UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9709 MATHEMATICS

9709/21

Paper 21, 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, which would have considered the acceptability of alternative answers.

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 2010 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



UNIVERSITY of CAMBRIDGE International Examinations

Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9709	21

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.

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9709	21

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.

	Page 4		Mark Scheme: Teachers' version Syllabus		Paper	
			GCE AS/A LEVEL – May/June 2010	9709	21	
1	o C		te or imply non-modular inequality $(2x - 3)^2 > 5^2$, or correspair of linear equations tain critical values -1 and 4 te correct answer $x < -1$, $x > 4$	ponding equation	M1 A1 A1	
	OR	or f Sta	te one critical value, e.g. $x = 4$, having solved a linear equation from a graphical method or by inspection te the other critical value correctly te correct answer $x < -1$, $x > 4$	ion (or inequality)	B1 B1 B1	[3]
2	Sub Use	btain integral $ln(x + 2)$ abstitute correct limits correctly se law for the logarithm of a product, a quotient or a power btain given answer following full and correct working			B1 M1 M1 A1	[4]
3	(i)	Use tan 45	$(\pm B)$ formula to obtain an equation in tan x $5^{\circ} = 1$ and obtain a correct equation in any form e given equation correctly		M1 A1 A1	[3]
	(ii)	Obtain a o Obtain se	given quadratic in $\tan x$ and evaluate an inverse tangent correct answer, e.g. 18.4° cond answer, e.g. 26.6° , and no others in the given interval giving of answers in radians as a misread. Ignore answers of	outside the given into	M1 A1 A1 erval.]	[3]
4	(i)	Obtain qu Obtain ren	the division by $x^2 + x - 1$ obtaining quotient of the form $x + k$ notient $x + 2$ mainder $3x + 4$ the quotient and remainder correctly		M1 A1 A1 A1√	[4]
	(ii)	Substitute Obtain an	x = -1 and evaluate expression swer 0		M1 A1	[2]
5	(i)	Substitute	nply $2^{-x} = \frac{1}{y}$, or $2^{-x} = y^{-1}$ e and obtain a 3-term quadratic in y e given answer correctly		B1 M1 A1	[3]
	(ii)	$2^x = a$, wh Obtain an	given quadratic and carry out correct method for solving an here $a > 0$ swer $x = 1.58$ or 1.585 swer $x = 0$	equation of the form	m M1 A1 B1	[3]

	Page 5		Mark Scheme: Teachers' version	Syllabus	Paper	•
			GCE AS/A LEVEL – May/June 2010	9709	21	
6 (i)		State 2xy	$+x^2 \frac{\mathrm{d}y}{\mathrm{d}x}$ as derivative of x^2y		B1	
		State $2y = \frac{1}{2}$	$\frac{dy}{dx}$ as derivative of y^2		B1	
		Equate de	privatives of LHS and RHS, and solve for $\frac{dy}{dx}$		M1	
		Obtain gi	ven answer		A1	[4]
	(ii)		e and obtain gradient $\frac{2}{5}$, or equivalent		B1	
		Obtain an	ation of tangent at the given point $(1, 2)$ swer $2x - 5y + 8 = 0$, or equivalent is dependent on at least one of the B marks being obtained.]		M1 A1	[3]
7	(i)		ecognisable sketch of a relevant graph, e.g. $y = 2 - x$ appropriate second graph, e.g. $y = e^{2x}$, and justify the given	statement	B1 B1	[2]
	(ii)		sign of $e^{2x} - (2 - x)$ at $x = 0$ and $x = 0.5$, or equivalent the argument correctly with correct calculations		M1 A1	[2]
	(iii)	Show that	t $e^{2x} = 2 - x$ is equivalent to $x = \frac{1}{2} \ln(2 - x)$, or vice versa		B1	[1]
	(iv)	Use the it	erative formula correctly at least once		M1	
		Obtain fir	nal answer 0.27	no in o sign alternat	A1	
			ficient iterations to justify its accuracy to 2 d.p., or show the erval (0.265, 0.275)	re is a sign change	A1	[3]
8	(i)	Use quoti	ent rule		M1	
			rrect derivative in any form ven result correctly		A1 A1	[3]
	(ii)		$x \equiv -1 + \cos ec^2 x$, or equivalent		B1	
			tegral $-x - \cot x$ (f.t. on signs in the identity) e correct limits correctly		B1√ M1	
			ven answer		A1	[4]
	(iii)	Use trig f	formulae to convert integrand to $\frac{1}{k \sin^2 x}$ where $k = \pm 2$, or ± 2	1	M1	
			ven answer $\frac{1}{2} \csc^2 x$ correctly		A1	
		Obtain an	swer $-\frac{1}{2}\cot x + c$, or equivalent		B1	[3]