

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

## **MARK SCHEME for the May/June 2008 question paper**

**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.

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  $\surd$  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.

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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 $\surd$ " 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.

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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  $\alpha = 11.31^\circ$  with no errors seen A1 [3]
- (ii)** Carry out evaluation of  $\cos^{-1}\left(\frac{4}{\sqrt{26}}\right) (\approx 38.3288\dots^\circ)$  M1  
Obtain answer  $27.0^\circ$  A1  
Carry out correct method for second answer M1  
Obtain answer  $310.4^\circ$  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  $2y \frac{dy}{dx}$  as derivative of  $y^2$ , or equivalent B1
- State  $4y + 4x \frac{dy}{dx}$  as derivative of  $4xy$ , or equivalent B1
- Equate derivative of LHS to zero and solve for  $\frac{dy}{dx}$  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]