

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

MARK SCHEME for the May/June 2009 question paper
for the guidance of teachers

9709/02

9709 MATHEMATICS

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, 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 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2009	9709	02

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 \surd 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 A/AS LEVEL – May/June 2009	9709	02

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 \surd " 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 A/AS LEVEL – May/June 2009	9709	02
1	Use logarithms to linearise an equation		M1
	Obtain $\frac{x}{y} = \frac{\ln 2.5}{\ln 1.25}$, or equivalent		A1
	Obtain answer 4.11		A1√ [3]
2	<i>EITHER</i> : State or imply non-modular inequality $(3x + 2)^2 < x^2$, or corresponding quadratic equation, or pair of linear equations $3x + 2 = \pm x$		M1
	Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations		M1
	Obtain critical values $x = -1$ and $x = -\frac{1}{2}$		A1
	State answer $-1 < x < -\frac{1}{2}$		A1
	<i>OR</i> : Obtain the critical value $x = -1$ from a graphical method or by inspection, or by solving a linear equation or inequality		B1
	Obtain the critical value $x = -\frac{1}{2}$ similarly		B2
	State answer $-1 < x < -\frac{1}{2}$		B1 [4]
3	(i) Show or imply correct ordinates 1, 0.5, 0.414213 ...		B1
	Use correct formula, or equivalent, with $h = 1$ and three ordinates		M1
	Obtain answer 1.21 with no errors seen		A1 [3]
	(ii) Justify the statement that the rule gives an over-estimate		B1 [1]
4	State $\frac{dx}{d\theta} = 4 \cos \theta$		B1
	State $\frac{dy}{d\theta} = 4 \sin 2\theta$, or equivalent		B1
	Use $\frac{dy}{dx} = \frac{dy}{d\theta} \div \frac{dx}{d\theta}$		M1
	Obtain $\frac{dy}{dx}$ in any correct form, e.g. $\frac{\sin 2\theta}{\cos \theta}$		A1
	Simplify and obtain answer $2 \sin \theta$		A1√ [5]
	[The f.t. is on gradients of the form $k \sin 2\theta / \cos \theta$, or equivalent.]		
5	Use $\tan^2 x = \sec^2 x - 1$ or $\sin^2 x = 1 - \cos^2 x$		M1
	Obtain 3-term quadratic in $\sec x$ or $\cos x$, e.g. $2\sec^2 x + \sec x - 6 = 0$		A1
	Make reasonable solution attempt at a 3-term quadratic		M1
	Obtain $\sec x = \frac{3}{2}$ and $\sec x = -2$, or equivalent		A1
	[or $6\cos^2 x - \cos x - 2 = 0$ $\cos x = \frac{2}{3}, -\frac{1}{2}$]		
	Obtain answer $x = 48.2^\circ$		A1
	Obtain answer $x = 120^\circ$ and no others in the range		A1 [6]
	[Ignore answers outside the given range.]		

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2009	9709	02

- 6 (i) Substitute $x = 2$, equate to zero and state a correct equation, e.g. $8 + 4a + 2b + 6 = 0$ B1
 Substitute $x = 1$ and equate to 4 M1
 Obtain a correct equation. e.g. $1 + a + b + 6 = 4$ A1
 Solve for a or for b M1
 Obtain $a = -4$ and $b = 1$ A1 [5]
- (ii) EITHER: Attempt division by $x - 2$ reaching a partial quotient of $x^2 + kx$ M1
 Obtain remainder quadratic factor $x^2 - 2x - 3$ A1
 State linear factors $(x - 3)$ and $(x + 1)$ A1
 OR: Obtain linear factor $(x + 1)$ by inspection B1
 Obtain factor $(x - 3)$ similarly B2 [3]
- 7 (i) Use product rule M1*
 Obtain derivative in any correct form A1
 Equate derivative to zero and solve for x M1(dep*)
 Obtain answer $x = -\frac{1}{2}$ correctly A1
 Obtain $y = -1/(2e)$ or exact equivalent A1 [5]
- (ii) Show that $20 = xe^{2x}$ is equivalent to $x = \frac{1}{2} \ln(20/x)$ or vice versa B1 [1]
- (iii) Use the iterative formula correctly at least once M1
 Obtain final answer 1.35 A1
 Show sufficient iterations to justify its accuracy to 2 d.p. A1 [3]
- 8 (a) State derivative is $k/(3x - 2)$ where $k = 3.1$, or $\frac{1}{3}$ M1
 State correct derivative $3/(3x - 2)$ A1
 Form the equation of the tangent at the point where $x = 1$ M1
 Obtain answer $y = 3x - 3$, or equivalent A1 [4]
- (b) (i) Carry out a complete method for finding A M1
 Obtain $A = 4$ A1 [2]
- (ii) Integrate and obtain term $2x$ B1
 Obtain second term of the form $a \ln(3x - 2)$ M1
 Obtain second term $\frac{4}{3} \ln(3x - 2)$ A1√
 Substitute limits correctly M1
 Obtain given answer following full and correct working A1 [5]