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MATHEMATICS **9709/12**

Paper 1 Pure Mathematics 1 **May/June 2024**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:
Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:
Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:
Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors 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.

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	$240\left[x^2\right]$ or $80a^2\,[x^2]$	**B1**	May be seen in an expansion.
	$240 = 12 \times 80a^2$	**M1**	*Their* 240 equated to 12 × *their* $80a^2$ which must contain a^2.
	0.5	**A1**	OE Condone ± 0.5
		3	

Question	Answer	Marks	Guidance
2	Stretch **factor** 4 in *y*-direction/parallel to the *y* axis/vertically.	**B1**	Allow use of SF in place of factor. Allow in/on/along the *y* axis or 'the *x* axis is invariant.'
	Translation $\begin{pmatrix}3\\0\end{pmatrix}$ or 3 parallel to the *x* axis or in the *x* direction, allow horizontally. $\begin{pmatrix}0\\-8\end{pmatrix}$ or -8 parallel to the *y* axis or in the *y* direction, allow vertically.	**B2**	Condone 'Shift'. These translations can be combined as $\begin{pmatrix}3\\-8\end{pmatrix}$, this counts as 2 elements. Give priority to a correct vector over any incorrect wording. B2 for all 3 B1 for 2 out of 3
	Two translations, one in each direction, and a stretch only.	**M1**	Condone inaccurate terminology, such as up, down, left and right, if the intention is clear.
	Correct order of operations. The stretch which must be in the in the *y* direction must come before the translation in the *y* direction.	**A1**	Condone inaccurate terminology if the intention is clear but numerical values must be correct.

Question	Answer	Marks	Guidance
2	**Alternative Method for Question 2**		
	Translation $\begin{pmatrix}3\\0\end{pmatrix}$ or 3 parallel to the x axis or in the x direction, allow horizontally. $\begin{pmatrix}0\\-2\end{pmatrix}$ or -2 parallel to the y axis or in the y direction, allow vertically.	**(B2)**	Condone 'Shift'. These translations can be combined as $\begin{pmatrix}3\\-2\end{pmatrix}$, this counts as 2 elements. Give priority to a correct vector over any incorrect wording. B2 for all 3. B1 for 2 out of 3.
	Stretch **factor** 4 in y-direction/parallel to the y axis/vertically.	**(B1)**	Allow use of SF in place of factor. Allow in/on/along the y axis or "the x axis is invariant."
	Two translations, one in each direction, and a stretch only.	**(M1)**	Condone inaccurate terminology, such as transform, move, up, down, left and right, if the intention is clear.
	Correct order of operations. The stretch which must be in the in the y direction must come after the translation in the y direction.	**(A1)**	Condone inaccurate terminology if the intention is clear but numerical values must be correct.
		5	

Question	Answer	Marks	Guidance
3(a)	$7\dfrac{\sin\theta}{\cos\theta} \div \cos\theta + 12[=0]$ $\left[\text{leading to } 7\dfrac{\sin\theta}{\cos\theta} + 12\cos\theta = 0\right]$	**M1***	OE Use of $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$.
	$7\sin\theta + 12\left(1 - \sin^2\theta\right)[=0]$	**DM1**	Use of $s^2 + c^2 = 1$.
	$\Rightarrow 12\sin^2\theta - 7\sin\theta - 12 = 0$	**A1**	AG, WWW Condone use of s, c and t and/or omission of θ throughout working but the A1 is for cao.
		3	
3(b)	$\left[12\sin^2\theta - 7\sin\theta - 12 = 0 \text{ leading to}\right]\left(4\sin\theta + 3\right)\left(3\sin\theta - 4\right)$	**M1**	
	$\sin\theta = -\dfrac{3}{4}$ $\left[\text{or } \dfrac{4}{3}\right]$	**B1**	OE, WWW Can be implied by a correct value for $\sin^{-1}\left(-\dfrac{3}{4}\right)$ e.g. $-48.6°$.
	$[\theta =]228.6°, 311.4°$	**B1**	AWRT, WWW No others in the range $0° \le \theta \le 360°$. Ignore any answers outside this range. Condone 229°, 311°.
		3	

Question	Answer	Marks	Guidance
4(a)	$\left[\mathrm{f}^{-1}(x)=\right](x+1)^2$	**B1**	ISW Condone '$y=$'.
		1	
4(b)	$0<\mathrm{g}(x)\leqslant\frac{1}{2}$ or $\mathrm{g}(x)>0$ and $\mathrm{g}(x)\leqslant\frac{1}{2}$ or $\left(0,\frac{1}{2}\right]$	**B1**	Do not allow $\mathrm{g}(x)>0, \mathrm{g}(x)\leqslant\frac{1}{2}$. Do not allow $\mathrm{g}(x)>0$ or $\mathrm{g}(x)\leqslant\frac{1}{2}$. Condone g or y in place of $\mathrm{g}(x)$.
	g^{-1} does not exist because it is one to many or g^{-1} does not exist because it is not one to one. Or g^{-1} does not exist because g is not one to one or g^{-1} does not exist because g is many to one or g^{-1} does not exist because g fails the horizontal line test.	**B1**	g^{-1} can be replaced by 'It' throughout. A correct statement followed by any further incorrect explanation can be awarded B1.
		2	

Question	Answer	Marks	Guidance
4(c)	$f\left(\frac{25}{16}\right)=\frac{1}{4}$	**B1**	SOI
	$\frac{1}{\left(\sqrt{x}-1\right)^2+2}=\frac{1}{4}$	**M1**	Equating $\frac{1}{\left(\sqrt{x}-1\right)^2+2}$, or *their* 'simplified' version, to *their* $f\left(\frac{25}{16}\right)$.
	$\left[\left(\sqrt{x}-1\right)^2+2=4 \text{ leading to}\right]$ $\sqrt{x}-1=\sqrt{2}$ leading to $x=\left(1\pm\sqrt{2}\right)^2$ Or $\left[x-2\sqrt{x}+1+2=4 \text{ leading to}\right]$ $x-2\sqrt{x}-1=0$ leading to $x=\left(1\pm\sqrt{2}\right)^2$ Or $\left[x-1=2\sqrt{x} \text{ leading to}\right]$ $x^2-6x+1=0$ leading to $x=\frac{6\pm\sqrt{36-4}}{2}$	**A1**	Simplification as far as $x=\ldots$ Allow just + in the results because $-$ can be disregarded at this stage. Can be implied by the final answer. Note: $x=1\pm\sqrt{2}$ scores A0.
	$3+2\sqrt{2}$	**A1**	Must discount the solution $3-2\sqrt{2}$.
		4	

Question	Answer	Marks	Guidance
5(a)	$[d =]\sin\theta - \tan\theta$	**M1**	For subtraction of *their* first term from *their* second term. Condone incorrect evaluation before subtraction.
	$[d =]\frac{\sqrt{2}}{2} - 1$	**A1**	OE Sight of –0.29 AWRT can be awarded M1A1.
	$[S_{40} =]\frac{40}{2}\left(2 \times \tan\theta + 39\left(\sin\theta - \tan\theta\right)\right)$	**M1**	Use of a correct formula for S_{40}. Condone use of *their*, clearly identified, incorrect values for a and d for this mark.
	$390\sqrt{2} - 740$ or $\frac{780}{\sqrt{2}} - 740$	**A1**	ISW If A0 then sight of -188 AWRT, -188.5 or -189 should be awarded M1A1M1A0.
		4	
5(b)(i)	$r = \frac{\sin\theta}{\tan\theta}$ $[= \cos\theta]$	**B1**	Condone omission of θ.
	$S_\infty = \frac{\tan\theta}{1 - \cos\theta}$ or $\frac{\sin\theta}{\cos\theta - cos^2\theta}$ or $\frac{\tan^2\theta}{\tan\theta - \sin\theta}$	**B1**	ISW Do not allow fractions within fractions nor omission of θ.
		2	

Question	Answer	Marks	Guidance
5(b)(ii)	$a = \sqrt{3}(1.73..)$ and $r = \frac{1}{2}$	**B1**	OE, SOI.
	$[S_{10} =]\sqrt{3}\left(\frac{1-\left(\frac{1}{2}\right)^{10}}{1-\frac{1}{2}}\right)$	**M1**	This mark can be awarded for a correct formula with *their* values for a and r or $a = \tan\theta$ and $r = \frac{\sin\theta}{\tan\theta}$ or $\cos\theta$. Condone $\frac{1}{2}^{10}$.
	= 3.46	**A1**	AWRT Condone $\frac{1023\sqrt{3}}{512}$.
		3	Note: S_9 gives the same answer but scores B1M0A0.

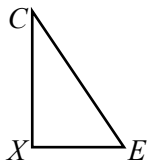
Question	Answer	Marks	Guidance
6(a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 2 - \frac{1}{2} \times 8x^{-\frac{1}{2}}$	**B1**	
	$2 - 4x^{-\frac{1}{2}} = 0$	**M1**	Equating *their* two term $\frac{\mathrm{d}y}{\mathrm{d}x}$, with at least one term correct, to 0.
	[A is] $(4, -8)$ or $x = 4, y = -8$	**A1**	
	[B is] $(16, 0)$ or $x = 16, y = 0$	**B1**	
		4	Note: Correct answers without use of $\frac{\mathrm{d}y}{\mathrm{d}x}$ can be awarded 4/4.

Question	Answer	Marks	Guidance
6(b)	$[\pm]\ \frac{2x^2}{2}-\frac{8}{\frac{3}{2}}x^{\frac{3}{2}}\ [+C]$	**B1**	Seen correct in unsimplified form or better.
	$[\pm]\frac{x^2-32x}{3}$ or $\frac{(2x-32)^2}{12}\ [+C]$	**B1**	Seen correct in unsimplified form or better.
	Attempt to integrate, defined by at least one correct power in each expression, and then subtract.	**M1**	Multiplying by 3 before integration scores M0.
	$\left\{\left(16^2-\frac{8}{\frac{3}{2}}.16^{\frac{3}{2}}\right)-\left(4^2-\frac{8}{\frac{3}{2}}.4^{\frac{3}{2}}\right)\right\}\ [-]\ \left\{\left(\frac{16^2-32\times16}{3}\right)-\left(\frac{4^2-32\times4}{3}\right)\right\}$	**M1**	Use of *their x* values, > 0, from **(a)** as limits in *their* integrated expressions. Allow, for correct limits, sight of $\pm\left(\left\{\left(-\frac{256}{3}\right)-\left(-\frac{80}{3}\right)\right\}[-]\left\{\left(-\frac{256}{3}\right)-\left(-\frac{112}{3}\right)\right\}\right)$. If incorrect limits are used, then clear substitution must be seen.

Question	Answer	Marks	Guidance
6(b)	**Alternative Method 1 for first 4 marks of Question 6(b)**		
	$\left[\left[\pm\right]\int 2x-8x^{\frac{1}{2}}\,dx=\right]\quad x^2-\frac{8}{\frac{3}{2}}x^{\frac{3}{2}}\quad\left[+C\right]$	**(B1)**	Seen correct in unsimplified form or better.
	[Area of triangle =] 48	**(B1)**	
	Attempt to integrate, defined by at least one correct power, and then subtract *their* triangle area.	**(M1)**	
	$\left\{\left(16^2-\frac{8}{\frac{3}{2}}.16^{\frac{3}{2}}\right)-\left(4^2-\frac{8}{\frac{3}{2}}.4^{\frac{3}{2}}\right)\right\}$	**(M1)**	Use of *their x* values, > 0, from **(a)** as limits in *their* integrated expression. Allow sight of $\pm\left(\left\{\left(-\frac{256}{3}\right)-\left(-\frac{80}{3}\right)\right\}\right)$. If incorrect limits are used, then clear substitution must be seen.

Question	Answer	Marks	Guidance
6(b)	**Alternative Method 2 for first 4 marks of Question 6(b)**		
	Subtract and then integrate, defined by at least two correct powers. Condone functions being the wrong way round.	**(M1)**	If terms in x have not been combined use the first scheme.
	$[\pm]\left(\frac{4}{3\times 2}x^2-\frac{8}{\frac{3}{2}}x^{\frac{3}{2}}+\frac{32x}{3}\right)$	**(B2,1,0)**	B2 for 3 correct terms, B1 for any 2 correct terms.
	$[\pm]\left(\left(\frac{4}{3\times 2}\times 16^2-\frac{8}{\frac{3}{2}}\times 16^{\frac{3}{2}}+\frac{32\times 16}{3}\right)-\left(\frac{4}{3\times 2}\times 4^2-\frac{8}{\frac{3}{2}}\times 4^{\frac{3}{2}}+\frac{32\times 4}{3}\right)\right)$	**(M1)**	Use of *their x* values, >0, from **(a)** as limits in *their* integrated expression. Allow sight of $\pm\left(0-\frac{32}{3}\right)$. If incorrect limits are used, then clear substitution must be seen.
	$\frac{32}{3}$, $10\frac{2}{3}$ or 10.7	**(B1)**	AWRT Allow $-\frac{32}{3}$ or $-\frac{32}{3}$ changed to $+\frac{32}{3}$ for this mark.
		(5)	Condone the inclusion of π for the first 4 marks but use of $\int y^2$ scores a maximum of B1 for the triangle.

Question	Answer	Marks	Guidance
7(a)	$(x-6)^2 + (2a-x+a)^2 = 18$	**M1***	Replacing y with $2a - x$ in the circle equation, condone incorrect expansion before substitution.
	$2x^2 - 12x - 6ax + 9a^2 + 36 - 18[=0]$	**A1**	All terms collected on one side of the equation. May be implied by the discriminant.
	$(12+6a)^2 - 4\times 2\times(9a^2+18)\ [=0]$	**DM1**	Correct use of "b^2 — $4ac$" from *their* 3 term quadratic equation in x, with an x term of the form $(m+na)x$ with both m and $n \neq 0$.
	$-36a^2 + 144a[+0=0]$	**A1**	
	$a = 0,\ a = 4$	**A1**	
		5	
7(b)	[Centre is] (6, −4) or [Point of intersection is] (9, −1)	**B1**	
	[Gradient of diameter] $=1$	**B1**	
	$y+4 = x-6$ or $y+1 = x-9$ [leading to $y = x-10$]	**B1FT**	FT on *their* point of intersection or *their* centre with an x co-ordinate of ±6 and gradient = 1.
		3	

Question	Answer	Marks	Guidance
8(a)(i)	 $X\hat{C}E = \frac{\pi}{6}$ $C\hat{E}X = \frac{\pi}{3}$		
	$\frac{XE}{0.4} = \sin\frac{\pi}{6}$ or $\frac{XE}{0.4} = \cos\frac{\pi}{3}$ $[XE = 0.2]$	**M1**	A correct trig expression involving XE. Do not condone a mixture of degrees and radians.
	Length $EF = 2 + 2 \times 0.2 = 2.4$	**A1**	AG
		2	

Question	Answer	Marks	Guidance
8(a)(ii)	$[CX =]0.4\cos\frac{\pi}{6}$ or $0.4\sin\frac{\pi}{3}$ or $\sqrt{0.4^2-0.2^2}$	**B1**	OE, SOI Expect $\frac{\sqrt{3}}{5}$ or 0.3464.
	$[\text{Sector} =]\frac{1}{2}\times(0.4)^2\times\frac{\pi}{3}$	**B1**	SOI Expect 0.0838 or $\frac{2\pi}{75}$. Allow use of $\frac{60}{360}\pi(0.4)^2$.
	Either Area of *their* (rectangle + two triangles + two sectors) Or Area of *their* (trapezium + two sectors)	**M1**	Either implied by a correct answer or areas clearly labelled. Expect 0.6928 + 0.06928 + 0.1676 or $\frac{2\sqrt{3}}{5}+\frac{\sqrt{3}}{25}+\frac{4\pi}{75}$. Or 0.7621 + 0.1676 or $\frac{11\sqrt{3}}{25}+\frac{4\pi}{75}$.
	0.930	**A1**	AWRT Condone $\frac{11\sqrt{3}}{25}+\frac{4\pi}{75}$.
		4	

Question	Answer	Marks	Guidance
8(b)	[Length AD =] $2+2r$	**B1**	Must be seen alone or part of a list and not part of a product.
	[Arc length =] $r\times\frac{\pi}{3}$	**B1**	May be implied by $r\times\frac{\pi}{3}\times 2$. Must be seen alone or part of a list.
	$[\text{EF} =]2+2r\sin\frac{\pi}{6}$ or $2+2r\cos\frac{\pi}{3}$ or $2+r$	**B1**	Must be seen alone or part of a list and not part of a product.
	[$4+3r+\frac{2\pi r}{3}=6$ leading to] 0.393	**B1**	AWRT Condone $\frac{6}{2\pi+9}$. NB: Using EF = 2.4 gives 0.391.
		4	

Question	Answer	Marks	Guidance
9(a)	$6(2x-3)^2-6x<0$ or $=0$	**B1***	Condone $\leqslant 0$. If $6(2x-3)^2$ only or $6(2x-3)^2-6$ is used, do not treat as a MR.
	$24x^2-78x+54$ or $4x^2-13x+9$ or $(x-1)(4x-9)$ OR $6(2x-3)^2<6x$ leading to $(2x-3)<\sqrt{x}$ leading to $2x-\sqrt{x}-3$	**M1**	Expanding brackets and collecting terms to arrive at a three term quadratic, only condone sign errors.
	$[x=]1,\frac{9}{4}$	**B1**	
	$1<x<\frac{9}{4}$ or $x>1$ and $x<\frac{9}{4}$ or $\left(1,\frac{9}{4}\right)$	**DB1FT**	OE Condone consistent use of $\leqslant$ and $\geqslant$ or [ ]. Do not allow $x>1 \text{or} x<\frac{9}{4}$ nor $x>1, x<\frac{9}{4}$. FT on *their* values coming from a correct initial statement.
		4	

Question	Answer	Marks	Guidance
9(b)	$\left[\mathrm{f}(x)=\right]\left\{\frac{6}{3\times 2}(2x-3)^3\right\}\left\{-\frac{6}{2}x^2\right\} \quad [+C]$	**B1 B1**	B1 for each $\{\text{Correct integral}\}$.
	$-1=(-1)^3-3\times 1^2+C$	**M1**	$\mathrm{f}(x)=-1$ equated to *their* integrated expression, defined by two terms with at least one correct power + C, with $x = 1$.
	$\left[f(x)=\right](2x-3)^3-3x^2+3$	**A1**	CAO Only condone $C = 3$ as final answer if coefficients have been simplified earlier. Do not ISW if the result is of the form $y=mx+c$.
	Alternative method for Question 9(b)		
	$\left[f'(x)=24x^2-78x+54\right.$ leading to $\left.\right]\left[\mathrm{f}(x)=\right]8x^3-39x^2+54x[+C]$	**(B2,1,0)**	B2 completely correct, B1 any two correct terms.
	$-1=8-39+54+C$	**(M1)**	$\mathrm{f}(x)=-1$ equated to *their* integrated expression, defined by three terms with at least one correct power + C, with $x = 1$.
	$\left[f(x)=\right]\ 8x^3-39x^2+54x-24$	**(A1)**	Only condone $C = -24$ as final answer if coefficients have been simplified earlier. Do not ISW if the result is of the form $y=mx+c$.
		4	

Question	Answer	Marks	Guidance
10(a)	$[x =] -2$	**B1**	
	$\frac{dy}{dx} = k(5-2x)^{\frac{1}{2}} \quad \left[= -2 \times \frac{3}{2}(5-2x)^{\frac{1}{2}}\right]$	**M1***	OE Differentiating to get $k(5-2x)^{\frac{1}{2}}$ only.
	$\left[\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} \text{ leading to}\right] \quad -9 = \pm 5 \times \frac{dt}{dx}$	**DM1**	Correct statement linking *their* numerical expression for $\frac{dy}{dx}$ with $\frac{dt}{dx}$ and ± 5.
	$\frac{5}{9}$ or $0.556 =$	**A1**	AWRT
		4	

Question	Answer	Marks	Guidance
10(b)	$k(5-2x)^{\frac{1}{2}} = -3$	**M1**	Equating *their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ of the form $k(5-2x)^{\frac{1}{2}}$ to -3.
	[B is] $(2,6)$	**A1**	
	Gradient $AB = m_1 = \frac{32-6}{-2-2}$,gradient of perpendicular $= -\frac{1}{m_1} = \frac{4}{26}$	**M1***	For A, y must be 32. Clear use of $\frac{\text{difference in y co-ordinates}}{\text{difference in x co-ordinates}}$ for points A and B, condone inconsistent order, and using $m_1 m_2 = -1$. If incorrect values or another complete method used, then working must be clear.
	Mid point is $\left(\frac{2-2}{2}, \frac{6+32}{2}\right) = (0,19)$	**M1***	Finding the midpoint of AB using A and B. If incorrect values used then all working must be clear. For A, y must be 32.
	$y - 19 = \frac{2}{13}(x-0)$	**DM1**	Finding the equation of the perpendicular bisector using *their* midpoint and *their* perpendicular gradient.
	$2x - 13y + 247 = 0$ or $\pm$ integer multiples of this.	**A1**	
		6	