Practice Paper – Set 3

A Level Mathematics A
H240/03 Pure Mathematics and Mechanics

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

FINAL

This document consists of 16 pages

Text Instructions

1. Annotations and abbreviations

Annotation in scoris	Meaning
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining a result or establishing a given result
dep*	Mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
AG	Answer given
awrt	Anything which rounds to
BC	By Calculator
DR	This question included the instruction: In this question you must show detailed reasoning.

2. Subject-specific Marking Instructions for A Level Mathematics A

a Annotations should be used whenever appropriate during your marking. The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded. For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.
If you are in any doubt whatsoever you should contact your Team Leader.

c The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
Mark for explaining a result or establishing a given result. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep*' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.
Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.) We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so. When a value is given in the paper only accept an answer correct to at least as many significant figures as the given value. This rule should be applied to each case. When a value is not given in the paper accept any answer that agrees with the correct value to 2 s.f. Follow through should be used so that only one mark is lost for each distinct accuracy error, except for errors due to premature approximation which should be penalised only once in the examination. There is no penalty for using a wrong value for *g*. E marks will be lost except when results agree to the accuracy required in the question.

g Rules for replaced work: if a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests; if there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others. NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question. Marks designated as cao may be awarded as long as there are no other errors. E marks are lost unless, by chance, the given results are established by equivalent working. 'Fresh starts' will not affect an earlier decision about a misread. Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

i If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers (provided, of course, that there is nothing in the wording of the question specifying that analytical methods are required). Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j If in any case the scheme operates with considerable unfairness consult your Team Leader.

Question			Answer	Marks	AO	Guidance	
1	(i)		$4x^2-12x+3=4(x^2-3x)+3$	M1	1.1	Take out a factor of 4	$4x^2-12x=4(x^2-3x)$
			$=4\left[\left(x-\frac{3}{2}\right)^2-\frac{9}{4}\right]+3$	A1	1.1		$x^2-3x=\left(x-\frac{3}{2}\right)^2-\frac{9}{4}$
			$4\left(x-\frac{3}{2}\right)^2-4\times\frac{9}{4}+3=4\left(x-\frac{3}{2}\right)^2-6$ **AG**	A1	2.1		
			Alternative method				
			$4\left(x-\frac{3}{2}\right)^2-6=4\left[x^2-3x+\frac{9}{4}\right]-6$	M1	1.1	multiply out square bracket	$x^2-3x=\left(x-\frac{3}{2}\right)^2-\frac{9}{4}$
			$=4x^2-4\times 3x+4\times\frac{9}{4}-6$	A1	1.1	intermediate step	$4x^2-12x=4(x^2-3x)$
			$=4x^2-12x+3$ **AG**	A1	2.1		
				[3]			
1	(ii)		Minimum point is $\left(\frac{3}{2},-6\right)$	B1 B1 [2]	1.1 1.1		

Question			Answer	Marks	AO	Guidance	
2	(i)			M1	1.1a	Attempt to differentiate – all powers reduced by 1	
			$\frac{dy}{dx}=4ax^3+3bx^2-2$	A1	1.1	Correct first derivative	
			$4a(2)^3+3b(2)^2-2=0\Rightarrow 16a+6b=1$	A1	2.2a	**AG –** sufficient working must be shown to establish given result	
				[3]			
2	(ii)		$\frac{d^2y}{dx^2}=12ax^2+6bx$	B1FT	1.1	Correct second derivative following through from their first derivative	
			$16a+6b=1$ and $4a+b=0\ \Rightarrow\ a=\ldots$ and $b=\ldots$	M1	2.1	Formulate two equations in a and b and attempt to solve for both a and b	
			$a=-\frac{1}{8},\ b=\frac{1}{2}$	A1	2.2a	Both values correct	No follow through for this mark

Question			Answer	Marks	AO	Guidance	
				[3]			

Question			Answer	Marks	AO	Guidance	
3	(i)		$2(1-\cos^2\theta)+\cos\theta=4\cos^2\theta$	M1	3.1a	Correctly removing square root and use of $\sin^2\theta=1-\cos^2\theta$ to obtain an equation in cos only	
			$2-2\cos^2\theta+\cos\theta=4\cos^2\theta$ $6\cos^2\theta-\cos\theta-2=0$	A1 **[2]**	2.2a	**AG –** sufficient working must be shown to establish given result	
3	(ii)		**DR** $(2\cos\theta+1)(3\cos\theta-2)=0$	M1	1.1	Correct method for solving quadratic	May use formula or completing the square
			$\cos\theta=-\frac{1}{2}$ and $\cos\theta=\frac{2}{3}$	A1	1.1		
			$\cos\theta=\frac{2}{3}\Rightarrow\theta=48.2,\ 311.8$	A1	1.1	**Any** two correct values	48.189…, 311.810…
			$\cos\theta=-\frac{1}{2}\Rightarrow\theta=120,\ 240$	A1 **[4]**	2.2a	All four correct values	And no others
3	(iii)		E.g. $\cos\theta\neq-\frac{1}{2}$ since $\cos\theta\geq 0$ in the RHS of the equation $\sqrt{2\sin^2\theta+\cos\theta}=2\cos\theta$	E1 **[1]**	2.3		

Question			Answer	Marks	AO	Guidance	
4	(i)		$4-4a=-2$ $4a=6 \Rightarrow a=\frac{3}{2}$	**M1** **A1** **[2]**	**3.1a** **2.2a**	Setting up equation with f(x) and –2 **AG**	
4	(ii)		$\ln\left(\frac{3}{2}b-8\right)-2=-2$ $\frac{3}{2}b-8=1 \Rightarrow b=...$ $b=6$	**M1*** **dep*M1** **A1** **[3]**	**3.1a** **1.1** **2.2a**	Setting up equation with $\ln(bx-8)-2=-2$ and their value of a Correctly removing ln and solving for b	
4	(iii)		$\text{ff}(-1)=\text{f}(8)$ $=\ln 40-2$	**M1** **A1** **[2]**	**1.1** **1.1**	Indication of applying f(–1) to 4 – 4x	
4	(iv)		E.g. f is a many-one function – from the diagram there are, for example, two values of x for which f(x) = 0	**B1** **[1]**	**2.4**	oe – f is not one-one with evidence of why f is not one-one	Some evidence must be given for either why f is many-one or not one-one

Question			Answer	Marks	AO	Guidance	
5			$\frac{\text{d}}{\text{d}x}\left(\text{e}^{2y-4}\right)=2\text{e}^{2y-4}\frac{\text{d}y}{\text{d}x}$	**B1**	**3.1a**	Correct application of implicit differentiation	
			$\frac{\text{d}}{\text{d}x}(5xy)=5y+5x\frac{\text{d}y}{\text{d}x}$	**M1**	**2.1**	Attempt at product rule (two terms, + sign)	
			$6x-5y-5x\frac{\text{d}y}{\text{d}x}+2\text{e}^{2y-4}\frac{\text{d}y}{\text{d}x}=0$	**A1**	**1.1**		
			$6-10-5\frac{\text{d}y}{\text{d}x}+2\frac{\text{d}y}{\text{d}x}=0\Rightarrow\frac{\text{d}y}{\text{d}x}=...$	**M1**	**1.1**	Substitute for $x = 1$ and $y = 2$ and attempt to find $\frac{\text{d}y}{\text{d}x}$	For reference: $\frac{\text{d}y}{\text{d}x}=-\frac{4}{3}$
			Tangent: $y-2=-\frac{4}{3}(x-1)$ with $x=0$	**M1**	**1.1**	Use equation of tangent with their m_T the point (1, 2) and $x = 0$	For reference: $y=\frac{10}{3}$
			Normal: $y-2=\frac{3}{4}(x-1)$ with $x=0$	**M1**	**1.1**	Use equation of normal with their $m_N=-\frac{1}{m_T}$, the point (1, 2) and $x = 0$	For reference: $y=\frac{5}{4}$
			Area of triangle = $\frac{1}{2}(1)\left(\frac{10}{3}-\frac{5}{4}\right)$	**M1**	**3.1a**	Area must be $\frac{1}{2}(1)\lvert y_T-y_N\rvert$ where y_N is the y-value of the normal at $x = 0$ and y_T is the corresponding value for the tangent – dependent on all previous M marks	
			$=\frac{25}{24}$	**A1** **[8]**	**2.2a**		

Question			Answer	Marks	AO	Guidance	
6	(i)		$y=0 \Rightarrow (t=0 \text{ or}) \ \cos t = 0$	M1	1.1a	Setting $y = 0$	
			$k = \frac{1}{2}\pi$	A1	2.2a		
				[2]			
6	(ii)			M1	1.1	Attempt at product rule – allow sign errors	
			$\frac{dy}{dt} = \cos t - t\sin t$	A1	1.1		
				[2]			
6	(iii)		$\cos t - t\sin t = 0 \Rightarrow \left(1-\frac{1}{2}t^2\right) - t(t) = 0$	M1*	2.1	Setting $\frac{dy}{dt} = 0$ and substituting small angle approximations for both sine and cosine	
			$\frac{3}{2}t^2 = 1 \Rightarrow t = ...$	dep*M1	1.1	Simplify and attempt to solve for t (with correct order of operations)	
			$t = \sqrt{\frac{2}{3}}$	A1	1.1		Allow $\pm$
			$x \approx 0.2$	A1	2.2a	Condone 0.18	0.1821878…
				[4]			
6	(iv)	(a)	$I = \int t\cos t\left(\frac{1}{4}\cos t\right) dt$	M1	1.2	Attempted use of $\int y\frac{dx}{dt}\,dt$	Ignore limits for first two marks
			$= \frac{1}{4}\int t\left(\frac{1}{2}(1+\cos 2t)\right) dt$	M1	3.1a	Use of $\cos^2 t \equiv \frac{1}{2}(1+\cos 2t)$	Allow sign errors in identity
			$= \frac{1}{8}\int_0^{\frac{1}{2}\pi} t(1+\cos 2t)\,dt$	A1FT	2.2a	$a = \frac{1}{2}\pi$ FT their k from part (i) $b = \frac{1}{8}$	
				[3]			

Question			Answer	Marks	AO	Guidance	
6	(iv)	(b)	**DR** $\int t\cos 2t\,\mathrm{d}t = \frac{1}{2}t\sin 2t - \frac{1}{2}\int \sin 2t\,\mathrm{d}t$	**M1***	**2.1**	$\int t\cos 2t\,\mathrm{d}t = \alpha t\sin 2t \pm \beta\int \sin 2t\,\mathrm{d}t$ Must be seen	For any non-zero α, β
			$\int t\cos 2t\,\mathrm{d}t = \frac{1}{2}t\sin 2t + \frac{1}{4}\cos 2t$	**A1**	**1.1**		
			$\int t\,\mathrm{d}t = \frac{1}{2}t^2$	**B1**	**1.1**		
			$I = \frac{1}{16}\left[t^2\right]_0^{\frac{1}{2}\pi} + \frac{1}{8}\left[\frac{1}{2}t\sin 2t + \frac{1}{4}\cos 2t\right]_0^{\frac{1}{2}\pi}$	**dep*M1**	**1.1**	Use of 0 and their k in their integrated expression	
			$= \frac{1}{64}(\pi^2 - 4)$	**A1**	**2.2a**	Or exact equivalent	
			Alternative method				
			$\int t(1+\cos 2t)\,\mathrm{d}t = t\left(t+\frac{1}{2}\sin 2t\right) - \int\left(t+\frac{1}{2}\sin 2t\right)\mathrm{d}t$	**M1***		For attempt at integration by parts	
				A1		Correct first application	
			$= t\left(t+\frac{1}{2}\sin 2t\right) - \left(\frac{1}{2}t^2 - \frac{1}{4}\cos 2t\right)$	**A1**		Complete integration correct	
			$I = \left[t\left(t+\frac{1}{2}\sin 2t\right)\right]_0^{\frac{1}{2}\pi} - \left[\frac{1}{2}t^2 - \frac{1}{4}\cos 2t\right]_0^{\frac{1}{2}\pi}$	**dep*M1**		Use of 0 and their k in their integrated expression	
			$= \frac{1}{64}(\pi^2 - 4)$	**A1**		Or exact equivalent	
				[5]			

Question			Answer	Marks	AO	Guidance	
7			Time for train to decelerate is $t_1 = \frac{32}{1.6}$	**B1**	**3.4**		$t_1 = 20$
			Time for train to accelerate is $t_2 = \frac{400}{\frac{1}{2}\times 32}$	**B1**	**3.4**		$t_2 = 25$
				M1	**3.3**	Setting up an equation for the area underneath the curve equal to either 2000 or 1600	
			$32T + \frac{1}{2}(32)t_1 = 1600 \Rightarrow T = ...$	**A1**	**1.1**	Fully correct equation for their t_1 or $\frac{1}{2}\left((25+20+T)+T\right)(32) = 2000$ and attempt to solve for T	$T = 40$
			$\text{Time} = t_1 + t_2 + T = 85\text{ s}$	**A1** **[5]**	**1.1**		

Question			Answer	Marks	AO	Guidance	
8	(i)			**M1**	**3.1b**	Attempt to differentiate – all powers reduced by 1	
			$\mathbf{v} = (8t-k)\mathbf{i} + (12t^2 + 4kt - 8)\mathbf{j}$	**A1**	**1.1**		
			$12\times 2^2 + 4\times k\times 2 - 8 = 0$	**M1**	**3.1b**	Equate **j**-component to 0 for $t = 2$	
			$k = -5$	**A1** **[4]**	**2.2a**	**AG** – sufficient working must be shown to indicate that a correct method has been applied	
8	(ii)		$\mathbf{a} = 8\mathbf{i} + (24t + 4k)\mathbf{j}$	**B1ft**	**1.1**	Differentiate their **v** correctly	Condone with k
			$8^2 + (24t+4k)^2 = 100$	**M1**	**1.1a**	Setting up an equation for the magnitude = 10 or magnitude^2 = 100	
			$24t + 4(-5) = \pm 6 \Rightarrow t = ...$	**M1**	**1.1**	Re-arrange and attempt to solve for t – leading to at least one value of t	
			$t = \frac{13}{12}$ and $\frac{7}{12}$	**A1** **[4]**	**1.1**	Both correct	

Question			Answer	Marks	AO	Guidance	
9	(i)		$\sin\theta = \frac{5}{13}$ and $\cos\theta = \frac{12}{13}$ or $\theta = 22.6\ldots$	**B1**	**1.1**	May be seen anywhere in solution	
			Moments about A: $3\times 10g\times\cos\theta = 6R_B$	**M1**	**3.3**	Allow sin/cos confusion	R_B is the force at B
			$\Rightarrow R = \dfrac{60g}{13}$	**A1**	**1.1**		
				[3]			
9	(ii)			**M1***	**3.3**	Resolving vertically – allow sign errors and sin/cos confusion	
			Vertically : $R_A + R_B\cos\theta = 10g$	**A1**	**1.1**	Where R_A is the normal contact force acting on the plank at A	$R_A = \dfrac{970g}{169}$
			Horizontally: $F = R_B\sin\theta$	**B1**	**1.1**	Resolving horizontally – F is the frictional force at the ground	$F = \dfrac{300g}{169}$
			Using $\mu = \dfrac{F}{R_A}$	**dep*M1**	**3.3**	With all angles replaced in their F and R_A	
			$\mu = \frac{30}{97}$ or 0.309	**A1**	**2.2a**		0.309 278…
				[5]			

Question			Answer	Marks	AO	Guidance	
10	(i)		$x = (5\cos\theta)t$	B1	3.3		
			$y = (5\sin\theta)t - 5t^2$	B1	3.3		Allow in terms of g
			$y = (5\sin\theta)\left(\frac{x}{5\cos\theta}\right) - 5\left(\frac{x}{5\cos\theta}\right)^2$	M1	3.4	Eliminate t by substitution of x into y	
			$y = x\tan\theta - \frac{5x^2}{25\cos^2\theta} \Rightarrow y = x\tan\theta - \frac{x^2}{5}\sec^2\theta$				
			$\Rightarrow y = x\tan\theta - \frac{x^2}{5}(1+\tan^2\theta)$	A1	2.2a	**AG –** sufficient working must be shown	
				[4]			
10	(ii)		$y = 3x - 2x^2$	M1	3.1b	Substitute $\tan\theta = 3$	
			$\Rightarrow \frac{dy}{dx} = 3 - 4x = 0 \Rightarrow x = ...$	M1	2.1	Set derivative equal to zero and attempt to solve for x	
			Max. height = 1.125 m	A1	1.1	oe, e.g. $\frac{9}{8}$ metres	
			Alternative method $y = 3x - 2x^2$	M1	3.1b	Substitute $\tan\theta = 3$	
			Vertex of parabola is at $x = -\frac{b}{2a} = -\frac{3}{2\times(-2)} = ...$	M1	2.1	attempt to find x coordinate of vertex	
			Max. height = 1.125 m	A1	1.1	oe, e.g. $\frac{9}{8}$ metres	
				[3]			

Question			Answer	Marks	AO	Guidance	
10	(iii)		$3-4x=\pm\frac{1}{3}$	M1*	3.1b	Set derivative equal to $\pm\frac{1}{3}$	Allow + only here
			$x=\frac{1}{4}\left(3\pm\frac{1}{3}\right)$	A1ft	1.1	One correct value of x – follow through their derivative	
			$x=\frac{2}{3}$ and $x=\frac{5}{6}$	A1	1.1	Both values correct	
			$t=\dfrac{x}{5\cos\theta}$	dep*M1	3.4	Used for at least one of their values of x and numerical attempt at $\cos(\tan^{-1}3)$	
			t = 0.422 and t = 0.527	A1	2.2a		$\frac{2}{15}\sqrt{10}$ and $\frac{1}{6}\sqrt{10}$
			Alternative solution				
			Vertical velocity = $5\sin\theta-10t$	B1		θ need not be evaluated here	$\sin\theta=\dfrac{3}{\sqrt{10}}$, $\theta\approx 71.6°$
			$\dfrac{5\sin\theta-10t}{5\cos\theta}=\pm\dfrac{1}{3}$	M1*		With numerical values for $\sin\theta$ and $\cos\theta$ (exact or decimal); allow + only on RHS for M mark	$\cos\theta=\dfrac{1}{\sqrt{10}}$
				A1		Correct equation with both + and –	
			$t=\dfrac{1}{10}\left(\dfrac{15}{\sqrt{10}}\pm\dfrac{5}{3\sqrt{10}}\right)$	dep*M1		Solve for t (exact or decimal values)	
			$t=\frac{2}{15}\sqrt{10}$ and $\frac{1}{6}\sqrt{10}$	A1		oe	0.4216…, 0.5270…
				[5]			
10	(iv)		e.g. air resistance not taken into account e.g. the value of g is not 10	B1 B1 [2]	3.5b 3.5b	Any valid reason Two valid reasons	

Question			Answer	Marks	AO	Guidance	
11	(i)		$R_1 = 2g\cos 30$	**B1**	1.1	Resolve perpendicular to Π_1 where R_1 is the normal contact force on P	$R_1 = g\sqrt{3}$
			$F = \frac{\sqrt{3}}{3} \times g\sqrt{3}$	**M1**	3.3	Use of $F = \mu R$	$F = g$
				M1	3.3	Applying N II parallel to the plane for P	The M marks for N II parallel to a plane require the correct number of terms and the weight resolved; allow sign errors and sin/cos confusion
			$T - F - 2g\sin 30 = 2(g\cos\theta)$	**A1**	1.1	Allow with a	
				M1	3.3	Applying N II parallel to the plane for Q	
			$8g\sin\theta - T = 8(g\cos\theta)$	**A1**	1.1	Allow with a	
			$8g\sin\theta - g - 2g\sin 30 = 10g\cos\theta$	**M1**	3.4	Combining simultaneous equations to eliminate T (dependent on all previous M marks)	
			$8\sin\theta - 1 - 1 = 10\cos\theta \Rightarrow 4\sin\theta - 5\cos\theta = 1$	**A1** **[8]**	2.2a	**AG**	
11	(ii)		$R = \sqrt{41}$	**B1**	1.1		6.403124…
			$R\cos\alpha = 4,\ R\sin\alpha = 5$	**M1**	1.1	Forming two equations in R and α (allow sign errors or sin/cos confusion)	This mark is implied if correct α seen
			$\tan\alpha = \frac{5}{4} \Rightarrow \alpha = 51.3$	**A1**	1.1		51.340191…
			$\theta - \alpha = \sin^{-1}\left(\frac{1}{R}\right)$	**M1**	1.1	Correct method for finding θ	$\theta - 51.34... = 8.9848...$
			$\theta = 60.3$	**A1**	1.1	If θ is obtained by calculator with none of the above marks earned, allow SC **B2** for 60.3 or better	60.325068…
			$T = 8g\sin 60.3 - 8g\cos 60.3$	**M1**	3.4	Using their θ to evaluate T	
			$T = 29.3\text{N}$	**A1** **[7]**	2.2a		29.303539…