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Cambridge International AS Level

MATHEMATICS **9709/21**

Paper 2 Pure Mathematics 2 **October/November 2025**

MARK SCHEME

Maximum Mark: 50

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.

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Cambridge International is publishing the mark schemes for the October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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- the standard of response required by a candidate as exemplified by the standardisation scripts.

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A1	Accuracy mark awarded one
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B2	Independent accuracy mark awarded two
BOD	Benefit of the doubt
BP	Blank Page
✗	Incorrect
Dep	Used to indicate DM0 or DM1

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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
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MR	Misread
O	Omission or Other solution
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Pre	Premature approximation
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SEEN	Indicates that work/page has been seen

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TE	Transcription error
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Mark Scheme Notes

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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.

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Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
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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

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Question	Answer	Marks	Guidance
1	Use identity to express integrand in the form $k_1 + k_2 \cos 2x$	**M1**	
	Obtain correct $3 - 3\cos 2x$	**A1**	
	Integrate to obtain $3x - \frac{3}{2}\sin 2x$	**A1**	Condone omission of $+c$.
		3	

Question	Answer	Marks	Guidance
2	Attempt solution of quadratic equation in e^{2x} to obtain at least one value of e^{2x}	**M1**	
	Obtain $(e^{2x} - 12)(e^{2x} + 4) = 0$ OE, and hence at least $e^{2x} = 12$	**A1**	
	Obtain $x = \frac{1}{2}\ln 12$ or 1.24 and no other solution	**A1**	
		3	

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Question	Answer	Marks	Guidance
3(a)	Solve $2x-3=5x+2$ to obtain $-\frac{5}{3}$	**B1**	Or exact equivalent.
	Attempt solution of linear equation where $2x$ and $5x$ have different signs	**M1**	
	Obtain $\frac{1}{7}$	**A1**	OE
	Alternative Method for Question 3(a)		
	State or imply non-modulus equation $(2x-3)^2=(5x+2)^2$	**B1**	
	Attempt complete solution of three-term quadratic equation	**M1**	
	Obtain $-\frac{5}{3}$ and $\frac{1}{7}$ or equivalents	**A1**	OE
		3	
3(b)	State or imply $\cos\theta=-\frac{3}{5}$	**B1 FT**	Following an appropriate answer from part **(a)**.
	Attempt correct process for finding third quadrant angle	**M1**	Condone working in degrees for this mark.
	Obtain 4.07	**A1**	Or greater accuracy 4.0688…
		3	

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Question	Answer	Marks	Guidance
4	Attempt to express equation in terms of $\tan\theta$ only	**M1***	
	Obtain $\frac{1}{\tan\theta}\times\frac{\tan\theta+\tan 45}{1-\tan\theta\tan 45}=7$	**A1**	OE
	Simplify to obtain equation $7\tan^2\theta-6\tan\theta+1=0$	**A1**	
	Attempt solution of three-term quadratic equation in $\tan\theta$ to obtain at least one value of θ	**DM1**	
	Obtain $\tan\theta=\frac{1}{7}(3\pm\sqrt{2})$ or equivalent and hence 12.8 and 32.2, and no others in the given range	**A1**	Or greater accuracy 12.764…, 32.235…
		5	

Question	Answer	Marks	Guidance
5(a)	Attempt solution of $8e^{-\frac{1}{2}x}-1=0$ with use of a relevant logarithm property	**M1**	E.g. $\frac{1}{2}\ln x=\ln 8$
	Confirm $x=6\ln 2$	**A1**	AG – necessary detail needed. Need to see $\ln 8=3\ln 2$ or $64=2^6$ OE used.
	Alternative Method for Question 5(a)		
	Substitute $x=6\ln 2$ in $8e^{-\frac{1}{2}x}-1$ and show use of a relevant logarithm property	**M1**	
	Obtain $8e^{-3\ln 2}-1$ and hence $8e^{\ln\frac{1}{8}}-1$ or equivalent and verify answer 0	**A1**	AG – necessary detail needed.
		2	
5(b)	Integrate $8e^{-\frac{1}{2}x}-1$ to obtain the form $ke^{-\frac{1}{2}x}-x$	**M1**	
	Obtain correct $-16e^{-\frac{1}{2}x}-x$	**A1**	
	Apply limits 0 and $6\ln 2$ to obtain $-16e^{-\frac{1}{2}\times 6\ln 2}-6\ln 2+16$	**A1**	OE $14-6\ln 2$
	Attempt area of triangle minus area under curve	**M1**	Allow decimals for this mark (14.56).
	Obtain $\frac{1}{2}\times 6\ln 2\times 7-(14-6\ln 2)$ or equivalent, and hence $27\ln 2-14$	**A1**	
		5	

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Question	Answer	Marks	Guidance
6(a)	Attempt use of chain rule for differentiation of y or simplification of y and use of the product rule.	**M1**	
	Obtain $\frac{dx}{d\theta} = \sec^2\theta$ and $\frac{dy}{d\theta} = \cos\theta - 6\sin^2\theta\cos\theta$	**A1**	
	Attempt expression for $\frac{dy}{dx}$ in terms of $\cos\theta$ only using *their* $\frac{dx}{d\theta}$ and $\frac{dy}{d\theta}$	**M1**	
	Obtain $6\cos^5\theta - 5\cos^3\theta$	**A1**	AG – necessary detail needed.
		4	
6(b)	Attempt solution of $y = 0$ to find value of θ	**M1**	Allow if degrees used
	Obtain $\sin^2\theta = \frac{1}{2}$ and hence $\theta = \frac{1}{4}\pi$	**A1**	Must be in radians here
	Obtain gradient of curve at the point is $-\frac{1}{\sqrt{2}}$ or exact equivalent	**A1**	
	Attempt equation of normal using negative reciprocal for their gradient	**M1**	
	Obtain $y = \sqrt{2}x - \sqrt{2}$ or exact equivalent	**A1**	
		5	

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Question	Answer	Marks	Guidance
7(a)	Substitute $x=-2$, equate to zero and attempt solution	**M1**	
	Obtain $32-8k+4k-34+18=0$ or equivalent and hence $k=4$	**A1**	
		2	
7(b)	State $\alpha=-2$	**B1**	
	Divide by $x+2$ at least as far as $2x^3+mx$	**M1**	Or equivalent method, e.g. inspection.
	Obtain $2x^3+4x+9$	**A1**	
	Rearrange $2x^3+4x+9=0$ to confirm $x=\sqrt[3]{-2x-4.5}$	**A1**	AG – necessary detail needed.
		4	
7(c)	Consider sign of $x-\sqrt[3]{-2x-4.5}$ or equivalent for -1.4 and -1.0	**M1**	Or Example 1: $\mathrm{f}(x)=2x^3+4x+9$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$. Example 2: $\mathrm{f}(x)=\sqrt[3]{-2x-4.5}$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$.
	Obtain $-0.2...$ and $0.3\ldots$ or equivalents and justify conclusion	**A1**	Example 1: $\mathrm{f}(-1)=3$, $\mathrm{f}(-1.4)=-1.2...$ with a correct conclusion. Example 2: $\mathrm{f}(-1)=-1.357....$ so $-1>-1.357...$ $\mathrm{f}(-1.4)=-1.193....$ so $-1.4<-1.19...$ with a correct conclusion. AG – necessary detail needed.
		2	

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Question	Answer	Marks	Guidance
7(d)	Use iterative process correctly at least once	**M1**	
	Obtain final answer -1.26	**A1**	Answer required to exactly 3 significant figures.
	Show sufficient iterations to 5 sf to justify answer or show sign change in interval $[-1.265,\ -1.255]$	**A1**	
		3	

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Question	Answer	Marks	Guidance
8	Differentiate to obtain the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$	***M1**	Where $k_1k_2 \neq 0$.
	Obtain correct first term $-8e^{1-2x}(3x-1)^{\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Obtain correct second term $+6e^{1-2x}(3x-1)^{-\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Equate first derivative to zero and attempt solution as far as $3x-1=k$	**DM1**	OE. Must be in the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$
	Obtain $3x-1=\frac{3}{4}$ OE, and hence $x=\frac{7}{12}$	**A1**	Or exact equivalent.
	Obtain $y=2\sqrt{3}\,e^{-\frac{1}{6}}$	**A1**	Or exact equivalent.
		6	

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WWW	Without Wrong Working
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1	Apply relevant logarithm property	*M1	
	Obtain correct equation without logarithms $\frac{3x+5}{x-2}=e^4$ or equivalent	A1	Allow recovery from an incorrect log statement.
	Solve equation to find exact value of x	DM1	Must be in correct form, condone one sign slip.
	Obtain $\frac{2e^4+5}{e^4-3}$	A1	Or exact equivalent.
		4	

Question	Answer	Marks	Guidance
2	Attempt identity involving $\tan^2\theta$ and $\sec^2\theta$ to obtain quadratic equation in $\sec\theta$ or $\cos\theta$	*M1	
	Obtain $2\sec^2\theta+3\sec\theta-20=0$ or $20\cos^2\theta-3\cos\theta-2=0$	A1	
	Solve three-term quadratic equation to obtain at least one value of θ	DM1	
	Obtain at least two values of ± 66.4 and ± 104.5	A1	Or greater accuracy 66.421…, 104.477…
	Obtain all four values and no others between –180 and 180	A1	Or greater accuracy.
		5	

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Question	Answer	Marks	Guidance
3(a)	Solve $3x-4=2x+5$ to obtain $x=9$	**B1**	Or inequality.
	Attempt solution of linear equation where $3x$ and $2x$ have different signs	**M1**	Or inequality.
	Obtain $x=-\frac{1}{5}$	**A1**	
	Conclude $-\frac{1}{5}\leqslant \quad \leqslant 9$	**A1**	Now using $\leqslant$ signs, allow $x\geqslant -\frac{1}{5}$ and $x\leqslant 9$.
	Alternative Method for Question 3(a)		
	State or imply non-modular equation $(3x-4)^2=(2x+5)^2$	**B1**	Or inequality.
	Attempt solution of three-term quadratic equation or inequality	**M1**	$5x^2-44x-9=0$
	Obtain values $-\frac{1}{5}$ and 9	**A1**	Allow if one critical value is rejected.
	Conclude $-\frac{1}{5}\leq x\leq 9$	**A1**	Now using $\leqslant$ signs, allow $x\geqslant -\frac{1}{5}$ and $x\leqslant 9$.
		4	
3(b)	State $7^{0.01N}=9$	**B1 FT**	Or inequality; following *their* positive upper limit from **(a)**.
	Use logarithms to find value of N	**M1**	Allow non-integer value 112.915… so far, or exact equivalent. If using trial and improvement, must show $N=113>9$ and $N=112<9$.
	Conclude with single integer 112	**A1**	
		3	

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Question	Answer	Marks	Guidance
4(a)	Carry out division as far as $x^2 \pm 10x$	**M1**	Or equivalent method, e.g. inspection.
	Obtain quotient $x^2 - 10x + 17$	**A1**	WWW
	Confirm remainder is –11	**A1**	WWW AG – necessary detail needed.
		3	
4(b)	State or imply that equation is $(x^2 + 3)(x^2 - 10x + 17) = 0$	**B1 FT**	Following *their* quotient from part **(a)**.
	Attempt solution of *their* three-term quadratic quotient from **(a)** to give two exact roots	**M1**	
	Obtain $5 \pm \sqrt{8}$ or $5 \pm 2\sqrt{2}$ and no other solutions	**A1**	Do not ISW. $16 \pm 2\sqrt{2}$ gets A0.
		3	

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Question	Answer	Marks	Guidance
5(a)	Differentiate to obtain $-8\sin 2x + 8\cos x$	**B1**	
	Attempt to solve equation of form $k_1 \sin 2x + k_2 \cos x = 0$ using correct identity	***M1**	Must have attempted differentiation.
	Obtain at least $\sin x = \frac{1}{2}$	**A1**	
	Attempt to find both coordinates of at least one maximum point	**DM1**	
	Obtain $\left(\frac{1}{6}\pi,\ 6\right)$ and $\left(\frac{5}{6}\pi,\ 6\right)$ and no others between 0 and π	**A1**	Angles must be in radians.
		5	
5(b)	Integrate to obtain expression of form $k_1 \sin 2x + k_2 \cos x$	***M1**	
	Obtain correct $2\sin 2x - 8\cos x$	**A1**	Condone poor notation for this mark.
	Apply *their* x-limits correctly to evaluate area under curve between A and B	***DM1**	Condone use of degrees for this mark.
	Obtain $6\sqrt{3}$ or exact unsimplified equivalent	**A1**	
	Carry out correct process to find area of shaded region	**DDM1**	The y-coordinates of both points must be the same. Rectangle – *their* $6\sqrt{3}$.
	Obtain $6\left(\frac{5}{6}\pi - \frac{1}{6}\pi\right) - 6\sqrt{3}$, and hence $4\pi - 6\sqrt{3}$	**A1**	Or exact equivalent.
		6	

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Question	Answer	Marks	Guidance
6(a)	Integrate to obtain expression of form $k_1e^{2x}+k_2e^{-x}$	*M1	
	Obtain correct $\frac{1}{4}e^{2x}-\frac{1}{4}e^{-x}$	A1	
	Apply limits and arrange at least as far as $\frac{1}{2}e^{2a}=...$ or $e^{2a}=...$	DM1	
	Confirm $a=\frac{1}{2}\ln(10+\frac{1}{2}e^{-a}+\frac{1}{2}e^{-4a})$	A1	AG – necessary detail needed.
		4	
6(b)	Consider sign of $a-\frac{1}{2}\ln(10+\frac{1}{2}e^{-a}+\frac{1}{2}e^{-4a})$ or equivalent for values 1.0 and 1.2	M1	May use an intermediate equation from part **(a)**. Example 1: consider $\frac{1}{2}\ln(10+\frac{1}{2}e^{-a}+\frac{1}{2}e^{-4a})$ for values 1.0 and 1.2. Example 2: consider $\frac{1}{2}e^{2a}-\frac{1}{4}e^{-a}-\frac{1}{4}e^{-4a}-5$ for values 1.0 and 1.2.
	Obtain –0.16… and 0.041… or equivalents and justify conclusion	A1	Example 1: $1.0<1.1608...$ and $1.2>1.1589...$ (allow to 2dp and truncation), so $1.0<\alpha<1.2$ OE. Example 2: $f(1.0)=-1.40...$ $f(1.2)=0.43...$ and change of sign so $1.0<\alpha<1.2$ OE.
		2	
6(c)	Use iteration process correctly at least once	M1	
	Obtain final answer 1.159	A1	Required to precisely 4 significant figures.
	Show sufficient iterations to justify answer or show a sign change in the interval [1.1585, 1.1595]	A1	
		3	

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Question	Answer	Marks	Guidance
7(a)	Attempt use of product rule for differentiating $5x^2y$	***M1**	Must have evidence of implicit differentiation.
	Obtain $10xy + 5x^2\frac{dy}{dx}$	**A1**	
	Differentiate $4e^{2y}$ and obtain $8e^{2y}\frac{dy}{dx}$	**B1**	
	Obtain $10xy + 5x^2\frac{dy}{dx} + 8e^{2y}\frac{dy}{dx} - 7 = 0$ and hence $\frac{dy}{dx} = \frac{7-10xy}{5x^2+8e^{2y}}$	**A1**	OE
	Attempt to find relevant value of x and substitute that and $y = 0$ to find gradient	**DM1**	$x = 2$
	Obtain $x = 2$ and gradient $\frac{1}{4}$	**A1**	OE
		6	
7(b)	Attempt to show that denominator of derivative cannot be zero	**M1**	Must not be using $\frac{dy}{dx}$ when $y = 0$.
	State that both terms are non-negative or equivalent and conclude appropriately	**A1 FT**	Following *their* denominator of form $k_1x^2 + k_2e^{2y}$, provided that $k_1k_2 > 0$.
		2	

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CAMBRIDGE
International Education

Cambridge International AS Level

MATHEMATICS **9709/23**

Paper 2 Pure Mathematics 2 **October/November 2025**

MARK SCHEME

Maximum Mark: 50

Published

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Question	Answer	Marks	Guidance
1	Use identity to express integrand in the form $k_1 + k_2 \cos 2x$	**M1**	
	Obtain correct $3 - 3\cos 2x$	**A1**	
	Integrate to obtain $3x - \frac{3}{2}\sin 2x$	**A1**	Condone omission of $+c$.
		3	

Question	Answer	Marks	Guidance
2	Attempt solution of quadratic equation in e^{2x} to obtain at least one value of e^{2x}	**M1**	
	Obtain $(e^{2x} - 12)(e^{2x} + 4) = 0$ OE, and hence at least $e^{2x} = 12$	**A1**	
	Obtain $x = \frac{1}{2}\ln 12$ or 1.24 and no other solution	**A1**	
		3	

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Question	Answer	Marks	Guidance
3(a)	Solve $2x-3=5x+2$ to obtain $-\frac{5}{3}$	**B1**	Or exact equivalent.
	Attempt solution of linear equation where $2x$ and $5x$ have different signs	**M1**	
	Obtain $\frac{1}{7}$	**A1**	OE
	Alternative Method for Question 3(a)		
	State or imply non-modulus equation $(2x-3)^2=(5x+2)^2$	**B1**	
	Attempt complete solution of three-term quadratic equation	**M1**	
	Obtain $-\frac{5}{3}$ and $\frac{1}{7}$ or equivalents	**A1**	OE
		3	
3(b)	State or imply $\cos\theta=-\frac{3}{5}$	**B1 FT**	Following an appropriate answer from part **(a)**.
	Attempt correct process for finding third quadrant angle	**M1**	Condone working in degrees for this mark.
	Obtain 4.07	**A1**	Or greater accuracy 4.0688…
		3	

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Question	Answer	Marks	Guidance
4	Attempt to express equation in terms of $\tan\theta$ only	**M1***	
	Obtain $\frac{1}{\tan\theta}\times\frac{\tan\theta+\tan 45}{1-\tan\theta\tan 45}=7$	**A1**	OE
	Simplify to obtain equation $7\tan^2\theta-6\tan\theta+1=0$	**A1**	
	Attempt solution of three-term quadratic equation in $\tan\theta$ to obtain at least one value of θ	**DM1**	
	Obtain $\tan\theta=\frac{1}{7}(3\pm\sqrt{2})$ or equivalent and hence 12.8 and 32.2, and no others in the given range	**A1**	Or greater accuracy 12.764…, 32.235…
		5	

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Question	Answer	Marks	Guidance
5(a)	Attempt solution of $8e^{-\frac{1}{2}x}-1=0$ with use of a relevant logarithm property	**M1**	E.g. $\frac{1}{2}\ln x=\ln 8$
	Confirm $x=6\ln 2$	**A1**	AG – necessary detail needed. Need to see $\ln 8=3\ln 2$ or $64=2^6$ OE used.
	Alternative Method for Question 5(a)		
	Substitute $x=6\ln 2$ in $8e^{-\frac{1}{2}x}-1$ and show use of a relevant logarithm property	**M1**	
	Obtain $8e^{-3\ln 2}-1$ and hence $8e^{\ln\frac{1}{8}}-1$ or equivalent and verify answer 0	**A1**	AG – necessary detail needed.
		2	
5(b)	Integrate $8e^{-\frac{1}{2}x}-1$ to obtain the form $ke^{-\frac{1}{2}x}-x$	**M1**	
	Obtain correct $-16e^{-\frac{1}{2}x}-x$	**A1**	
	Apply limits 0 and $6\ln 2$ to obtain $-16e^{-\frac{1}{2}\times 6\ln 2}-6\ln 2+16$	**A1**	OE $14-6\ln 2$
	Attempt area of triangle minus area under curve	**M1**	Allow decimals for this mark (14.56).
	Obtain $\frac{1}{2}\times 6\ln 2\times 7-(14-6\ln 2)$ or equivalent, and hence $27\ln 2-14$	**A1**	
		5	

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Question	Answer	Marks	Guidance
6(a)	Attempt use of chain rule for differentiation of y or simplification of y and use of the product rule.	**M1**	
	Obtain $\frac{dx}{d\theta} = \sec^2\theta$ and $\frac{dy}{d\theta} = \cos\theta - 6\sin^2\theta\cos\theta$	**A1**	
	Attempt expression for $\frac{dy}{dx}$ in terms of $\cos\theta$ only using *their* $\frac{dx}{d\theta}$ and $\frac{dy}{d\theta}$	**M1**	
	Obtain $6\cos^5\theta - 5\cos^3\theta$	**A1**	AG – necessary detail needed.
		4	
6(b)	Attempt solution of $y = 0$ to find value of θ	**M1**	Allow if degrees used
	Obtain $\sin^2\theta = \frac{1}{2}$ and hence $\theta = \frac{1}{4}\pi$	**A1**	Must be in radians here
	Obtain gradient of curve at the point is $-\frac{1}{\sqrt{2}}$ or exact equivalent	**A1**	
	Attempt equation of normal using negative reciprocal for their gradient	**M1**	
	Obtain $y = \sqrt{2}x - \sqrt{2}$ or exact equivalent	**A1**	
		5	

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Question	Answer	Marks	Guidance
7(a)	Substitute $x=-2$, equate to zero and attempt solution	**M1**	
	Obtain $32-8k+4k-34+18=0$ or equivalent and hence $k=4$	**A1**	
		2	
7(b)	State $\alpha=-2$	**B1**	
	Divide by $x+2$ at least as far as $2x^3+mx$	**M1**	Or equivalent method, e.g. inspection.
	Obtain $2x^3+4x+9$	**A1**	
	Rearrange $2x^3+4x+9=0$ to confirm $x=\sqrt[3]{-2x-4.5}$	**A1**	AG – necessary detail needed.
		4	
7(c)	Consider sign of $x-\sqrt[3]{-2x-4.5}$ or equivalent for -1.4 and -1.0	**M1**	Or Example 1: $\mathrm{f}(x)=2x^3+4x+9$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$. Example 2: $\mathrm{f}(x)=\sqrt[3]{-2x-4.5}$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$.
	Obtain $-0.2...$ and $0.3\ldots$ or equivalents and justify conclusion	**A1**	Example 1: $\mathrm{f}(-1)=3$, $\mathrm{f}(-1.4)=-1.2...$ with a correct conclusion. Example 2: $\mathrm{f}(-1)=-1.357....$ so $-1>-1.357...$ $\mathrm{f}(-1.4)=-1.193....$ so $-1.4<-1.19...$ with a correct conclusion. AG – necessary detail needed.
		2	

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Question	Answer	Marks	Guidance
7(d)	Use iterative process correctly at least once	**M1**	
	Obtain final answer -1.26	**A1**	Answer required to exactly 3 significant figures.
	Show sufficient iterations to 5 sf to justify answer or show sign change in interval $[-1.265,\ -1.255]$	**A1**	
		3	

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Question	Answer	Marks	Guidance
8	Differentiate to obtain the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$	***M1**	Where $k_1k_2 \neq 0$.
	Obtain correct first term $-8e^{1-2x}(3x-1)^{\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Obtain correct second term $+6e^{1-2x}(3x-1)^{-\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Equate first derivative to zero and attempt solution as far as $3x-1=k$	**DM1**	OE. Must be in the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$.
	Obtain $3x-1=\frac{3}{4}$ OE, and hence $x=\frac{7}{12}$	**A1**	Or exact equivalent.
	Obtain $y=2\sqrt{3}\,e^{-\frac{1}{6}}$	**A1**	Or exact equivalent.
		6	

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CAMBRIDGE
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MATHEMATICS **9709/25**

Paper 2 Pure Mathematics 2 **October/November 2025**

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		3	

Question	Answer	Marks	Guidance
2	Attempt solution of quadratic equation in e^{2x} to obtain at least one value of e^{2x}	**M1**	
	Obtain $(e^{2x} - 12)(e^{2x} + 4) = 0$ OE, and hence at least $e^{2x} = 12$	**A1**	
	Obtain $x = \frac{1}{2}\ln 12$ or 1.24 and no other solution	**A1**	
		3	

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Question	Answer	Marks	Guidance
3(a)	Solve $2x-3=5x+2$ to obtain $-\frac{5}{3}$	**B1**	Or exact equivalent.
	Attempt solution of linear equation where $2x$ and $5x$ have different signs	**M1**	
	Obtain $\frac{1}{7}$	**A1**	OE
	Alternative Method for Question 3(a)		
	State or imply non-modulus equation $(2x-3)^2=(5x+2)^2$	**B1**	
	Attempt complete solution of three-term quadratic equation	**M1**	
	Obtain $-\frac{5}{3}$ and $\frac{1}{7}$ or equivalents	**A1**	OE
		3	
3(b)	State or imply $\cos\theta=-\frac{3}{5}$	**B1 FT**	Following an appropriate answer from part **(a)**.
	Attempt correct process for finding third quadrant angle	**M1**	Condone working in degrees for this mark.
	Obtain 4.07	**A1**	Or greater accuracy 4.0688…
		3	

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Question	Answer	Marks	Guidance
4	Attempt to express equation in terms of $\tan\theta$ only	**M1***	
	Obtain $\frac{1}{\tan\theta}\times\frac{\tan\theta+\tan 45}{1-\tan\theta\tan 45}=7$	**A1**	OE
	Simplify to obtain equation $7\tan^2\theta-6\tan\theta+1=0$	**A1**	
	Attempt solution of three-term quadratic equation in $\tan\theta$ to obtain at least one value of θ	**DM1**	
	Obtain $\tan\theta=\frac{1}{7}(3\pm\sqrt{2})$ or equivalent and hence 12.8 and 32.2, and no others in the given range	**A1**	Or greater accuracy 12.764…, 32.235…
		5	

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Question	Answer	Marks	Guidance
5(a)	Attempt solution of $8e^{-\frac{1}{2}x}-1=0$ with use of a relevant logarithm property	M1	E.g. $\frac{1}{2}\ln x=\ln 8$
	Confirm $x=6\ln 2$	A1	AG – necessary detail needed. Need to see $\ln 8=3\ln 2$ or $64=2^6$ OE used.
	Alternative Method for Question 5(a)		
	Substitute $x=6\ln 2$ in $8e^{-\frac{1}{2}x}-1$ and show use of a relevant logarithm property	M1	
	Obtain $8e^{-3\ln 2}-1$ and hence $8e^{\ln\frac{1}{8}}-1$ or equivalent and verify answer 0	A1	AG – necessary detail needed.
		2	
5(b)	Integrate $8e^{-\frac{1}{2}x}-1$ to obtain the form $ke^{-\frac{1}{2}x}-x$	M1	
	Obtain correct $-16e^{-\frac{1}{2}x}-x$	A1	
	Apply limits 0 and $6\ln 2$ to obtain $-16e^{-\frac{1}{2}\times 6\ln 2}-6\ln 2+16$	A1	OE $14-6\ln 2$
	Attempt area of triangle minus area under curve	M1	Allow decimals for this mark (14.56).
	Obtain $\frac{1}{2}\times 6\ln 2\times 7-(14-6\ln 2)$ or equivalent and hence $27\ln 2-14$	A1	
		5	

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Question	Answer	Marks	Guidance
6(a)	Attempt use of chain rule for differentiation of y or simplification of y and use of the product rule.	**M1**	
	Obtain $\frac{dx}{d\theta} = \sec^2\theta$ and $\frac{dy}{d\theta} = \cos\theta - 6\sin^2\theta\cos\theta$	**A1**	
	Attempt expression for $\frac{dy}{dx}$ in terms of $\cos\theta$ only using *their* $\frac{dx}{d\theta}$ and $\frac{dy}{d\theta}$	**M1**	
	Obtain $6\cos^5\theta - 5\cos^3\theta$	**A1**	AG – necessary detail needed.
		4	
6(b)	Attempt solution of $y = 0$ to find value of θ	**M1**	Allow if degrees used
	Obtain $\sin^2\theta = \frac{1}{2}$ and hence $\theta = \frac{1}{4}\pi$	**A1**	Must be in radians here
	Obtain gradient of curve at the point is $-\frac{1}{\sqrt{2}}$ or exact equivalent	**A1**	
	Attempt equation of normal using negative reciprocal for their gradient	**M1**	
	Obtain $y = \sqrt{2}x - \sqrt{2}$ or exact equivalent	**A1**	
		5	

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Question	Answer	Marks	Guidance
7(a)	Substitute $x=-2$, equate to zero and attempt solution	**M1**	
	Obtain $32-8k+4k-34+18=0$ or equivalent and hence $k=4$	**A1**	
		2	
7(b)	State $\alpha=-2$	**B1**	
	Divide by $x+2$ at least as far as $2x^3+mx$	**M1**	Or equivalent method, e.g. inspection.
	Obtain $2x^3+4x+9$	**A1**	
	Rearrange $2x^3+4x+9=0$ to confirm $x=\sqrt[3]{-2x-4.5}$	**A1**	AG – necessary detail needed.
		4	
7(c)	Consider sign of $x-\sqrt[3]{-2x-4.5}$ or equivalent for -1.4 and -1.0	**M1**	Or Example 1: $\mathrm{f}(x)=2x^3+4x+9$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$. Example 2: $\mathrm{f}(x)=\sqrt[3]{-2x-4.5}$, finding $\mathrm{f}(-1.4)$ and $\mathrm{f}(-1)$.
	Obtain $-0.2...$ and $0.3\ldots$ or equivalents and justify conclusion	**A1**	Example 1: $\mathrm{f}(-1)=3$, $\mathrm{f}(-1.4)=-1.2...$ with a correct conclusion. Example 2: $\mathrm{f}(-1)=-1.357....$ so $-1>-1.357...$ $\mathrm{f}(-1.4)=-1.193....$ so $-1.4<-1.19...$ with a correct conclusion. AG – necessary detail needed.
		2	

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Question	Answer	Marks	Guidance
7(d)	Use iterative process correctly at least once	**M1**	
	Obtain final answer -1.26	**A1**	Answer required to exactly 3 significant figures.
	Show sufficient iterations to 5 sf to justify answer or show sign change in interval $[-1.265,\ -1.255]$	**A1**	
		3	

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Question	Answer	Marks	Guidance
8	Differentiate to obtain the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$	***M1**	Where $k_1k_2 \neq 0$.
	Obtain correct first term $-8e^{1-2x}(3x-1)^{\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Obtain correct second term $+6e^{1-2x}(3x-1)^{-\frac{1}{2}}$	**A1**	OE. Allow unsimplified
	Equate first derivative to zero and attempt solution as far as $3x-1=k$	**DM1**	OE. Must be in the form $k_1e^{1-2x}(3x-1)^{\frac{1}{2}}+k_2e^{1-2x}(3x-1)^{-\frac{1}{2}}$.
	Obtain $3x-1=\frac{3}{4}$ OE, and hence $x=\frac{7}{12}$	**A1**	Or exact equivalent.
	Obtain $y=2\sqrt{3}\,e^{-\frac{1}{6}}$	**A1**	Or exact equivalent.
		6	

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