UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the November 2004 question paper

9709 MATHEMATICS

9709/02

Paper 2, maximum raw mark 50

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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 discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the November 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.



Grade thresholds taken for Syllabus 9709 (Mathematics) in the November 2004 examination.

	maximum	minimum mark required for grade:			
	mark available	A	В	E	
Component 2	50	33	29	15	

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.



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.



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.



November 2004

GCE AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/02

MATHEMATICS Paper 2 (Pure Mathematics 2)



	Page '	1	Mark Scheme	Syllabus	Paper
			AS LEVEL – NOVEMBER 2004	9709	2
1			<i>IER:</i> State or imply non-modular inequality $(x + 1)^2 >$ Iratic equation or linear equation $x + 1 = -x$	x^2 or corre	esponding
			Obtain critical value $-\frac{1}{2}$		
			State answer $x > -\frac{1}{2}$		
	(OR:	Obtain critical value $-\frac{1}{2}$ by solving a linear inequ	quality or b	у
			graphical method or inspection		
			State answer $x > -\frac{1}{2}$		
	[[For	$2x + 1 > 0, x > + \frac{1}{2}$, or similar reasonable method]		
2		العم	logarithms to obtain an equation in ln <i>x</i>		
2			in ln x = $\frac{\ln 11}{(3.9-3.2)}$, or equivalent		
			()		
	(Obta	in answer <i>x</i> = 31 (accept 30.7, 30.74)		
3		At ar	ny stage, state answer $x = 90^{\circ}$ (c.w.o)		
	١	Write	e the equation in the form $6\sin x \cos x = \cos x$		
			ove factor of $\cos x$ and solve an equation in $\sin x$ for x		
			in answer $x = 9.59^{\circ}$ and no others in the range (9.6° C ore answers outside the given range.)	rk. rudne)	
4	ę	State	e or obtain 16 – 20 + 2 <i>a</i> + <i>b</i> = 0		
			stitute $x = -1$ and equate to -6		
			in a 3-term equation in any correct form e a relevant pair of equations, obtaining <i>a</i> or <i>b</i>		
			in $a = 1$ and $b = 2$		
5 (i) (Use	the product rule to obtain the first derivative (must invo	olve 2 terms	s)
- (in derivative $2x \ln x + x^2 \frac{1}{x}$ or equivalent		- /
			ate derivative to zero and solve for x		
		-			
	·	ODIE	in answer $x = e^{-0.5}$ or $\frac{1}{\sqrt{e}}$ or equivalent (e.g. 0.61)		
(rmine nature of stationary point using correct second of		
			2Inx) or correct first derivative or equation of the curve values, central one y(exp (– 0.5))		
			v point is a minimum completely correctly		
6 (i) I	Mak	e recognisable sketch of an appropriate trig curve, e.g.	$y = \cot x$,	
•			$< \chi < \frac{1}{2}\pi$	·	
			2 ch the appropriate second curve e.g. <i>y</i> = <i>x</i> correctly an	nd justify the	e
			n statement		-

Pag	e 2	Mark Scheme Sy	llabus	Paper	
		AS LEVEL – NOVEMBER 2004	9709	2	
(ii)	Con	sider sign of cot $x - x$ at $x = 0.8$ and $x = 0.9$, or equivalent			M1
()		plete the argument correctly with appropriate calculations			A1
(iii)	Shov	w, using $\cot x = \frac{1}{\tan x}$, that $\cot x = x$ is equivalent to $x = \arctan x$	$\operatorname{ctan}\left(\frac{1}{2}\right)$		
. ,			(\mathbf{x})		D 4
	(or v	ice versa)			B1
(iv)	Use	the iterative formula correctly at least once			M1
. ,	Obta	ain final answer 0.86			A1
		w sufficient iterations to justify its accuracy to 2 decimal pl	aces, or	show	D 4
	that	there is a sign change in (0.855, 0.865)			B1
(i)	State	e coordinates (0, 5)			B1
(ii)	State	e first derivative of the form $k e^{x} + m e^{-2x}$, where $km \neq 0$			M1
(")		ain correct first derivative 2 $e^x - 6 e^{-2x}$			A1
		stitute $x = 0$, obtaining gradient of -4			A1v
		n equation of line through A with this gradient (NOT the no	ormal)		M1
		ain equation in any correct form e.g. $y - 5 = -4x$			A1
	Obla	ain coordinates (1.25, 0) or equivalent			A1
(iii)	Intec	grate and obtain 2 $e^x - \frac{3}{2}e^{-2x}$, or equivalent		B1 ·	+ B1
()		E E			
		limits $x = 0$ and $x = 1$ correctly ain answer 4.7			M1 A1
(1)	01-1				D4
(i)		e answer $R = \sqrt{2}$ trigonometric formulae to find α			В1 М1
	Obta	ain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}$ ° somewhere	re, later)		A1
		_ 1			
(ii)	Use	$\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer	r		B1
(iii)		rentiate using the quotient or product rule			M1 A1
		ain derivative in any correct form ain the given answer correctly			A1
(iv)	Conv	vert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$			B1
. ,		• 2			
	Integ	grate, to obtain function $\frac{1}{2}$ tan ($\theta - \frac{\pi}{4}$)			M1
	Subs	stitute (correct) limits correctly, to obtain given result			A1