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MATHEMATICS **9709/15**

Paper 1 Pure Mathematics 1 **October/November 2025**

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 October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level 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.

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

Question	Answer	Marks	Guidance
1(a)	$\{(x-2)^2\}\left\{+(y-6)^2\right\}=\left\{100 \text{ or } 10^2\right\}$ or $\left\{x^2-4x\right\}\left\{+y^2-12y\right\}\{-60=0\}$ oe	**B2,1,0**	B2 All 3 components correct, B1 Any 2 components correct.
		2	
1(b)	$(8-2)^2+(k-6)^2=100$ or $k^2-12k-28=0$	**M1***	Substituting the point into *their* equation to obtain an equation in k.
	$k-6=\pm 8$ or $(k-14)(k+2)=0$ oe	**DM1**	Simplify to the point where k can be found (allow one sign error).
	$k=14$,–2	**B1**	**SC B2** only for both answers without working. Allow ‘ $y=$ ’.
		3	

Question	Answer	Marks	Guidance
2(a)	$r = \dfrac{5-\sqrt{2}}{3+4\sqrt{2}}$	B1	Correct quotient SOI.
	$= \dfrac{\left(5-\sqrt{2}\right)\left(3-4\sqrt{2}\right)}{9-32}$	M1	Rationalise *their* denominator (must see clear process), or equate *their* r to $\sqrt{2}+p$ and solve.
	$= \dfrac{23-23\sqrt{2}}{-23} = \sqrt{2}-1\ [p=-1]$	B1	
		3	
2(b)	$S_\infty = \dfrac{3+4\sqrt{2}}{1-\left(\sqrt{2}-1\right)}$	M1	Uses S_∞ formula. FT $a = 3+4\sqrt{2}$ and *their* r from **2(a)**, provided $-1<r<1$ and r is evaluated. Do not condone missing brackets unless corrected in the calculation.
	$\left[= \dfrac{14+11\sqrt{2}}{2}\right]$ or $\left[7+\dfrac{11\sqrt{2}}{2}\right]$	A1	Allow answers from a correct expression which round to 14.8 to 3sf.
		2	

Question	Answer	Marks	Guidance
3(a)	$\{4\}\left\{\left(x+\frac{5}{4}\right)^2\right\}\left\{-\frac{1}{4}\right\}$	**B2,1,0**	B2 All 3 components correct, B1 Any 2 components correct. Allow $a=4,\ b=\frac{5}{4},\ c=-\frac{1}{4}$ unless contradicted by the algebraic expression. Allow decimals.
		2	
3(b)	$k=-\frac{1}{4}$ or -0.25 $\left(\text{allow } -\frac{1}{4} \text{ or } y=-\frac{1}{4}\right)$	**B1 FT**	Follow through *their c* from **3(a)**. Don't allow $x=-\frac{1}{4}$. If solved through restarting answer must be WWW.
		1	

Question	Answer	Marks	Guidance
4(a)	Arc Length $= \left(2\pi - \frac{1}{3}\pi\right) \times r \left[= \frac{5}{3}\pi r\right]$	**M1**	Finding the reflex angle AND using arc length formula or $2\pi r - r\left(\frac{1}{3}\pi\right)$.
	Perimeter $= \frac{5}{3}\pi r + 2r$ oe e.g. $2\pi r - \frac{1}{3}\pi r + 2r$	**A1**	Answer must be exact.
		2	
4(b)	$r\left(\frac{5\pi}{3} + 2\right) = 200$	**M1**	Equating *their* expression to 200 and attempting to solve (*their* expression must be linear).
	$r = 27.6[4]$ allow $r = \dfrac{200}{\frac{5\pi}{3} + 2}$ oe	**A1**	CAO
	Area of Rhombus $= 2\left(\frac{1}{2}\right)(27.64)^2 \sin\left(\frac{1}{3}\pi\right)(= 661.6)$ Or Area of segment $= \frac{1}{2}(27.64)^2\left(\frac{\pi}{3}\right) - \frac{1}{2}(27.64)^2 \sin\left(\frac{1}{3}\pi\right)$	**M1**	Using 2(0.5*ab* sin *C)* with $a = b = their\ r$ and $C = \frac{1}{3}\pi$ to get the area of the rhombus (or suitable other method), with *their* value of *r* which may be substituted later. Expect segment area = 400 – 330.8 = 69.2. Must be an attempt to find and use *r*.
	Area of Sector $= \left(\frac{1}{2}\right)(27.64)^2\left(\frac{5}{3}\pi\right)(= 2000)$ oe Or Total Area = Circle area – Segment area + Triangle area	**M1**	Using sector area formula with *their r* and $\frac{5}{3}\pi$, or complete method using the segment. Must be an attempt to find and use *r*.
	Total Area $= 2000 + 661.6 = 2660$ (3sf) Or Total area = 2400 – 69.2 + 330.8 = 2660 (3sf)	**A1**	CAO WWW AWRT 2660 (3sf).
		5	

Question	Answer	Marks	Guidance
5	$[x^6 - 28x^3 + 27 = 0] \to u^2 - 28u + 27[=0]$	**M1***	Multiply by x^3 and recognise as a quadratic in x^3.
	$\left[\left(x^3-1\right)\left(x^3-27\right)=0\right] \to (u-27)(u-1)[=0]$	**DM1**	Solve quadratic using suitable method. E.g. factorisation, quadratic formula, completing the square.
	$x = 1,\ 3$	**B1**	WWW
		3	
6(a)	$6\sin\theta + \dfrac{\cos\theta}{\sin\theta} = \dfrac{4}{\sin\theta} \Rightarrow 6\sin^2\theta + \cos\theta = 4$	**M1**	Using identity for $\tan\theta$ and multiplying through by $\sin\theta$.
	$6(1-\cos^2\theta) + \cos\theta = 4$	**M1**	Uses $\sin^2\theta + \cos^2\theta = 1$.
	$6\cos^2\theta - cos\theta - 2 = 0$	**A1**	AG Expands out and simplifies to give the answer.
		3	
6(b)	$(3\cos\theta - 2)(2\cos\theta + 1) = 0$	**M1**	Suitable method for solving quadratic.
	$\cos\theta = \dfrac{2}{3},\ \cos\theta = -\dfrac{1}{2}$	**B1**	Obtaining both values of $\cos\theta$.
	$\theta = 48.2,\ 120,\ 240,\ 311.8$	**B1**	Any 2 values of θ correct.
		B1	All 4 values of θ correct and no other values in the given range. **SC B1** All four answers in radians: 0.841, 2π/3, 4π/3, 5.44.
		4	

Question	Answer	Marks	Guidance
7(a)	$2\pi rh + \pi r^2 = 600\pi$ oe $\left[h = \dfrac{600\pi - \pi r^2}{2\pi r} = \dfrac{600 - r^2}{2r}\right]$	**M1***	Uses given info and correct formulae to form equation in h and r.
	$V = \dfrac{\left(600 - r^2\right)}{2r} \times \pi r^2$ oe	**DM1**	Sub *their* expression for h into $V = \pi r^2 h$.
	$= \dfrac{\pi r\left(600 - r^2\right)}{2}$	**A1**	AG CAO WWW
		3	
7(b)	$V = \dfrac{1}{2}\pi\left(600r - r^3\right)$ $\dfrac{\mathrm{d}V}{\mathrm{d}r} = \dfrac{1}{2}\pi\left(600 - 3r^2\right)$ or $\left(300\pi - \dfrac{3\pi r^2}{2}\right)$ **Alternative:** $h = r$ at max V, so $2\pi r(r) + \pi r^2 = 600\pi$ oe	**M1***	Differentiate given expression for V. Condone missing $\dfrac{1}{2}\pi$ (must be of form $a - br^2$).
	$600 - 3r^2 = 0$ **Alternative:** Solving $2\pi r(r) + \pi r^2 = 600\pi$	**DM1**	Equate their derivative to zero and attempt to solve as far as an equation of the form ‘ $r =$ ’.
	$r = 10\sqrt{2}$	**A1**	CAO (accept $\sqrt{200}$).
		3	
7(c)	$V = \dfrac{\pi}{2}\left(600\left(10\sqrt{2}\right) - \left(10\sqrt{2}\right)^3\right)$	**M1**	Sub *their* value of r from **7(b)** into the given expression for V, providing *their* value of $r > 0$ and gives $V > 0$.
	$8890(3\text{sf})$ Accept exact answer $2000\,\pi\sqrt{2}$	**A1**	AWRT 8890 (3sf).
		2	

Question	Answer	Marks	Guidance
8(a)	$V = \pi\int_a^{2a}(6x+5)[\mathrm{d}x]$	**B1**	CAO SOI Must include π and the correct limits.
	$=[\pi]\left\{3x^2+5x\right\}_a^{2a}$ or $=[\pi]\left\{\dfrac{(6x+5)^2}{12}\right\}_a^{2a}$	**M1***	Correct integral of $6x+5$ (can be awarded if π is missing and the limits are missing or incorrect).
	$=[\pi]\left(12a^2+10a-3a^2-5a\right)$ $[\geqslant 46\pi]$	**DM1**	Correct substitution of correct limits.
	$9a^2+5a-46\geqslant 0$	**A1**	AG Can only be awarded if the argument leading to the statement is complete and clear.
		4	
8(b)	Solve inequality (or equation)	**M1**	Solve quadratic by suitable method.
	Obtain $-\dfrac{23}{9}$, 2	**B1**	Condone absence of $-\dfrac{23}{9}$. Condone use of x.
	Final answer $a\geqslant 2$	**B1**	WWW Don't allow $x\geqslant 2$.
		3	

Question	Answer	Marks	Guidance
9(a)	$4 \times p^3 \times q$ or $6 \times p^2 \times q^2$	**M1**	Attempt to find either term in x or x^2 – must use binomial coefficients. May see x terms.
	$\frac{p}{q} = \frac{3}{2}$ oe	**DM1**	Equate coefficients and simplify to an equation equivalent to $2p = 3q$ (no x's should be present).
	$p : q = 3 : 2$	**A1**	Must be in this form only.
		3	
9(b)	$4p \times q^3 = 486$	**B1**	Set coefficient of the term in x^3 equal to 486. May include x^3 on both sides of the equation.
	$4 \times \frac{3q}{2} \times q^3 = 486$	**M1**	Substitute *their* **9(a)** equation, providing this is of the form $p = aq$ where a is positive and rational.
	$q^4 = 81 \Rightarrow q = 3,\ p = \frac{9}{2}$	**A1**	Solve for q (or p).
		A1	Solve for p and q with no negative answer. **SC B1** for answers without working.
		4	

Question	Answer	Marks	Guidance
10(a)	$4 = 3 + \frac{7}{a-2}$	**M1**	Forms an equation in a.
	$a = 9$	**A1**	Condone $x = 9$.
		2	
10(b)	Swap x and y and change the subject. This can be viewed as four stages: e.g. $x = 3 + \frac{7}{y-2}$, $x - 3 = \frac{7}{y-2}$, $y - 2 = \frac{7}{x-3}$, $y = 2 + \frac{7}{x-3}$ or $x = 3 + \frac{7}{y-2}$, $x(y-2) = 3y - 6 + 7$, $xy - 3y = 2x + 1$, $y = \frac{2x+1}{x-3}$	**M1**	Any two stages.
		M1	The other two stages. Condone one sign error present in the complete method. One algebraic slip would result in only one M1.
	$f^{-1}(x) = 2 + \frac{7}{x-3}$	**A1**	CAO $\left(\text{Could be written as } \frac{2x+1}{x-3}\right)$ Need to see '$f^{-1}(x) =$' or '$f^{-1} : x \rightarrow$', not just '$y =$'.
	Domain: $x > 3$	**B1**	Allow equivalent statement but must involve x.
		4	

Question	Answer	Marks	Guidance
10(c)	$\mathrm{fg}(x) \equiv 3 + \dfrac{7}{\left(\dfrac{1+4x}{2x-3}\right) - 2}$ **Alternative 1:** $\mathrm{g}(x) = \mathrm{f}^{-1}(kx) \to \dfrac{1+4x}{2x-3} = 2 + \dfrac{7}{kx-3}$	**B1**	Substitute $\mathrm{g}(x)$ into $\mathrm{f}(x)$.
	$3 + \dfrac{14x-21}{1+4x-4x+6}$ or $3 + \dfrac{7(2x-3)}{1+4x-2(2x-3)}$ oe **Alternative 1:** Clearly amending fractions to a linear equation to solve **Alternative 2:** Solve $3 + \dfrac{7}{\left(\dfrac{1+4x}{2x-3}\right) - 2} = kx$ to a linear equation	**M1**	Simplify to expression with no embedded fractions (working may be minimal).
	$3 + \dfrac{14x-21}{7} \equiv 2x$ or $k = 2$	**A1**	Cannot just state $k = 2$. Must have supporting algebra. Trying several values to establish $k = 2$ scores M0A0.
		3	

Question	Answer	Marks	Guidance
11(a)	$\dfrac{dy}{dx} = 8x - 3x^2$	**B1**	CAO
	$\dfrac{dy}{dx} = 24 - 27 = -3$ $[\text{when } x = 3]$	**B1**	
	$y = 9$ [when $x = 3$]	**B1**	SOI
	$y - 9 = -3(x - 3)$ or $y = -3x + c \rightarrow 9 = -9 + c \rightarrow c = 18$ oe	**M1**	Uses *their* y and *their* numerical $\dfrac{dy}{dx}$ to find equation of the tangent; condone one sign error.
	$y = -3x + 18$	**A1**	
		5	

Question	Answer	Marks	Guidance
11(b)	Area between curve and x-axis = $\int_3^4 (4x^2 - x^3)$ [dx] and attempt to integrate	**M1***	Must obtain $ax^3 + bx^4$ and indicate the limits 3 and 4.
	$= \left[\frac{4x^3}{3} - \frac{x^4}{4}\right]_3^4$	**A1**	**SC B1** for use of wrong or no limits (only for correct integral).
	$\left(\frac{256}{3} - 64\right) - \left(36 - \frac{81}{4}\right)$	**DM1**	Correct sub of correct limits (allow one slip). Minimum acceptable: $\frac{64}{3} - \frac{63}{4}$.
	$= \frac{67}{12}$	**A1**	SOI May be implied by a correct final answer if the two areas are combined. **SC B1** if substitution of the limits is not seen.
	Shaded region **=** $(6-3) \times \frac{9}{2} - \textit{their}\ \frac{67}{12}$ or $\left[\frac{-3x^3}{2} + 18x\right]_3^6 - \textit{their}\ \frac{67}{12}$	**DM1**	Expect $\frac{27}{2}$ – '*their* integral', but must be 'area under *their* line' minus '*their* area under the curve', where '*their* integral' is an attempt at the area under the curve between $x=3$ and $x=4$. May use the lengths from *their* tangent equation.
	$= \frac{95}{12}$ any equivalent exact answer	**A1**	Calculating area of triangle – (correct) area under the curve.

Question	Answer	Marks	Guidance
11(b)	**Alternative Method for Question 11(b):**		
	Finds area between curve and tangent between $x=3$ and $x=4$ $\int_3^4 (-3x+18)-(4x^2-x^3)\mathrm{d}x$	**M1***	Integrate at least two of the four terms correctly. Area under the line could be found from the trapezium area $\frac{(4-3)}{2}(9+6)$.
	$=\left[-\frac{3x^2}{2}+18x-\frac{4x^3}{3}+\frac{x^4}{4}\right]_3^4$	**A1**	Integrating all four terms correctly. **SC B1** for the correct integral $\pm\left(-\frac{4x^3}{3}+\frac{x^4}{4}\right)$.
	$=\left(-24+72-\frac{256}{3}+64\right)-\left(-\frac{27}{2}+54-36+\frac{81}{4}\right)$	**DM1**	Correct sub of limits (allow one slip).
	$=\frac{23}{12}$	**A1**	SOI **SC B1** if substitution of the limits is not seen.
	Shaded region = $(6-4)\times 6\times\frac{1}{2}+\frac{23}{12}$	**DM1**	Calculating area of triangle between $x=4$ and $x=6$ + *their* area, providing limits of 3 and 4 are used to find the area between the curve and the tangent.
	$=\frac{95}{12}$	**A1**	Must be exact.
		6	

Question	Answer	Marks	Guidance
11(c)(i)	$y = 36x^2 - 27x^3$ or state $m = 36, n = -27$	**B1**	CAO (must be expanded)
		1	
11(c)(ii)	$Q(1, 9)$	**B1**	CAO coordinates of Q.
	Area $= \frac{95}{36}$	**B1 FT**	$\frac{1}{3}$ of *their* area from **11(b)**. Allow 2.64.
		2	

