 + 4.5^2}$ or $\sqrt{36 + 20.25}$ or $\sqrt{56.25}$ or 7.5	M1dep	oe $\frac{4.5}{3} \times 5$ or $\frac{6}{4} \times 5$ oe is M2
	11 + 4.5 + their 7.5 + $x = 30$ or 30 – 11 – 4.5 – their 7.5	M1dep	oe any letter
	7	A1	
	<b>Alternative method 2</b>		
	(Angle $BDC =$ ) $\tan^{-1} \frac{4.5}{6}$ or [36.86, 37] or (angle $BCD =$ ) $\tan^{-1} \frac{6}{4.5}$ or [53, 53.14]	M1	
	$\frac{4.5}{\sin(\text{their } [36.86, 37])}$ or $\frac{6}{\sin(\text{their } [53, 53.14])}$ or [7.477, 7.513]	M1dep	oe eg $\frac{6}{\cos(\text{their } [36.86, 37])}$ $\frac{4.5}{\cos(\text{their } [53, 53.14])}$
	11 + 4.5 + their [7.477, 7.513] + $x = 30$ or 30 – 11 – 4.5 – their [7.477, 7.513]	M1dep	oe any letter
	7	A1	

Additional Guidance for question 8 is on the next page

<b>Additional Guidance</b>		
<b>8 cont.</b>	The first two method marks may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts	
	$x^2 = 6^2 + 4.5^2 - 2 \times 6 \times 4.5 \times \cos 90$	M1
	Angle $BDC = 36.9$ and $x^2 = 11^2 + 6^2 - 2 \times 11 \times 6 \times \cos 36.9$	M1M0
	Decimal answer rounded to 7	M1M1M1A0

Q	Answer	Mark	Comments
<b>9</b>	<b>Alternative method 1</b>		
	$9p^2 + 45p$	M1	
	$6p^2 + 24p$ or $-6p^2 - 24p$	M1	
	$c = 3$ and $d = 28$	A1ft	ft M1M0 or M0M1 with at most 1 error
	<b>Alternative method 2</b>		
	$9p^2 - 6p^2 = cp^2$ or $3p^2 = cp^2$ or $9 - 6 = c$	M1	equating $p^2$ terms or coefficients implied by $c = 3$
	$45p - 24p + 7p = dp$ or $28p = dp$ or $45 - 24 + 7 = d$	M1	equating $p$ terms or coefficients implied by $d = 28$
	$c = 3$ and $d = 28$	A1ft	ft M1M0 or M0M1 with at most 1 error
	<b>Additional Guidance</b>		
	Allow recovery of missing brackets, eg $9p^2 + 45p - 6p^2 + 24p + 7p = 3p^2 + 28p$ $c = 3$ and $d = 28$		M1M1A1
	$3p^2 + 28p$ in working implies the method marks		M1M1A0
	$c = 3p^2$ and $d = 28p$ implies the method marks		M1M1A0
	$9p^2 + 45p - 6p^2 - 24p = 3p^2 + 21p$ $c = 3$ and $d = 21$		M1M1A0
	$9p^2 + 45p - 6p^2 + 24p + 7p = 3p^2 + 76p$ $c = 3$ and $d = 76$ (one error)		M1M0A1ft
	$9p^2 + 45p - 5p^2 - 24p + 7p = 4p^2 + 28p$ $c = 4$ and $d = 28$ (one error)		M1M0A1ft
$9p^2 + 35p - (6p^2 + 24p) + 7p = 3p^2 + 18p$ $c = 3$ and $d = 18$ (one error)		M0M1A1ft	
$9p^2 + 45p - 6p^2 + 24p = 3p^2 + 69p$ $c = 3$ and $d = 69$ (two errors)		M1M0A0ft	

Q	Answer	Mark	Comments
10(a)	{1, 4, 6, 8, 9}	B1	

Q	Answer	Mark	Comments
10(b)	1, 4, 9 and 1, 8 or 1, 4, 8, 9	M1	allow 1, 1, 4, 8, 9 may be in brackets ignore order
	4	A1	
	<b>Additional Guidance</b>		
	Condone {4}		M1A1
	1 + 4 + 8 + 9		M1

Q	Answer	Mark	Comments
11	$t > -\frac{8 \times 3}{2}$ or $-t < \frac{8 \times 3}{2}$ or $2t > -8 \times 3$ or $-2t < 8 \times 3$ or $\frac{t}{3} > -\frac{8}{2}$ or $-\frac{t}{3} < \frac{8}{2}$	M1	oe eg $-t < 12$ or $2t > -24$ or $-2t < 24$ or $\frac{t}{3} > -4$ or $-\frac{t}{3} < 4$
	$t > -12$ or $-12 < t$	A1	SC1 incorrect symbol eg $t \geq -12$ or $t < -12$ or $t \leq -12$ or $(t =) -12$
	<b>Additional Guidance</b>		
	Solving an equation may be recovered eg $-2t = 8 \times 3$ with $t > -12$ on answer line		M1A1

Q	Answer	Mark	Comments
12	$(5 - 2) \times 180$ or $5 \times \left(180 - \frac{360}{5}\right)$ or $5 \times 108$ or 540	M1	oe
	$103 + 89 + 150 + x + x + 50 = \text{their } 540$ or their $540 - 103 - 89 - 150$ or 198	M1	oe eg $2x + 392 = 540$ their 540 must be an integer $> 392$
	their $540 - 103 - 89 - 150 - 50$ or their $198 - 50$ or 148	M1dep	oe eg $2x = 148$ dep on 2nd M1
	74	A1	

Q	Answer	Mark	Comments
13	<b>Alternative method 1 – cost of 6 rolls each week</b>		
	$1.4(0) \times 6 - 1.4(0) \times 6 \times 0.15$ or $8.4(0) - 1.26$ or $1.4(0) \times 6 \times 0.85$ or 7.14	M1	oe week 1
	$(1.4(0) \times 2 + 1.4(0) \div 2) \times 2$ or $3.5(0) \times 2$ or $1.4(0) \times 4 + 1.4(0) \times 2 \div 2$ or $1.4(0) \times 5$ or 7	M1	oe week 2
	$(1.4(0) + 1.4(0) \times 0.75) \times 3$ or $2.45 \times 3$ or $4.2(0) + 3.15$ or 7.35	M1	oe week 3
	7.14 and 7 and 7.35 and 2	A1	
	<b>Alternative method 2 – saving made each week</b>		
	$1.4(0) \times 6 \times 0.15$ or 1.26	M1	oe week 1
	$1.4(0) \div 2 \times 2$ or $1.4(0)$	M1	oe week 2
	$1.4(0) \times 3 \times 0.25$ or 1.05	M1	oe week 3
	1.26 and $1.4(0)$ and 1.05 and 2	A1	
	<b>Alternative method 3 – equivalent rolls being paid for</b>		
	$6 \times 0.85$ or 5.1	M1	oe week 1
	$2 \times 2.5$ or 5	M1	oe week 2
	$3 \times 1.75$ or 5.25	M1	oe week 3
	5.1 and 5 and 5.25 and 2	A1	
	<b>Additional Guidance</b>		
	Mark by the method that gives the best mark		

Q	Answer	Mark	Comments
14	<b>Alternative method 1</b>		
	36 ÷ 3 or 12	M1	oe
	4 × their 12 or 48	M1dep	oe $\frac{4}{3} \times 36$ is M2
	180 – 36 – their 48 or 96	M1dep	
	8	A1	
	<b>Alternative method 2</b>		
	36 ÷ 3 or 12	M1	oe
	(3 + 4) × their 12 or 84	M1dep	oe
	180 – their 84 or 96	M1dep	
	8	A1	
	<b>Alternative method 3</b>		
	$\frac{3}{3 + 4 + x} \times 180 = 36$	M1	oe $\frac{540}{7 + x} = 36$
	540 = 36(7 + x)	M1dep	oe 540 = 252 + 36x
	36x = 288	M1dep	oe equation of the form $ax = b$
	8	A1	
	<b>Alternative method 4</b>		
	36 ÷ 3 or 12	M1	oe
	180 ÷ their 12 or 15	M1dep	oe $180 \times \frac{3}{36}$ is M2
	15 – 3 – 4	M1dep	oe
	8	A1	
	<b>Additional Guidance</b>		
	Accept 3 : 4 : 8		M1M1M1A1
	3 : 4 : 8 in working but 96 on answer line		M1M1M1A0

Q	Answer	Mark	Comments
15	$n^2 + n \geq 0$	B1	

Q	Answer	Mark	Comments
16	<b>Alternative method 1</b>		
	$25 + c + 26 + d + 9 + 3 = 120$ or $63 + c + d = 120$ or $c + d = 57$	M1	oe may be implied by a pair of non-negative integers for $c$ and $d$ totalling 57
	$(0 \times 25$ or $0)$ and $1 \times c$ or $c$ and $2 \times 26$ or $52$ and $3 \times d$ or $3d$ and $4 \times 9$ or $36$ and $5 \times 3$ or $15$	M1	oe allow 1 error
	$((0 \times 25) + 1 \times c + 2 \times 26 + 3 \times d + 4 \times 9 + 5 \times 3) \div 120 = 2$ or $c + 3d = 240 - 2 \times 26 - 4 \times 9 - 5 \times 3$ or $c + 3d = 137$	M1dep	oe dep on second M1
	$3d - d = 137 - 57$ or $d = 40$ or $3c - c = 3 \times 57 - 137$ or $c = 17$	M1	oe eliminates one unknown from their two linear equations
	$c = 17$ and $d = 40$	A1	

**Alternative method 2 and Additional Guidance is on the next page**

Q	Answer	Mark	Comments
<b>16 cont.</b>	<b>Alternative method 2</b>		
	$25 + c + 26 + d + 9 + 3 = 120$ or $63 + c + d = 120$ or $c + d = 57$	M1	oe
	Test two values totalling 57 in correct mean calculation	M1	implies M2
	Second test of two values totalling 57 in correct mean calculation	M1dep	
	$c = 17$ and $d = 40$	A2	
	<b>Additional Guidance</b>		
	Alt 2 scores up to M3 or M3A2		
	$c = 20$ and $d = 37$		M1
	$((0 +) c + 52 + 3d + 36 + 15) \div 6$ implies the second method mark (alt 1)		M1
	$(0 +) c + 52 + 3d + 36 + 15 = 120$ implies the second method mark (alt 1)		M1
	$\frac{25 + c + 26 + d + 9 + 3}{2} = 120$		M0
	$\frac{25 + c + 26 + d + 9 + 3}{6} = 2$		M0
Beware $120 - (2 \times 26 + 4 \times 9 + 5 \times 3) = 17$		M0	

Q	Answer	Mark	Comments
17	$(x + 5)(x - 4)$ or $\frac{-1 \pm \sqrt{1^2 - 4 \times 1 \times -20}}{2 \times 1}$ or -5 and 4	M1	oe may be implied
	$\frac{1}{3} \times 9$ or $\frac{1}{3} \times (\text{their } 4 - \text{their } -5)$ or 3 or $\frac{2}{3} \times 9$ or 6	M1	oe finding $\frac{1}{3}$ of the distance from their A to their B or $\frac{2}{3}$ of the distance from their B to their A their 4 and their -5 must be correct for their factorisation (if shown)
	$x = -2$	A1	
	$y = -18$	A1ft	ft their $x$ -coordinate if M2 awarded
	<b>Additional Guidance</b>		
$(x + 5)(x - 4)$ $x = 5$ and $x = -4$ $\frac{1}{3} \times (5 - -4)$ $x = 3$ $y = -8$	M1  M1 A0A1ft		
(-5, 0) and (4, 0) or (0, -5) and (0, 4) implies the first M1			

Q	Answer	Mark	Comments
<b>18</b>	$52 \times 2$ or 104 or $30 \times 0.75$ or 22.5 or $104 + 22.5$ or 126.5	M1	oe stage 1 or stage 2 distance or total
	$48 \times (2 + 0.75 + 1)$ or $48 \times 3.75$ or 180 or $\frac{52 \times 2 + 30 \times 0.75 + x}{2 + 0.75 + 1} = 48$	M1	oe total distance  any letter
	their 180 – their 126.5 or $48 \times 3.75 - (52 \times 2 + 30 \times 0.75)$	M1dep	oe dep on M2 their 180 and their 126.5 must both be from fully correct methods
	53.5	A1	oe SC3 39.1 or 48.1
	<b>Additional Guidance</b>		
M1 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts			

Q	Answer	Mark	Comments
19	(15, 0)	B1	

Q	Answer	Mark	Comments	
20	<b>Alternative method 1</b>			
	(AOC =) $360 - 10x$	M1		
	(ABC =) $5x$	M1		
	$5x + 2x + 360 - 10x + y = 360$	M1dep	oe dep on M2	
	$y = 3x$	A1		
	<b>Alternative method 2</b>			
	(AOC =) $360 - 10x$	M1		
	(ABO =) $2x$ and (OBC =) $y$	M1		
	$2x + 2x + y + y + 360 - 10x = 360$	M1dep	oe dep on M2	
	$y = 3x$	A1		
	<b>Alternative method 3</b>			
	(ABC =) $5x$	M1		
	(ABO =) $2x$ and (OBC) = $y$	M1		
	$2x + y = 5x$	M1dep	oe dep on M2	
	$y = 3x$	A1		
	<b>Additional Guidance</b>			
	Working for M1M1 may be seen on diagram			
Ignore reasons				
The first two marks may be awarded even if not subsequently used				
$3x$ on answer line with $y = 3x$ in working			M1M1M1A1	

Q	Answer	Mark	Comments
	$(\overrightarrow{PS} =) 2\mathbf{a}$ or $(\overrightarrow{SP} =) -2\mathbf{a}$	B1	oe may be seen on diagram or implied by $\overrightarrow{SR}$ , $\overrightarrow{RS}$ , or $\overrightarrow{SQ} = -2\mathbf{a} + 4\mathbf{b}$ or $\overrightarrow{QS} = 2\mathbf{a} - 4\mathbf{b}$
	$(\overrightarrow{SR} =)$ their $-2\mathbf{a} + 4\mathbf{b} + \mathbf{a}$ or $(\overrightarrow{RS} =) -\mathbf{a} - 4\mathbf{b} +$ their $2\mathbf{a}$ or $(\overrightarrow{RS} =) \mathbf{a} - 4\mathbf{b}$	M1	oe eg $(\overrightarrow{SR} =)$ their $(-2\mathbf{a} + 4\mathbf{b}) + \mathbf{a}$ or $(\overrightarrow{RS} =) -\mathbf{a} +$ their $(2\mathbf{a} - 4\mathbf{b})$
	$4\mathbf{b} - \mathbf{a}$ or $-\mathbf{a} + 4\mathbf{b}$	A1	
<b>Additional Guidance</b>			
<b>21</b>	An incorrect expression for $\overrightarrow{SP}$ can be recovered $\overrightarrow{SP} = 2\mathbf{a}$ (incorrect) $\overrightarrow{SR} = -2\mathbf{a} + 4\mathbf{b} + \mathbf{a}$ and $-\mathbf{a} + 4\mathbf{b}$		B1M1A1
	A correct equation for $\overrightarrow{SR}$ or $\overrightarrow{RS}$		B1M1
	$2\mathbf{a} + 4\mathbf{b} + \mathbf{a}$ implies $\overrightarrow{SP} = 2\mathbf{a}$		B0M1
	$2\mathbf{a}$ or $-2\mathbf{a}$ followed by an incorrect equation or no equation for $\overrightarrow{SR}$ or $\overrightarrow{RS}$		B1M0
	$\overrightarrow{SP} = 2\mathbf{a}$ (incorrect) $\overrightarrow{SR} = 2\mathbf{a} + 4\mathbf{b} + \mathbf{a}$		B0M1
	$\overrightarrow{SP} = -2\mathbf{a}$ (correct) $\overrightarrow{SR} = 2\mathbf{a} + 4\mathbf{b} + \mathbf{a}$		B1M0
	$(\overrightarrow{PR} =) \mathbf{a} - 4\mathbf{b}$ (incorrect) followed by $-2\mathbf{a} + \mathbf{a} - 4\mathbf{b}$ implies $\overrightarrow{SP} = 2\mathbf{a}$		B1M0
	$\overrightarrow{PS}$ or $\overrightarrow{SP}$ not stated or shown on diagram followed by $\overrightarrow{SR} = 2\mathbf{a} + 4\mathbf{b} - \mathbf{a} = \mathbf{a} + 4\mathbf{b}$		B0M0

Q	Answer	Mark	Comments
<b>22</b>	<b>Alternative method 1</b>		
	$\frac{2-4}{7-1} \text{ or } \frac{4-2}{1-7}$ $\text{or } -\frac{2}{6} \text{ or } -\frac{1}{3}$	M1	oe method to find gradient of $AB$ eg $4 = m + c$ and $2 = 7m + c$ with correct method to solve the equations and $m$ evaluated
	$\frac{-1}{\text{their } -\frac{1}{3}} \text{ or } 3$	M1	oe
	$2 = \text{their } 3 \times 7 + c$ or $\text{their } 3 = \frac{(y-2)}{(x-7)}$	M1dep	oe dep on second M1 ft their perpendicular gradient
	$y = 3x - 19$	A1	
	<b>Alternative method 2</b>		
	$(7 + 2, 2 + 6) \text{ or } (9, 8)$	M1	coordinates of point C identified
	$\frac{\text{their } 8 - 2}{\text{their } 9 - 7} \text{ or } \frac{2 - \text{their } 8}{7 - \text{their } 9}$ $\text{or } \frac{6}{2} \text{ or } \frac{-6}{-2} \text{ or } 3$	M1	oe their 8 must be $> 2$ their 9 must be $> 7$
	$2 = \text{their } 3 \times 7 + c$ or $\text{their } 3 = \frac{(y-2)}{(x-7)}$ or $\text{their } 8 = \text{their } 3 \times \text{their } 9 + c$	M1dep	oe dep on second M1
	$y = 3x - 19$	A1	

**Alternative method 3 and Additional Guidance are on the next page**

Q	Answer	Mark	Comments
<b>22 cont.</b>	<b>Alternative method 3</b>		
	$(7 + 2, 2 + 6)$ or $(9, 8)$	M1	coordinates of point C identified
	$2 = 7m + c$ and their 8 = (their 9) $m + c$ and correct method to solve the equations and one unknown evaluated	M1	oe their 8 must be $> 2$ their 9 must be $> 7$
	Evaluates the other unknown using a correct method	M1dep	dep on second M1
	$y = 3x - 19$	A1	
	<b>Additional Guidance</b>		
	If $y = mx + c$ and simultaneous equations are used to find the gradient of AB, ignore $c$ if $m$ evaluated correctly		
	$m = 3$ and $c = -19$		M1M1M1A1
	$y = 3x + c$ with no attempt to find $c$		M1M1M0
	In alt 3 arithmetical errors may occur in solving the simultaneous equations but the method marks may still be awarded  $C = (9, 6)$ $2 = 7m + c$ and $6 = 9m + c$ and $m = 4$ $c = 2 - 7 \times 4 = 26$ (incorrect value but method correct)		M0 M1 M1

Q	Answer	Mark	Comments											
23(a)	$15 \div 50$ or 0.3 or $150 \div 30$ or 5 or $124 \div 20$ or 6.2 or $75 \div 150$ or 0.5	M1	oe eg $\frac{15}{50}$ implied by bar of correct height $\pm \frac{1}{2}$ small square											
	Three or four correct frequency densities	M1dep	at least three from 0.3, 5, 6.2, 0.5 implied by bars of correct heights $\pm \frac{1}{2}$ small square											
	Fully correct histogram	A1												
	<b>Additional Guidance</b>													
	Bar widths and heights <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td><math>200 \leq t &lt; 250</math></td> <td>50</td> <td>0.3</td> </tr> <tr> <td><math>250 \leq t &lt; 280</math></td> <td>30</td> <td>5</td> </tr> <tr> <td><math>280 \leq t &lt; 300</math></td> <td>20</td> <td>6.2</td> </tr> <tr> <td><math>300 \leq t &lt; 450</math></td> <td>150</td> <td>0.5</td> </tr> </tbody> </table>			$200 \leq t < 250$	50	0.3	$250 \leq t < 280$	30	5	$280 \leq t < 300$	20	6.2	$300 \leq t < 450$	150
$200 \leq t < 250$	50	0.3												
$250 \leq t < 280$	30	5												
$280 \leq t < 300$	20	6.2												
$300 \leq t < 450$	150	0.5												
Condone frequency polygon superimposed over the histogram														

Q	Answer	Mark	Comments
23(b)	$10 \times 5$ or $\frac{10}{280-250} \times 150$ or $150 - 20 \times 5$ or $150 - \frac{20}{280-250} \times 150$ or 50	M1	oe eg $\frac{1}{3} \times 150$ $150 - \frac{2}{3} \times 150$
	65	A1	

Q	Answer	Mark	Comments
24	<b>Alternative method 1</b>		
	$(9^{6x} =) 81^{3x}$	M1	may be seen in an equation eg $81^{7x} = 81^{3x} \times 81^2$ or $81^{3x+2}$
	$7x = 3x + 2$	M1dep	oe
	0.5	A1	oe
	<b>Alternative method 2</b>		
	$(81^{7x} =) 9^{14x}$ or $(81^2 =) 9^4$	M1	may be seen in an equation eg $9^{14x} = 9^{6x} \times 9^4$ or $9^{14x} = 9^{6x+4}$
	$14x = 6x + 4$	M1dep	oe both $9^{14x}$ and $9^4$ must be correct
	0.5	A1	oe
	<b>Alternative method 3</b>		
	$(81^{7x} =) 3^{28x}$ or $(9^{6x} =) 3^{12x}$ or $(9^4 =) 3^8$	M1	may be seen in an equation eg $3^{28x} = 3^{12x} \times 3^8$ or $3^{28x} = 3^{12x+8}$
	$28x = 12x + 8$	M1dep	oe $3^{28x}$ , $3^{12x}$ and $3^8$ must be correct
	0.5	A1	oe

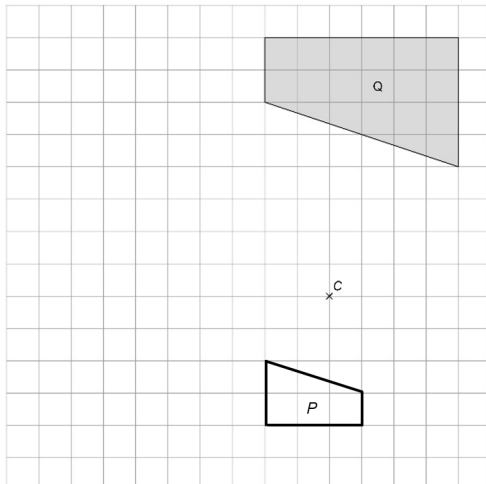
Q	Answer	Mark	Comments
25(a)	0.75, 0.8 and 0.9 in correct position	B2	oe B1 one or two correct values in their correct position(s)
	<b>Additional Guidance</b>		
	Correct diagram  	B2	

Q	Answer	Mark	Comments
25(b)	their $0.75 \times 0.8$ or $0.6$ or $0.25 \times 0.1$ or $0.025$ or their $0.75 \times 0.2$ or $0.15$ or $0.25 \times 0.9$ or $0.225$	M1	oe ft their tree diagram provided all probabilities are $> 0$ and $< 1$
	their $0.6 + 0.025$ or $1 - (0.15 + 0.225)$	M1dep	oe their $0.6$ and their $0.025$ must both be from correct methods their $0.15$ and their $0.225$ must both be from correct methods
	0.625	A1ft	oe fraction or percentage ft their tree diagram provided all probabilities are $> 0$ and $< 1$

<b>26</b>	45	B3	B2 63 or 630 or any complete correct method for 45 B1 27 or 42 or 35 or 90 or 270 or 900
	<b>Additional Guidance</b>		
	B2 and B1 values may be implied by reciprocals eg $\frac{1}{900}$ implies B1		

Q	Answer	Mark	Comments
27(a)	$16\sqrt{10}$	B1	

Q	Answer	Mark	Comments
27(b)	$\frac{(7-\sqrt{3})}{(2+\sqrt{3})} \times \frac{(2-\sqrt{3})}{(2-\sqrt{3})}$	M1	may be implied by the second mark
	$14 - 2\sqrt{3} - 7\sqrt{3} + 3$ or $14 - 9\sqrt{3} + 3$ or $17 - 2\sqrt{3} - 7\sqrt{3}$ and $4(-2\sqrt{3} + 2\sqrt{3}) - 3$	M1dep	accept $2^2$ for 4
	$17 - 9\sqrt{3}$ or $a = 17$ and $b = -9$ with working for M1M1 seen	A1	accept $2^2$ for 4
	<b>Additional Guidance</b>		
	Further working eg $17 - 9\sqrt{3} = 8\sqrt{3}$		M1M1A0
	Multiplying across to reach $17 - 9\sqrt{3}$ or $a = 17$ and $b = -9$		M0M0A0

Q	Answer	Mark	Comments	
28		B2	B1 vertices plotted correctly but shape not drawn or shape drawn with correct orientation and size but in wrong position	
	<b>Additional Guidance</b>			
	It is not necessary to label P			
	Ignore labelling of vertices			

Q	Answer	Mark	Comments
29	$(fg =) x^3 + 2$ or $f(3^3)$ or $f(27)$ or $3^3 + 2$ or 29	M1	
	$(gf =) (x + 2)^3$ or $g(2 + 2)$ or $g(4)$ or $(2 + 2)^3$ or $4^3$ or 64	M1	
	93	A1	

Q	Answer	Mark	Comments
<b>30</b>	<b>Alternative method 1</b>		
	Second difference is $-4$ or $2a = -4$ or $a = -2$ or $-2n^2$	M1	second difference seen at least once and not contradicted
	Subtracts $-2n^2$ values from at least two consecutive terms in the original sequence	M1dep	eg $25 - -2 \times 1^2$ and $20 - -2 \times 2^2$ or 27 and 28 or $11 - -2 \times 3^2$ and $-2 - -2 \times 4^2$ or 29 and 30
	$-2n^2 + n + 26$	A1	oe allow $a = -2$ $b = 1$ $c = 26$
	<b>Alternative method 2</b>		
	Any three of $a + b + c = 25$ $4a + 2b + c = 20$ $9a + 3b + c = 11$ $16a + 4b + c = -2$ or $a = -2$	M1	using $an^2 + bn + c$
	Any 2 correct equations in the same 2 unknowns	M1dep	eg $3a + b = -5$ and $5a + b = -9$ $5a + b = -9$ and $7a + b = -13$
	$-2n^2 + n + 26$	A1	oe allow $a = -2$ $b = 1$ $c = 26$

**Alternative methods 3 & 4 and Additional Guidance are on the next page**

<b>30 cont.</b>	<b>Alternative method 3</b>		
	Second difference is $-4$ or $2a = -4$ or $a = -2$ or $-2n^2$	M1	second difference seen at least once and not contradicted
	$3a + b = -5$ and substitutes their $a$ or $b = 1$ or $n$	M1dep	oe eg $5a + b = -9$ and substitutes their $a$
	$-2n^2 + n + 26$	A1	oe allow $a = -2$ $b = 1$ $c = 26$
	<b>Alternative method 4</b>		
	Second difference is $-4$ or $2a = -4$ or $a = -2$ or $-2n^2$	M1	second difference seen at least once and not contradicted
	$ax^2 + bx + c = 26$ or $c = 26$	M1	continues sequence backwards to the 0th term to find the value of $c$
	$-2n^2 + n + 26$	A1	oe allow $a = -2$ $b = 1$ $c = 26$
	<b>Additional Guidance</b>		
	Sequence           (26)   25    20    11    -2 1st differences       (-1)   -5    -9   -13 2nd differences           -4    -4    -4		
Accept $1n$ for $n$			

Q	Answer	Mark	Comments
<b>31</b>	<b>Alternative method 1</b>		
	$\frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{17}{12}\pi r^3$ or $\frac{17}{12}\pi r^3 - \frac{2}{3}\pi r^3 = \frac{9}{12}\pi r^3$	M1	oe forms a correct equation in $r$ and $h$  correctly subtracts to find the volume of the cone in terms of $r$
	$\frac{1}{3}\pi r^2(2r + h) = \frac{17}{12}\pi r^3$ or $\frac{1}{3}\pi r^2 h = \frac{(17-8)}{12}\pi r^3$ or $\frac{1}{3}\pi r^2 h = \frac{9}{12}\pi r^3$	M1dep	oe fully factorising the left hand side of the equation  rearranging the equation  equating the two expressions for the volume of the cone
	$\frac{12}{3(17-8)} = \frac{r}{h} \quad \text{or} \quad \frac{4}{9} = \frac{r}{h}$ or $h = \frac{9r}{4}$	M1dep	oe eg $\frac{r}{h} = \frac{1}{3} \div \frac{9}{12}$
	$\tan \theta = \frac{4}{9} \quad \text{or} \quad 0.44\dots$ or $\sin \theta = \frac{4}{\sqrt{97}} \quad \text{or} \quad 0.406\dots \quad \text{or} \quad 0.41$ or $\cos \theta = \frac{9}{\sqrt{97}} \quad \text{or} \quad 0.91\dots$	M1	oe  ft from $h = \frac{ar}{b}$ oe
	[23.96, 24]	A1	

**Alternative method 2 and Additional Guidance are on the next page**

Q	Answer	Mark	Comments
<b>31</b> <b>cont.</b>	<b>Alternative method 2</b>		
	$\frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 h = \frac{17}{12}\pi r^3$	M1	oe
	$h = \frac{r}{\tan \theta}$ or $r = h \tan \theta$	M1	
	$\frac{2}{3} + \frac{1}{3 \tan \theta} = \frac{17}{12}$	M1dep	oe eg $\frac{2}{3} \tan \theta + \frac{1}{3} = \frac{17}{12} \tan \theta$ dep on M2
	$\tan \theta = \frac{4}{9}$	M1dep	oe
	$[23.96, 24]$	A1	
	<b>Additional Guidance</b>		
	Allow the consistent use of a value for $\pi$		
	The 4th mark in alt 1 is independent an can be awarded following MOMOMO		
	$r = h \tan \theta$ and $\frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2 \times \frac{r}{\tan \theta} = \frac{17}{12}\pi r^3$ (alt 2)		M1M1
$\frac{1}{3}(2r + h) = \frac{17}{12}r$		M1M1	
$\frac{2}{3}r^3 + \frac{1}{3}r^2 h = \frac{17}{12}r^3$		M1	
$\frac{2}{3}r + \frac{1}{3}h = \frac{17}{12}r$		M1	
The 4th mark in alt 1 is independent an can be awarded following MOMOMO			

Q	Answer	Mark	Comments	
32	$12x^2 - 3$	M1	oe eg $4 \times 3 \times x^{3-1} - 3$	
	their $(12x^2 - 3) < 0$ or $(2x + 1)(2x - 1) < 0$	M1	oe eg $12x^2 < 3$ ft their derivative of the form $ax^2 + b$ with one term correct allow = or $\leq$	
	$x^2 < \frac{1}{4}$ or $x < \frac{1}{2}$ or $-\frac{1}{2} < x$	M1dep	oe eg $x^2 < \frac{3}{12}$ ft their derivative of the form $ax^2 + b$ with one term correct allow = or $\leq$	
	$-\frac{1}{2} < x < \frac{1}{2}$	A1	oe eg $-0.5 < x < 0.5$	
	<b>Additional Guidance</b>			
	$-\frac{1}{2} < x$ and $x < \frac{1}{2}$ $-\frac{1}{2} < x$ (,) $x < \frac{1}{2}$			M1M1M1A1
	$-\frac{1}{2} < x$ or $x < \frac{1}{2}$			M1M1M1A0
	$x = \frac{1}{2}$ or $x = -\frac{1}{2}$ or $x \leq \frac{1}{2}$ or $-\frac{1}{2} \leq x$			M1M1M1A0
$8x^2 - 3 < 0$ and $x^2 < \frac{3}{8}$			M0M1M1A0	
$12x^2 - 3 > 0$ or $12x^2 - 3 \geq 0$			M1M0	