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Mark Scheme (Results)

January 2021

Pearson Edexcel International GCSE
Mathematics A (4MA1)
Paper 2HR

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- **Types of mark**
    - M marks: method marks
    - A marks: accuracy marks
    - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
    - cao – correct answer only
    - ft – follow through
    - isw – ignore subsequent working
    - SC - special case
    - oe – or equivalent (and appropriate)
    - dep – dependent
    - indep – independent
    - eeoo – each error or omission

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- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.

  If a candidate misreads a number from the question. Eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review. If there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

  If there is no answer on the answer line then check the working for an obvious answer.

- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**

  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

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International GCSE Maths

Apart from Q9, 10, 12, 17b, 18, 19a & 21 (where the mark scheme states otherwise) the correct answer, unless obtained from an incorrect method, should be taken to imply a correct method.

Q	Working	Answer	Mark	Notes
1 (a)	$5 \times (-2)^2 - (-2)^3$ (= 20 – –8)		2	M1 for correct expression or at least one of 20 or 5×4 or – – 8 or (+) 8
		28		A1
(b)		$2p(4p - 1)$	2	B2 B1 for $p(8p - 2)$ or $2(4p^2 - p)$ or $2p(4p - 1)$ with two terms inside the bracket with one term correct.
(c)		$12t^2 - 8t$	2	B2 B1 for $12t^2$ or $-8t$
(d)	$5x^2 + 20x - 2x - 8$		2	M1 for 4 correct terms (ignoring signs) or 3 correct terms with correct signs. or $5x^2 + 18x$ + ... or … + $18x$ − 8
		$5x^2 + 18x - 8$		A1
				Total 8 marks

2	$0.5 \times \pi \times 6^2$ (= 56.54…) **or** 12×6 (= 72) **or** $\pi \times 6^2$ oe		3	M1
	"72" – "56.54…"			M1 dep M1 for a complete method
		15.5		A1 15.4 to 15.5
				Total 3 marks

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3	(a) (i)		24, 30	1	B1	No repeats, omissions or extra values
	(ii)		21, 23, 25, 27, 29	1	B1	No repeats, omissions or extra values
	(b)		$(A \cup B)'$ or $A' \cap B'$	1	B1	or $(B \cup A)'$ or $B' \cap A'$
						Total 3 marks

4	(a)		$81k^8$	2	B2	B1 for 81 or k^8 seen in their final answer.
	(b)		$7m^4n^6$	2	B2	B1 for $7m^4$ or n^6 in a product with no other terms in m or n
						Total 4 marks

5	(a)	vertices at (–9, 6) (–9, 9) (–3, 9) (–6, 6)	Shape in correct position	2	B2	B1 for congruent shape in correct orientation but wrong position **or** quadrilateral with 2 or 3 vertices correct.
	(b)	vertices at (7, 3) (10, 6) (13, 6) (13, 3)	Shape in correct position	1	B1	
	(c)		enlargement scale factor 2 centre (– 3, 3)	3	B1 B1 B1	for enlargement, enlarge, etc so long as no mention of rotation, reflection or translation, flip, move etc. SF 2, double, two times etc. (– 3, 3) stated. Accept about, from etc. with no mention of line, or column vector.
						Total 6 marks

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6	$x \times 1.05 = 1.26$ oe eg $(x =) 1.26 \div 1.05$ oe $(= 1.2)$	or 30×1.26 (= 37.80)	or $30 \div 1.05$ (= 28.57)		3	M1
	30 ×"1.2"	"37.80" ÷ 1.05	"28.57…" × 1.26			M1
				36		A1 cao If no marks awarded, SC B1 for one operation used correctly, even with another incorrect operation. eg $1.26 \times 0.95 \times 30$ oe or $1.26 \times 1.05 \times 30$ oe or $1.26 \div 0.95 \times 30$ oe
						Total 3 marks

7		$y \geq 1$ oe $x \leq 3$ oe $y \leq 3x - 2$ oe	3	B1 B1 B1	Allow $1 \leq y \leq 7$ Allow $1 \leq x \leq 3$ Condone < and > in place of ≤ and ≥ throughout. SC B1 if no marks awarded, recognition of lines $x = 3$ **and** $y = 1$. Allow incorrect inequality and condone use of equals signs eg $y < 1$, $x = 3$ may be seen on diagram.
					Total 3 marks

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8	(a)		Pacific	1	B1	Accept 1.357×10^5
	(b)	$1.119 \times 10^5 - 1.797 \times 10^4$		2	M1	Accept 111 900 – 17 970 oe or 93 930 or −93 930
			$9.393(0) \times 10^4$		A1	Accept $(\pm)$ $9.393(0) \times 10^4$ or $(\pm)$ 9.39×10^4 or $(\pm)$ 9.4×10^4
						Total 3 marks

9	eg $(x \pm 20)(x \pm 1)$	$\frac{-(-21) \pm \sqrt{(-21)^2 - 4 \times 1 \times 20}}{2 \times 1}$ **or** $\left(x - \frac{21}{2}\right)^2 - \left(\frac{21}{2}\right)^2 + 20 = 0$		3	M1	If factorising, allow brackets which expanded give 2 out of 3 terms correct – if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{21 \pm \sqrt{441 - 80}}{2}$ or eg $\left(x - \frac{21}{2}\right)^2 - \frac{361}{4} = 0$ oe
	$(x - 20)(x - 1)$	eg $\frac{21 \pm \sqrt{441 - 80}}{2}$ or $\frac{21 \pm \sqrt{361}}{2}$ or $\frac{21 \pm 19}{2}$ **or** $x = \pm\sqrt{\frac{361}{4}} + \frac{21}{2}$ oe			M1	dep on M1 for correct factorisation, or a correct expression for x if completing the square. or a correct substitution into quadratic formula with some processing.
			1, 20		A1	for both correct values, dep on 1st M1 with no incorrect working.
						Total 3 marks

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10	(11 × 3) + (8 × 5) + (6 × 7) + (5 × 9) (= 160) (= 33 + 40 + 42 + 45 = 160)		4	M1	Correct numerical products using midpoints (allowing one error) with intention to add. May be seen in table.
	"160" + x = 4. 25 × (11 + 8 + 6 + 5 + x) oe or $\frac{"160"+x}{"30"+x} = 4.25$ or "160" + x = 4.25 × "30" + 4.25x			M1	dep M1 for correct equation ft *their* 160.
	"160" − "127.5" = 4.25x − x or 32.5 = 3.25x			M1	Isolating x and number terms
		10		A1	dep 1st M1
					Total 4 marks

Alternative Mark Scheme for question 10					
10	(11 × 3) + (8 × 5) + (6 × 7) + (5 × 9) (= 33 + 40 + 42 + 45 =160)		4	M1	Correct numerical products using midpoints (allowing one error) with intention to add. May be seen in table.
	4.25y = "160" + [y – (11 + 8 + 6 + 5)] oe 4.25y = "160" + y – 30			M1	dep M1 for correct equation ft *their* 160, where y = total number of pupils
	4.25y – y = "160" – 30 or 3.25y = 130 or y = 40			M1	Isolating y and number terms **or** y = 40
		10		A1	dep 1st M1
					Total 4 marks

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11	$360 - 40$ (= 320) or $\frac{320}{360}$ oe **or** $\frac{40}{360} \times 2\pi \times 9$ (= 6.28...)		4	M1
	$\frac{"320"}{360} \times 2\pi \times 9$ (= 16π = 50.26...) **or** $2\pi \times 9$ – "6.28" (= 50.26)			M1
	"50.26" + 2 × 9			M1 complete method to find perimeter
		68.3		A1 68.2 to 68.3
				Total 4 marks

12	eg. $10x + 35y = 85$ $10x + 6y = -2$ with the operation of subtraction **or** $29y = 87$ **or** $6x + 21y = 51$ $35x + 21y = -7$ with the operation of subtraction **or** $29x = -58$ **or** eg $5\left(\frac{17-7y}{2}\right)+3y=-1$ **or** eg $5x+3\left(\frac{17-2x}{7}\right)=-1$		4	M1 for correct method to eliminate one variable – multiplying one or both equations so the coefficient of x or y is the same in both, with the correct operation to eliminate one variable (condone one arithmetic error) **or** isolating x or y in one equation and substituting into the other (condone one arithmetic error).
				M1 dep 1st M1 Substitute found value into one equation **or** correct method to eliminate second unknown.
		$x = -2$ $y = 3$		A1 dep 1st M1 A1
				Total 4 marks

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13	$\sin 23° = \frac{"h"}{500}$ oe or $\cos 67° = \frac{"h"}{500}$ oe or $\frac{"h"}{\sin 23°} = \frac{500}{\sin 90°}$ or $\frac{\sin 23}{"h"} = \frac{\sin 90}{500}$ oe **or** $\cos 23° = \frac{"x"}{500}$ oe or $"x" = 500\cos 23°$ (= 460.25..) **and** $"h"^2 = 500^2 - ("460.25...")^2$ oe		3	M1	for a correct expression involving "*h*"
	"*h*" = 500 × sin 23° oe **or** $"h" = \sqrt{500^2 - ("460.25...")^2}$			M1	
		195. 4		A1	195 – 195.4
					Total 3 marks

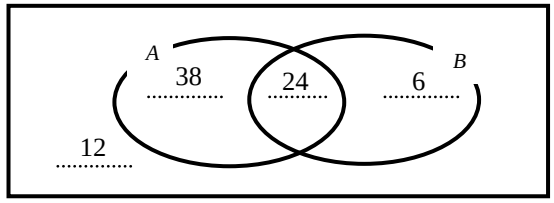
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14	$0.85 \times x^2 = 1.0285$ **or** $85 \times x^2 = 102.85$ oe or $(x^2 =)\ 1.0285 \div 0.85$ **or** $(x^2 =)\ 102.85 \div 85$ oe **or** 1.21 oe		4	M2	for a correct equation using their chosen letter or value in place of letter, or a correct division or 1.21 seen otherwise: (M1 for either 0.85 or 1.0285 seen)
	$(x =)\ \sqrt{1.0285 \div 0.85}$ **or** $(x =)\ \sqrt{102.85 \div 85}$ oe **or** $(x =)\ 1.1(0)$			M1	for a correct expression or value for x
		10		A1	
					Total 4 marks

Alternative Mark Scheme for Q14					
14	$\left(\frac{100+y}{100}\right)^2 \times 0.85 = 1.0285$ oe **or** $\left(\frac{100+y}{100}\right)^2 = 1.21$ oe or $10^4 + 200y + y^2 = 12100$ oe		4	M2	for a correct equation using their chosen letter, otherwise: (M1 for either 0.85 or 1.0285 seen)
	$\frac{100+y}{100} = 1.1$ **or** $100 + y = 110$ oe or $(y + 210)(y - 10) = 0$			M1	for a correct equation involving y with no square terms **or** a correct method for solving the quadratic: If factorising, allow brackets which expanded give 2 out of 3 terms correct – if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{-200 \pm \sqrt{40000 + 8400}}{2}$ or eg $(y + 100)^2 - 12100 = 0$ oe
		10		A1	
					Total 4 marks

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15	eg $(2m + 1)(2n + 1)$ or eg $(2m - 1)(2n + 3)$		4	M2	Product of 2 <u>different</u> odd numbers (in the form $2n + k$ where k is odd). Must have different letters/variables. (M1 for the product of same or different odd numbers where the variable is the same eg $(2n + 1)(2n - 1)$ or $(2n + 1)(2n + 3)$)
	eg $4mn + 2m + 2n + 1$ or eg $4n^2 + 4n + 1$ or eg $4n^2 - 1$ or eg $4n^2 + 8n + 3$			M1	dep M1 Multiplying out the two brackets with odd numbers correctly.
	eg $2(2mn + m + n) + 1$ therefore odd	Proved		A1	dep M3 Factorising <u>and</u> a conclusion **or** stating that the 3 leading terms are all even, hence result is odd.
					Total 4 marks

16 (a)		12, 38, 24, 6	2	B2	B2 for all 4 correct values, in correct regions. B1 for 2 or 3 correct values in correct regions
(b) (i)		$\frac{24}{80}$ oe	1	B1ft	0.3 ft their 24
(ii)	eg 62 + "12" or 80 – "6" oe		2	M1ft	A complete method to find the number of elements in the required set.
		$\frac{74}{80}$ oe		A1 ft	0.925 Penalise incorrect probability notation once only
					Total 5 marks

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17	(a)	g(3) = – 7 **or** f(3 – 10) = $(3 – 10)^2 + 6$ **or** $3^2 – 20\times3+106$ oe		2	M1	
			55		A1	
	(b)	$(x – 10)^2 + 6 = x^2 + 6$		3	M1	Using f(x – 10) and setting equal to $x^2 + 6$
		$x^2 – 10x – 10x + 100$ oe			M1	for $(x – 10)^2$ expanded correctly.
			5		A1	dep 1st M1
	(c)		0	1	B1	accept $x \neq 0$ or $x = 0$
	(d)	eg $yx = 2x – 4$ oe or $xy = 2y – 4$ oe or $4 = 2x – yx$ or $4 = 2y – yx$		3	M1	Removing denominator equation may be rearranged
		eg $4 = x(2 – y)$ oe or $4 = y(2 – x)$ oe or $\frac{4}{x} = 2 – y$ or $\frac{4}{y} = 2 – x$ or $\frac{4}{2 – y} = x$ or $\frac{4}{2 – x} = y$			M1	for correct factorisation or implied factorisation
			$\frac{4}{2 – x}$ or $\frac{–4}{x – 2}$		A1	oe
						Total 9 marks

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18	$\frac{5}{x+2}+\frac{3}{x(x+2)}$ $(=2)$ or $\frac{5x}{x^2+2x}+\frac{3}{x^2+2x}$ $(=2)$		5	M1	Factorising $x^2 + 2x$ in correct expression on LHS or for writing the two fractions over a common denominator.
	$\frac{5x+3}{x(x+2)}=2$ **or** $\frac{5x+3}{x^2+2x}=2$ **or** $5x + 3 = 2x(x + 2)$ oe **or** $5x + 3 = 2x^2 + 4x$ oe			M1	Correct simplified single fraction = 2 or correct equation with no fractions.
	$2x^2 – x – 3$ $(= 0)$			M1	Correct 3 term quadratic
	$(2x – 3)(x + 1)$ $(=0)$ **or** $\frac{--1\pm\sqrt{(-1)^2-4\times2\times(-3)}}{2\times2}$ **or** $\left(x-\frac{1}{4}\right)^2-\frac{1}{16}-\frac{3}{2}=0$ oe			M1ft	independent For solving *their* 3 term quadratic equation using any correct method. If factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{1\pm\sqrt{1+24}}{4}$ or eg $\left(x-\frac{1}{4}\right)^2=\frac{25}{16}$ oe
		1.5 and –1		A1	oe dep on M3
					Total 5 marks

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Alternative Mark Scheme for question 18 (obtaining a cubic)					
18	$\frac{5(x^2+2x)+3(x+2)}{(x^2+2x)(x+2)}$ (=2) oe		5	M1	Correct fraction over a common denominator (may be 2 separate fractions)
	eg $5(x^2+2x)+3(x+2)=2(x^2+2x)(x+2)$ oe			M1	Correct equation with no fractions.
	$2x^3+3x^2-5x-6 \quad (=0)$			M1	Correct cubic
	$(x+1)(2x-3)(x+2) \quad (=0)$			M1	For product of 3 correct linear factors.
		1.5 and –1		A1	oe dep on M3 Do not award A mark if extra solution (–2) given.
					Total 5 marks

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19	(a)	eg $(2^3)^2 \times \sqrt[3]{(2^2)^6}$ **or** $(2^3)^2 \times (4)^{\frac{6}{3}}$ **or** $4^3 \times 4^2$ **or** 2^6 or 2^4 seen **or** $2^6 \times 16$ or 64×4^2 or $8^2 \times 4^2$ or $8^2 \times 16$ or 64×16			3	M1 a correct first stage.
		$2^6 \times (2^{12})^{\frac{1}{3}}$ **or** 1024 **or** 32^2 **or** 4^5 or $2^6 \times 2^4$				M1 dep on 1st M mark.
				2^{10}		A1 dependent on first M1 isw if 2^{10} seen but then 10 given as answer.
	(b)	$(n^{-\frac{4}{5}} =) \frac{1}{16}$ or 0.0625 oe	eg $\left(n^{-\frac{1}{5}}\right)^4 = \left(\frac{1}{2}\right)^4$		4	M1 for sight of $\frac{1}{16}$ oe, even if raised to an incorrect power. **or** for algebraic approach, separating out the 4, or 5 or -1 in the power
		$(n =)\ 16^{\frac{5}{4}}$ or $0.0625^{-\frac{5}{4}}$ oe $(n =)\ 2^5$ or $\sqrt[4]{1048576}$ oe or $\frac{1}{0.0625^{\frac{5}{4}}}$ or $\left(\frac{1}{16}\right)^{-\frac{5}{4}}$	eg $(n =)\ \left(\frac{1}{2}\right)^{-5}$			M2 for a correct expression for n (M1 for one correct algebraic stage eg $n^{-\frac{1}{5}} = \frac{1}{2}$)
				32		A1
						Total 7 marks

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20	75 × 2 (=150)		5	M1	"150" for *AOC* may be seen on diagram.
	$\frac{"150"\times\pi r^2}{360}$ oe (= $1.309r^2$ or $\frac{5\pi}{12}r^2$)			M1	dep 1st M1
	0.5 × sin ("150") × r^2 oe (= $0.25r^2$)			M1	dep 1st M1 a complete method to find the area of triangle *OAC* in terms of *r*
	eg $\frac{150\pi}{360}r^2 - 0.5\sin(150)r^2 = 200$ oe or $(1.309... - 0.25)r^2 = 200$			M1	correct equation in r^2 or rearranged to make r^2 or *r* the subject.
		13.7		A1	accept 13.7 – 13.8
					Total 5 marks

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21	$\frac{6}{n}\times\frac{5}{n-1}$ or $\frac{n-6}{n}\times\frac{n-7}{n-1}$ oe **or** $\frac{6}{n}\times\frac{n-6}{n-1}$		6	M1	for red, red or blue, blue This may be seen as part of an equation allow eg $n-6-1$ in place of $n-7$ **or** for red, blue
	$\frac{6}{n}\times\frac{5}{n-1}$ and $\frac{n-6}{n}\times\frac{n-7}{n-1}$ oe **or** $2\times\frac{6}{n}\times\frac{n-6}{n-1}$ oe			M1	for both products, with no other products This may be seen as part of an equation **or** for red, blue + blue, red
	$\frac{6}{n}\times\frac{5}{n-1}+\frac{n-6}{n}\times\frac{n-7}{n-1}=\frac{9}{17}$ oe **or** $2\times\frac{6}{n}\times\frac{n-6}{n-1}=1-\frac{9}{17}$ oe			M1	Correct equation **or** correct equation using the complementary event.
	$2n^2 - 53n + 306$ (= 0) oe			A1	Correct simplification of equation to a 3 term quadratic. eg $8n^2 - 212n + 1224$ (= 0)
	$(2n - 17)(n - 18)$ (= 0) or $\frac{--53\pm\sqrt{(-53)^2-4\times2\times306}}{2\times2}$ or $\left(n-\frac{53}{4}\right)^2-\left(\frac{53}{4}\right)^2+153=0$ oe			M1	For solving **correct** 3 term quadratic equation using any correct method. If factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{53\pm\sqrt{2809-2448}}{4}$ or eg $\left(n-\frac{53}{4}\right)^2=\frac{361}{16}$ oe **or** for both correct solutions of the correct quadratic. $n = 18$, $n = 8.5$
		18		A1	cao dep M3 do not award if non-integer solution also given.
					Total 6 marks

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22	$\sin\left(\frac{180-140}{2}\right)=\frac{MB}{8}$ oe or $\cos\left(\frac{140}{2}\right)=\frac{MB}{8}$ oe **or** $\frac{8}{\sin 20}=\frac{AC}{\sin 140}$ **and** $(MB^2)=8^2-\left(\frac{"15.035"}{2}\right)^2$ **or** $AC=\sqrt{8^2+8^2-2\times8\times8\times\cos140}$ (=15.035…) **and** $(MB^2)=8^2-\left(\frac{"15.035"}{2}\right)^2$		4	M1	for a correct expression with *MB* included, or an expression for MB^2 If using sine or cosine rule on the isosceles triangle *ABC*, use of Pythagoras required to obtain an expression for MB^2
	(*MB* =) 8sin(“20”) (= 2.736) or (*MB* =) 8cos(“70”) (= 2.736) or $(MB)=\sqrt{8^2-\left(\frac{"15.035"}{2}\right)^2}$			M1	
	$\tan TMB=\frac{10}{"2.736"}$			M1	dep 1st M1
		74.7		A1	74.65 to 74.75
					Total 4 marks
					TOTAL FOR PAPER 100 MARKS

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