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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

9709 MATHEMATICS

9709/02 Paper 2, maximum raw mark 50

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2008 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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Mark Scheme Notes

Marks are of the following three types:

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.

- 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 (or dep*) 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.

- The symbol √ 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 and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.

- Note: B2 or A2 means that the candidate can earn 2 or 0.
  B2/1/0 means that the candidate can earn anything from 0 to 2.

  The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

- For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking *g* equal to 9.8 or 9.81 instead of 10.

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The following abbreviations may be used in a mark scheme or used on the scripts:

AEF Any Equivalent Form (of answer is equally acceptable)

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

BOD Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)

CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)

CWO Correct Working Only - often written by a 'fortuitous' answer

ISW Ignore Subsequent Working

MR Misread

PA Premature Approximation (resulting in basically correct work that is insufficiently accurate)

SOS See Other Solution (the candidate makes a better attempt at the same question)

SR Special Ruling (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)

Penalties

MR -1 A penalty of MR -1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures - this is regarded as an error in accuracy. An MR-2 penalty may be applied in particular cases if agreed at the coordination meeting.

PA -1 This is deducted from A or B marks in the case of premature approximation. The PA -1 penalty is usually discussed at the meeting.

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1	**EITHER**	State or imply non-modular inequality $(3x-1)^2 < 2^2$, or corresponding equation or pair of linear equations	M1	
		Obtain critical values $-\frac{1}{3}$ and 1	A1	
		State correct answer $-\frac{1}{3} < x < 1$	A1	
	OR	State one critical value, e.g. $x = 1$, by solving a linear equation (or inequality) or from a graphical method or by inspection	B1	
		State the other critical value correctly	B1	
		State correct answer $-\frac{1}{3} < x < 1$	B1	[3]
2		Use law for the logarithm of a product, a quotient or a power	M1*	
		Obtain $x\ln 4 = \ln 2 + x\ln 3$, or equivalent	A1	
		Solve for x	M1 (dep*)	
		Obtain answer $x = 2.41$	A1	[4]
3		Obtain integral $\frac{1}{2}\sin 2x - \cos x$	B1 + B1	
		Substitute limits correctly in an integral of the form $a \sin 2x + b \cos x$	M1	
		Use correct exact values, e.g. of $\cos\left(\frac{1}{6}\pi\right)$	M1	
		Obtain answer $1 - \frac{1}{4}\sqrt{3}$, or equivalent	A1	[5]
4		Substitute $x = -1$, equate to zero and obtain a correct equation in any form	B1	
		Substitute $x = -2$ and equate to 5	M1	
		Obtain a correct equation in any form	A1	
		Solve a relevant pair of equations for a or for b	M1	
		Obtain $a = 2$ and $b = -3$	A1	[5]
5	**(i)**	State $R = \sqrt{26}$	B1	
		Use trig formula to find a	M1	
		Obtain $\alpha = 11.31°$ with no errors seen	A1	[3]
	(ii)	Carry out evaluation of $\cos^{-1}\left(\frac{4}{\sqrt{26}}\right)$ ($\approx 38.3288\ldots°$)	M1	
		Obtain answer 27.0°	A1	
		Carry out correct method for second answer	M1	
		Obtain answer 310.4° and no others in the range	A1√	[4]
		[Ignore answers outside the given range.]		
6	**(i)**	Use product rule	M1*	
		Obtain correct derivative in any form, e.g. $(x-1)e^x$	A1	
		Equate derivative to zero and solve for x	M1* (dep)	
		Obtain $x = 1$	A1	
		Obtain $y = -e$	A1	[5]
	(ii)	Carry out a method for determining the nature of a stationary point	M1	
		Show that the point is a minimum point, with no errors seen	A1	[2]

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7	(i)	State $2y\dfrac{dy}{dx}$ as derivative of y^2, or equivalent	B1	
		State $4y + 4x\dfrac{dy}{dx}$ as derivative of $4xy$, or equivalent	B1	
		Equate derivative of LHS to zero and solve for $\dfrac{dy}{dx}$	M1	
		Obtain given answer correctly	A1	[4]
		[The M1 is dependent on at least one of the B marks being obtained.]		
	(ii)	State or imply that the coordinates satisfy $2y - x = 0$	B1	
		Obtain an equation in x^2 (or y^2)	M1	
		Solve and obtain $x^2 = 4$ (or $y^2 = 1$)	A1	
		State answer (2, 1)	A1	
		State answer (–2, –1)	A1	[5]
8	(i)	Obtain terms $\frac{1}{2}x^2$ and $\ln x$	B1 + B1	
		Substitute limits correctly	M1	
		Obtain correct equation in any form, e.g. $\frac{1}{2}a^2 + \ln a - \frac{1}{2} = 6$	A1	
		Obtain given answer correctly	A1	[5]
	(ii)	Consider sign of $a - \sqrt{(13 - 2\ln a)}$ at $a = 3$ and $a = 3.5$, or equivalent	M1	
		Complete the argument correctly with correct calculations	A1	[2]
	(iii)	Use the iterative formula correctly at least once	M1	
		Obtain final answer 3.26	A1	
		Show sufficient iterations to justify its accuracy to 2 d.p. or show there is a sign change in the interval (3.255, 3.265)	B1	[3]

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