CAMBRIDGE
International Education

Cambridge International AS & A Level

MATHEMATICS **9709/13**

Paper 1 Pure Mathematics 1 **May/June 2026**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

Mathematics-Specific Marking Principles

1 Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.

2 Unless specified in the question, non-integer answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.

3 Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.

4 Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).

5 Where a candidate has misread a number or sign in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 A or B mark for the misread.

6 Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

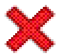
Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	**Meaning**
^	More information required
A0	Accuracy mark awarded zero
A1	Accuracy mark awarded one
B0	Independent accuracy mark awarded zero
B1	Independent accuracy mark awarded one
B2	Independent accuracy mark awarded two
BOD	Benefit of the doubt
BP	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
FT	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
ISW	Ignore subsequent work
J	Judgement
JU	Judgement
M0	Method mark awarded zero
M1	Method mark awarded one
M2	Method mark awarded two
MR	Misread
O	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
PE	Judgment made by the PE
Pre	Premature approximation
SC	Special case
SEEN	Indicates that work/page has been seen

Annotation	**Meaning**
SF	Error in number of significant figures
✓	Correct
TE	Transcription error
XP	Correct answer from incorrect working

Mark Scheme Notes

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method mark, awarded for a valid method applied to the problem. Method marks are not 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. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

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).

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

DM or **DB** When a part of a question has two or more 'method' steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

FT Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.

- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above).
- For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).
- The total number of marks available for each question is shown at the bottom of the Marks column.
- Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
- Square brackets [ ] around text or numbers show extra information not needed for the mark to be awarded.

Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no 'follow through' from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

Question	Answer	Marks	Guidance
1(a)	$3x^2 - 18x + 15$ OR $y^2 - 40y + 256[=0]$	M1	OE Equates two equations and simplifies to a three-term quadratic. Condone +/– errors only.
	$3(x-1)(x-5)$ OR $(y-8)(y-32)[=0]$	M1	OE Suitable solution method for *their* new three-term quadratic equation.
	$[x=]1,\ 5$ or $[y=]8,\ 32$	A1	Correct x- or y-values.
	$(1,\ 8)$ and $(5,\ 32)$	A1	Both points correct. Allow $x=1,\ y=8$ and $x=5,\ y=32$.
			SC After M1M0, B1B1 for correct answers.
		4	
1(b)	$1 \le x \le 5$	B1FT	OE as *their* final answer. FT *their* x-values from **1(a)**. Accept two separate inequalities.
		1	

Question	Answer	Marks	Guidance
2(a)	$\left[x\sqrt{x} =\right] x^{\frac{3}{2}}, x^{1\frac{1}{2}}$ or $x^{1.5}$	B1	Condone $n = \frac{3}{2},\ 1\frac{1}{2}$ or 1.5 for this mark.
		1	

Question	Answer	Marks	Guidance
2(b)	$\left(x^{\frac{3}{2}}\right)^2 - 9\left(x^{\frac{3}{2}}\right) + 8$ or $x^6 - 65x^3 + 64[=0]$	B1	OE SOI WWW Form a quadratic from the given equation; $x^{\frac{3}{2}}$ or x^3 may be replaced by a new variable. Correct factors or correct use of the quadratic formula can imply this equation.
	$x^{\frac{3}{2}} = 1,\ 8$ or $x^3 = 1,\ 64$	B1	1 and 8 must be associated with $x^{\frac{3}{2}}$ or its explicitly designated replacement. 1 and 64 must be associated with x^3 etc.
	$[x=]1, 4$	B1	**Note:** Correct final answers with no working is B0B0B1.
		3	

Question	Answer	Marks	Guidance
3(a)	$[\text{LHS} =]\ \dfrac{1-\cos^2\theta}{\cos\theta}$	*M1	Combining two terms to form a single fraction in $\cos\theta$.
	$\dfrac{\sin^2\theta}{\cos\theta}$	DM1	OE Appropriate use of $\sin^2\theta + \cos^2\theta = 1$. Arriving at this expression WWW implies M1DM1.
	$\dfrac{\sin\theta\sin\theta}{\cos\theta}$ $= \tan\theta\sin\theta\ [= \text{RHS}]$	A1	**AG** Separate the $\sin^2\theta$ into two terms, OE, and complete a convincing argument.
	Note: Starting with the RHS: $\dfrac{\sin^2\theta}{\cos\theta}$ M1 $\Rightarrow \dfrac{1-\cos^2\theta}{\cos\theta}$ DM1 $\Rightarrow \dfrac{1}{\cos\theta} - \dfrac{\cos^2\theta}{\cos\theta} \Rightarrow \dfrac{1}{\cos\theta} - \cos\theta$ A1		
		3	

Question	Answer	Marks	Guidance
3(b)	**Either** $\tan\theta(2\sin\theta - 1) = 0$ or $2\sin\theta = 1$	**M1**	OE Collecting terms on one side, condone +/– errors only, and factorising or dividing both sides by $\tan\theta$.
	And $\tan\theta = 0$ and $\sin\theta = \frac{1}{2}$	**A1**	Solving correctly for both $\tan\theta$ and $\sin\theta$.
	Or $\left[2\frac{\sin^2\theta}{\cos\theta} = \frac{\sin\theta}{\cos\theta} \Rightarrow\right] 2\sin^2\theta - \sin\theta = 0$	**M1**	OE Replacing $\tan\theta$ with $\frac{\sin\theta}{\cos\theta}$ and collecting terms on one side, condone +/– errors only.
	And $\sin\theta = 0$ and $\sin\theta = \frac{1}{2}$	**A1**	Getting two correct values for $\sin\theta$.
	Then $\theta = 0, 180, 360,\ \theta = 30, 150$	**A1**	At least two correct values, ignore other incorrect values. Answers in radians are not acceptable.
	$[\theta =]\, 0, 30, 150, 180, 360$	**A1**	All five correct values, with no other values in the given interval. Ignore any values outside the given interval. **SC** B1 for $0, \frac{1}{6}\pi, \frac{5}{6}\pi, \pi, 2\pi$ OE.
		4	

Question	Answer	Marks	Guidance
4(a)	$\left[\frac{\mathrm{d}y}{\mathrm{d}x}=\right]3-3kx^2$	**B1**	
	$-3=their\left(3-3k(1)^2\right)$ or $\frac{-1}{their\left(3-3k(1)^2\right)}=\frac{1}{3}$	**M1**	OE Equating *their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ with $x=1$ to -3, or equating $\frac{-1}{their\,\frac{dy}{dx}\,with\,x=1}$ to $\frac{1}{3}$. *Their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ must be of the form $a+bx^2$.
	$[k=]2$	**A1**	
		3	
4(b)	$-3=their\left\{3-3(their\,k)x^2\right\}$ or $\frac{-1}{their\left\{3-3(their\,k)x^2\right\}}=\frac{1}{3}$	***M1**	*Their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ must be of the form $a+bx^2$. Expect $-3=3-6x^2$ or $\frac{-1}{3-6x^2}=\frac{1}{3}$ OE.
	$[x=]\pm 1$	**A1**	WWW SOI Condone '+1' being omitted.
	$[y=]3(their\text{ negative }x\text{-value})-(their\,k)(their\text{ negative }x\text{-value})^3+4$	**DM1**	Using *their* negative x-value and *their* k in the given equation to obtain the y-coordinate. Can be implied by the correct y-value(s) but not if there is no working. Condone use of a second x-value.
	$[Q](-1,\ 3)$	**A1**	Q must be correctly identified if $(1,\ 5)$ is also given. Allow $x=-1,\ y=3$.
		4	

Question	Answer	Marks	Guidance
5(a)	$2^5+\binom{5}{1}(2)^4(3x)^1+\binom{5}{2}(2)^3(3x)^2+\binom{5}{3}(2)^2(3x)^3\ldots$ Or $2^5\left\{1+5\left(\frac{3x}{2}\right)+\frac{5.4}{2!}\left(\frac{3x}{2}\right)^2+\frac{5.4.3}{3!}\left(\frac{3x}{2}\right)^3\ldots\right\}$	**B1**	Correct unsimplified binomial expansion for at least three terms, can be implied by correct final answer. Condone terms given in a list. Ignore higher power terms if given.
	$32+240x+720x^2+1080x^3$	**B1**	At least three simplified terms correct.
		B1	All four simplified terms correct. Ignore higher power terms if given. Condone terms given in a list.
		3	
5(b)	$\left(their\left(32+240x+720x^2+1080x^3\right)\right)-\left(their\left(96x+720x^2+2160x^3\ldots\right)\right)$	**M1**	Evidence of multiplying *their* expansion, which has at least three terms, by $(1-3x)$.
	$32+144x\left[+0x^2\right]-1080x^3$	**A1**	Ignore higher power terms if given. Condone terms given in a list.
		2	
5(c)	$x=0.01$	**B1**	WWW SOI
	Replacing x with 0.01 or 0.1 in *their* expansion of $(1-3x)(2+3x)^5$ from **5(b)**	**M1**	*Their* expansion must be of the form $a+bx+cx^2+dx^3$, where $a,b,d\neq 0$ and c may be 0. *Their* value for x must not come from obviously wrong working. Condone a restart of the correct expansion.
	33.43892	**A1**	WWW The exact value is 33.438895480571. M0A0 scored if this or 33.43890 is stated as final answer with no correct working.
		3	

Question	Answer	Marks	Guidance
6(a)	$f'(x) = -\frac{48}{x^4} + 3$	*M1	OE Differentiate to get $\frac{a}{x^4} + b$.
	$f'(x) = 0 \Rightarrow x = \pm 2$	DM1	Solve $f'(x) = 0$ resulting in two real values.
	$(2, 13)$ and $(-2, -3)$	A1, A1	A1 for each correct point. Accept $x = 2,\ y = 13$ and $x = -2,\ y = -3$. Note**:** M1DM0A1A0 is possible.
		4	
6(b)	$\frac{16}{(-x)^3} + 3(-x) + 5 + [a]$	B1	B1 for an expression for $f(-x)$ or $g(-x)$, and B1 for an expression for $-g(x)$. Any value for x can be used in either. $5 + a = -5 - a$ OE implies B1B1.
	$-\left(\frac{16}{x^3} + 3x + 5 + a\right)$	B1	
	$a = -5$	B1	WWW
		3	

Question	Answer	Marks	Guidance
7(a)	[Arc length =] $\left(their\,\frac{1}{3}\pi\right)\times r$ [m]	**M1**	*Their* '$\frac{1}{3}\pi$' must be $<\pi$. Can be implied by final answer.
	[Perimeter =] $\left(\frac{1}{3}\pi r+\frac{1}{3}\pi r+r\right)$[m]	**A1**	ISW$\left[=\left(\frac{2}{3}\pi r+r\right)[\text{m}]\right]$
		2	
7(b)	Area of sector = $\frac{1}{2}\times18^2\times\left(their\,\frac{1}{3}\pi\right)$ $[=54\pi]$ Area of triangle = $\frac{1}{2}\times18^2\times\sin\left\{their\,\frac{1}{3}\pi\right\}$ $\left[=81\sqrt{3}\right]$ Area of segment = $\frac{1}{2}\times18^2\times\left(their\,\frac{1}{3}\pi-\sin\left\{their\,\frac{1}{3}\pi\right\}\right)$ $\left[=162\left(\frac{1}{3}\pi-\frac{1}{2}\sqrt{3}\right)\right]$	**M1**	Any one of these gets the first M1.
		M1	M1M1 for any two of these expressions. Their areas must be seen to come from $r=18$ and $\left\{their\,\frac{1}{3}\pi\right\}$ must be $<\pi$. They may be evaluated incorrectly.
	[Required Area =] $2\left(\frac{1}{2}\times18^2\times their\,\frac{1}{3}\pi\right)-\frac{1}{2}\times18^2\times\sin\left\{their\,\frac{1}{3}\pi\right\}$ OR $\frac{1}{2}\times18^2\times\sin\left(their\,\frac{1}{3}\pi\right)+2\left(\frac{1}{2}\times18^2\times\left(their\,\frac{1}{3}\pi-\sin\left\{their\,\frac{1}{3}\pi\right\}\right)\right)$ OR $\frac{1}{2}\times18^2\times their\,\frac{1}{3}\pi\;+\;\frac{1}{2}\times18^2\times\left(their\,\frac{1}{3}\pi-\sin\left\{their\,\frac{1}{3}\pi\right\}\right)$	**M1**	2 × area of sector – area of triangle OR Triangle area + 2 × segment area OR Sector area + segment area
	$108\pi-81\sqrt{3}$ $\left[\text{m}^2\right]$	**A1**	CAO 198.99 or 199 (3 sf) implies 3/4.
		4	

Question	Answer	Marks	Guidance
8	$\int_1^t \frac{2}{5x^3}\,[\mathrm{d}x]$ or $\int_1^t \frac{2}{5}x^{-3}\,[\mathrm{d}x] = \frac{1}{9}$	*M1	Writing given area as an integral equation and equating to $\frac{1}{9}$. Limits may be implied by later steps, condone limits the wrong way round. Equating to $\frac{1}{9}$ may also be implied later.
	$\frac{2}{5}x^{-2} \div (-2)\left[= -\frac{1}{5x^2}\right]$ $[+\,C]$	B1	OE Correct integration, allow unsimplified.
	$-\frac{1}{5t^2} - -\frac{1}{5}$	*M1	OE Correct use of limits t and 1 in *their* integral, which must be of the form ax^{-2}, condone using limits the wrong way round.
	$\left[\left(\textit{their} -\frac{1}{5t^2} + \frac{1}{5}\right) = \frac{1}{9} \Rightarrow\right] \frac{1}{5t^2} = \frac{4}{45}$	DM1	OE *Their* two-term expression equated to $\frac{1}{9}$ and valid rearrangement to get one term in t^2 equated to a positive constant.
	$\left[t^2 = \frac{9}{4}\right]$ $t = \frac{3}{2}$	A1	OE Solve for t. If $t = -\frac{3}{2}$ is considered, then it must be rejected for this mark to be awarded.
		5	

Question	Answer	Marks	Guidance
9(a)	$\frac{dy}{dx} = a(3x+1)^{-\frac{1}{2}}$	M1	Do not accept $\frac{1}{2}-1$ in place of $-\frac{1}{2}$ unless evaluated later.
	$\frac{1}{2}(3x+1)^{-\frac{1}{2}} \times 3$	A1	OE $\left[= \frac{3}{2}(3x+1)^{-\frac{1}{2}}\right]$. Award for a correct unsimplified expression then ISW.
		2	

Question	Answer	Marks	Guidance
9(b)	$\dfrac{dx}{dt}=6$	**B1**	SOI
	Then either when $y=4$, $x=5$ only.	**B1**	
	$\left[\dfrac{dy}{dt}=\dfrac{dx}{dt}\times\dfrac{dy}{dx}=\right]6\times\left(their\ \dfrac{3}{2}(3x+1)^{-\frac{1}{2}}\right)$	**M1**	Use rates of change correctly with *their* $\dfrac{dy}{dx}$ to obtain an expression for $\dfrac{dy}{dt}$. *Their* $\dfrac{dy}{dx}$ must contain $(3x+1)^{-\frac{1}{2}}$.
	$\left[\dfrac{dy}{dt}=\right]\dfrac{6\times\frac{3}{2}}{\sqrt{3\times(their\ 5)+1}}$ $\left[=6\times\dfrac{3}{8}\right]$	**M1**	Substitute *their* x-value from $y=4$ into *their* $\dfrac{dy}{dx}$. This can be implied by $\frac{3}{8}$. Using two x-values gets DM0.
	Or $\left[\dfrac{dy}{dt}=\dfrac{dx}{dt}\div\dfrac{dx}{dy}=\right]6\div\left(their\ \dfrac{2y}{3}\text{ from }\dfrac{y^2-1}{3}=x\right)$	**M1**	Use rates of change correctly with *their* $\dfrac{dx}{dy}$ to obtain an expression for $\dfrac{dy}{dt}$.
	$\dfrac{dx}{dy}=\dfrac{8}{3}$	**B1**	
	$\left[\dfrac{dy}{dt}=\right]6\div\dfrac{8}{3}$	**M1**	This can be implied by a correct final answer.
	$\left[\dfrac{dy}{dt}=\right]\dfrac{9}{4}$	**A1**	OE $\pm\frac{9}{4}$ gets A0.
		5	

Question	Answer	Marks	Guidance
10(a)	$ar = a + 3d$ and $ar^2 = a + 5d$ $\left[\text{Or } \dfrac{a+5d}{a+3d} = \dfrac{a+3d}{a}\right]$	M1	Two equations connecting geometric and arithmetic sequences where at least one is correct. An incorrect statement must be of the form $ar^p = a + qd$ where p and q are positive integers for M1.
	Either		
	$5a(r-1) = 3a(r^2-1)$ Or $ar^2 = a + \dfrac{5a(r-1)}{3}$ Or $ar = a + \dfrac{3a(r^2-1)}{5}$	A1	OE, having correctly eliminated d.
	Or		
	$\dfrac{3d}{r-1} = \dfrac{5d}{r^2-1}$ Or $\dfrac{3d}{r-1}r^2 = \dfrac{3d}{r-1} + 5d$ Or $\dfrac{5d}{r^2-1} = \dfrac{5d}{r^2-1} + 3d$ Or $\dfrac{3d}{r-1}r^2 = \dfrac{3d}{r-1}r + 2d$	A1	OE, having correctly eliminated a.
	Or		
	$\dfrac{a(r^2-1)}{a(r-1)} = \dfrac{5d}{3d}$ or $\dfrac{a(r-1)}{a(r^2-r)} = \dfrac{3d}{2d}$	A1	OE These statements can imply the M1.

Question	Answer	Marks	Guidance
10(a)	**Hence**		
	$3r^2 - 5r + 2 = 0$	**A1**	**AG** WWW Clear simplification, showing all necessary steps to arrive at the given equation.
		3	
10(b)	$r = \frac{2}{3}(\text{or } 1)$	**B1**	Candidates may arrive at this after a great deal of working.
	$\frac{a}{1-r} = 54 \Rightarrow a = 54(1-r)\ [=18]$	***M1**	Equating $\frac{a}{1-r}$ to 54 with $\lvert \textit{their } r \rvert < 1$ to find a.
	Using $ar = a + 3d$ or $ar^2 = a + 5d$ or $d = \frac{a(1-r)}{5-r}$ etc.	**DM1**	Using a correct relationship with *their a* to get as far as $d = \ldots$.
	$[d =] -2$	**A1**	
		4	

Question	Answer	Marks	Guidance
11(a)	Centre (0, 4) or (radius)^2 = 10	**B1**	OE Either correct but without wrong working. Condone "invisible brackets" if recovered. $\left(\text{Accept } r = \frac{1}{2}\sqrt{40}\right)$
	$x^2 + (y-4)^2 = 10$	**M1**	Correct form of circle equation using *their* centre and radius.
	$x^2 + y^2 - 8y + 16 = 10 \Rightarrow x^2 + y^2 - 8y + 6 = 0$	**A1**	**AG** Working must be shown for this mark. Do not condone rearrangement of the given form.
	Or		
	Stating that there is only one circle that has these as diameter endpoints.	**B1**	This may appear as a conclusion.
	Substituting both pairs of co-ordinates into the given equation.	**M1**	May use $x^2 + y^2 - 8y + c = 0 \Rightarrow c = \ldots$
	Correct algebra to arrive at "0 = 0"	**A1**	OE
		3	

Question	Answer	Marks	Guidance
11(b)	**EITHER:** **Method 1**		
	$x^2+(-3x+c)^2-8(-3x+c)+6[=0]$	**(*M1**	Substitute linear expression into the circle equation.
	$10x^2+24x-6cx+c^2-8c+6[=0]$	**A1**	Simplify to form the correct quadratic, the x and constant coefficients may not be collected, this mark can be implied by *their* discriminant.
	$(24-6c)^2-4\times10\times(c^2-8c+6)=0$	**DM1**	Uses $b^2-4ac=0$, with *their* coefficients but 'a' must be a constant, 'b' must be a two-term linear in c and 'c' must be a three-term quadratic in c.
	$-4c^2+32c+336[=0]$	**A1)**	**AG** OE, e.g. $c^2-8c-84=0$. Expand and simplify to form the given quadratic.
	OR: **Method 2**		
	Using $y=\frac{1}{3}x+d$ and $(4,0)$ to find a value of d $[\Rightarrow d=4]$ $x^2+\left(\frac{1}{3}x+their\,d\right)^2-8\left(\frac{1}{3}x+their\,d\right)+6[=0]$	**(*M1**	Using the equation of the normal and the centre of the circle to find d. Then substituting *their* equation of the normal into the circle equation.
	$\left[\frac{10}{9}x^2-10=0\Rightarrow x=\right]\pm3$	**A1)**	CAO
	Or		
	$\frac{dy}{dx}=\pm\frac{1}{2}(-2x)(10-x^2)^{-\frac{1}{2}}$	**(*M1**	An attempt at differentiation of the circle equation to arrive at an expression for $\frac{dy}{dx}$ which must contain $(-2x)(10-x^2)^{-\frac{1}{2}}$..

Question	Answer	Marks	Guidance
11(b)	$\left[\pm\frac{1}{2}(-2x)\left(10-x^2\right)^{-\frac{1}{2}}=-3 \Rightarrow x=\right]\pm 3$	A1	CAO
	Then Using an appropriate equation to find y-values $[\Rightarrow y=5,\ 3]$ $(\textit{their}\,5)=-9+c\ [\Rightarrow c=14]$ and $(\textit{their}\,3)=-9+c[\Rightarrow c=-6]$	DM1	Using *their* x-values in the circle equation to find the y-values. Then each pair of values in the tangent equation to find the c-values.
	$(c+6)(c-14)=0 \Rightarrow c^2-8c-84=0$	A1)	**AG** Using *their* c-values to form the given quadratic.
	Available marks	**4**	
11(c)	$c=14$ or $c=-6$	B1	
	$0=-3x+(\textit{their}$ positive c-value$)$ and $0=-3x+(\textit{their}$ negative c-value$)$	*M1	Use *their* values of c and $y=0$ to find the x-values at S and Q.
	$x=\frac{14}{3}$ and -2	A1	Both values correct.
	[Area =] e.g. $\frac{1}{2}\times(14+6)\times 2+\frac{1}{2}\times(14+6)\times\frac{14}{3}$ Or $\frac{1}{2}\left\|28+12+28+\frac{196}{3}\right\|$ OE from the "shoelace" method. Or $\frac{1}{2}\times\left(\frac{14}{3}\sqrt{10}+2\sqrt{10}\right)\times 2\sqrt{10}$ OE – area of a trapezium.	DM1	OE $\left[20+\frac{140}{3}\right]$ Correct method for finding the required area with at least three out of four values correct. Areas of the four small triangles are 14, 6, 14, $\frac{98}{3}$.
	Area $=\frac{200}{3}$ or $66\frac{2}{3}$	A1	66.7 without sight of an exact value is A0.
		5	