

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level
Advanced International Certificate of Education

MARK SCHEME for the June 2004 question papers

9709 MATHEMATICS

9709/01	Paper 1 (Pure 1), maximum raw mark 75
9709/02	Paper 2 (Pure 2), maximum raw mark 50
9709/03, 8719/03	Paper 3 (Pure 3), maximum raw mark 75
9709/04	Paper 4 (Mechanics 1), maximum raw mark 50
9709/05, 8719/05	Paper 5 (Mechanics 2), maximum raw mark 50
9709/06, 0390/06	Paper 6 (Probability and Statistics 1), maximum raw mark 50
9709/07, 8719/07	Paper 7 (Probability and Statistics 2), maximum raw mark 50

These mark schemes are published as an aid to teachers and students, to indicate the requirements of the examination. They show the basis on which Examiners were initially instructed to award marks. They do 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 June 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.



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

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 1	75	63	56	31
Component 2	50	37	33	18
Component 3	75	61	55	29
Component 4	50	38	34	18
Component 5	50	36	32	17
Component 6	50	38	34	19
Component 7	50	42	37	22

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 $\surd$ 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.

- 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 $\sqrt{}$ " 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.

June 2004

GCE A AND AS LEVEL

MARK SCHEME

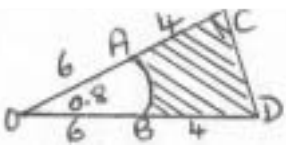
MAXIMUM MARK: 75

SYLLABUS/COMPONENT: 9709/01

**MATHEMATICS
Paper 1 (Pure 1)**



Page 1	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2004	9709	1

1. (i) $a/(1-r) = 256$ and $a = 64$ $\rightarrow r = \frac{3}{4}$ (ii) $S_{10} = 64(1-0.75^{10}) / (1-0.75)$ $\rightarrow S_{10} = 242$	M1 A1 [2] M1 A1 [2]	Use of correct formula Correct only Use of correct formula – 0.75^{10} not 0.75^9 Correct only
2. $\int_0^1 \sqrt{3x+1} dx = (3x+1)^{1.5} \div 1.5$ then 3 $\rightarrow []$ at 1 – $[]$ at 0 $\rightarrow 16/9 - 2/9 = 14/9$ or 1.56	B1 M1 M1 A1 [4]	MI for $(3x+1)^{1.5} \div 1.5$ For division by 3 Must attempt $[]$ at $x=0$ (not assume it is 0) and be using an integrated function Fraction or decimal. (1.56+C loses this A1)
3. (i) $\sin^2 \theta + 3\sin \theta \cos \theta = 4\cos^2 \theta$ divides by $\cos^2 \theta$ $\rightarrow \tan^2 \theta + 3\tan \theta = 4$ (ii) Solution $\tan \theta = 1$ or $\tan \theta = -4$ $\rightarrow \theta = 45^\circ$ or 104.0°	M1 A1 [2] M1 A1 A1 [3]	Knowing to divide by $\cos^2 \theta$ Correct quadratic (not nec = 0) Correct solution of quadratic = 0 Correct only for each one.
4. (i) Coeff of $x^3 = 6C3 \times 2^3$ $= 160$ (ii) Term in $x^2 = 6C2 \times 2^2 = 60$ reqd coeff = $1 \times (i) - 3 \times 60$ $\rightarrow -20$	B1 B1 B1 [3] B1 M1 A1 [3]	B1 for $6C3$ B1 for 2^3 B1 for 160 B1 for 60 (could be given in (i)) Needs to consider 2 terms co
5.  (i) Area of sector = $\frac{1}{2} 6^2 0.8$ (14.4) Area of triangle = $\frac{1}{2} \cdot 10^2 \cdot \sin 0.8$ (35.9) $\rightarrow$ Shaded area = 21.5 (ii) Arc length = 6×0.8 (4.8) CD (by cos rule) or $2 \times 10 \sin 0.4$ (7.8) $\rightarrow$ Perimeter = $8 + 4.8 + 7.8 = 20.6$	M1 M1 A1 [3] M1 M1 A1 A1 [4]	Use of $\frac{1}{2}r^2\theta$ with radians Use of $\frac{1}{2}ab\sin C$ or $\frac{1}{2}bh$ with trig Correct only Use of $s=r\theta$ with radians Any correct method – allow if in (i) Correct only

Page 2	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2004	9709	1

6. (i) eliminates x (or y) completely $\rightarrow x^2+x-6=0$ or $y^2-17y+66=0$ Solution of quadratic = 0 $\rightarrow (2, 6)$ and $(-3, 11)$ (ii) Midpoint = $(-\frac{1}{2}, 8\frac{1}{2})$ Gradient of line = -1 Gradient of perpendicular = 1 $\rightarrow y - 8\frac{1}{2} = 1(x + \frac{1}{2})$ (or $y = x + 9$)	M1 A1 DM1 A1 [4] B1 ✓ M1 M1 A1 [4]	Needs x or y removed completely Correct only (no need for = 0) Equation must = 0. Everything ok. For his two points in (i) Use of y-step x-step (beware fortuitous) Use of $m_1m_2 = -1$ Any form – needs the M marks.
7. (i) Differentiate $y=18/x \rightarrow -18x^{-2}$ Gradient of tangent = $-\frac{1}{2}$ Gradient of normal = 2 Eqn of normal $y-3 = 2(x-6)$ $(y=2x-9)$ If $y = 0$, $x = 4\frac{1}{2}$ (ii) $\text{Vol} = \pi \int_{x^2}^{324} dx = \pi[-324x^{-1}]$. Uses value at $x=6$ – value at $x= 4.5$ $-54\pi - -72\pi = 18\pi$	M1 A1 DM1 DM1 A1 [5] M1 A1 DM1 A1 [4]	Any attempt at differentiation For $-\frac{1}{2}$ Use of $m_1m_2 = -1$ Correct method for eqn of line Ans given – beware fortuitous answers. Use of $\int y^2 dx$ for M. correct(needs π) for A Use of 6 and 4.5 Beware fortuitous answers (ans given)
8. (i) $2h + 2r + \pi r = 8$ $\rightarrow h = 4 - r - \frac{1}{2}\pi r$  (ii) $A=2rh+\frac{1}{2}\pi r^2 \rightarrow A = r(8-2r-\pi r) + \frac{1}{2}\pi r^2$ $\rightarrow A = 8r - 2r^2 - \frac{1}{2}\pi r^2$ (iii) $dA/dr = 8 - 4r - \pi r$ $= 0$ when $r = 1.12$ (or $8/(4+\pi)$) (iv) $d^2A/dr^2 = -4 - \pi$ This is negative $\rightarrow$ Maximum	M1 A1 [2] M1 A1 M1 A1 DM1 A1 [4] M1 A1 [2]	Reasonable attempt at linking 4 lengths + correct formula for $\frac{1}{2}C$ or C. Co in any form with h subject. Adds rectangle + $\frac{1}{2}x$circle (eqn on own ok) Co beware fortuitous answers (ans given) Knowing to differentiate + some attempt Setting his dA/dr to 0. Decimal or exact ok. Looks at 2nd differential or other valid complete method. Correct deduction but needs d^2A/dr^2 correct.

Page 3	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2004	9709	1

9. $\vec{OA} = \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix}, \vec{OB} = \begin{pmatrix} 3 \\ -1 \\ 3 \end{pmatrix}, \vec{OC} = \begin{pmatrix} 4 \\ 2 \\ p \end{pmatrix}, \vec{OD} = \begin{pmatrix} -1 \\ 0 \\ q \end{pmatrix}$ (i) $\vec{AB} = \mathbf{b} - \mathbf{a} = 2\mathbf{i} - 4\mathbf{j} + 4\mathbf{k}$ Unit vector = $(2\mathbf{i} - 4\mathbf{j} + 4\mathbf{k}) / \sqrt{2^2 + 4^2 + 4^2}$ $= \pm (2\mathbf{i} - 4\mathbf{j} + 4\mathbf{k}) / 6$ (ii) $\vec{OA} \cdot \vec{OC} = 4 + 6 - p$ $= 0$ for 90° $\rightarrow p = 10$ (iii) $(-2)^2 + 3^2 + (q+1)^2 = 7^2$ $\rightarrow (q+1)^2 = 36$ or $q^2 + 2q = 35$ $q = 5$ and $q = -7$	M1 M1 A1 [3] M1 DM1 A1 [3] M1 A1 DM1 A1 or B1 B1 [4]	Condone notation throughout. Allow column vectors or $\mathbf{i}, \mathbf{j}, \mathbf{k}$ throughout Use of $\mathbf{b} - \mathbf{a}$, rather than $\mathbf{b} + \mathbf{a}$ or $\mathbf{a} - \mathbf{b}$ Dividing by the modulus of "his" $\vec{AB}$ Co (allow – for candidates using $\mathbf{a} - \mathbf{b}$) Use of $x_1x_2 + y_1y_2 + z_1z_2$ Setting to 0 + attempt to solve co Correct method for length with $\pm \mathbf{d} - \mathbf{a}, \mathbf{d} + \mathbf{a}$ Correct quadratic equation Correct method of solution. Both correct. Or B1 for each if $(q+1)^2 = 36, q=5$ only.
10. $f: x \mapsto x^2 - 2x, \quad g: x \mapsto 2x + 3$ (i) $x^2 - 2x - 15 = 0$ End-points -3 and 5 $\rightarrow x < -3$ and $x > 5$ (ii) Uses $dy/dx = 2x - 2 = 0$ or $(x-1)^2 - 1$ Minimum at $x = 1$ or correct form Range of y is $f(x) \geq -1$ No inverse since not 1 : 1 (or equivalent) (iii) $gf(x) = 2(x^2 - 2x) + 3 \quad (2x^2 - 4x + 3)$ $b^2 - 4ac = 16 - 24 = -8 \rightarrow -ve$ $\rightarrow$ No real solutions. [or $gf(x) = 0 \rightarrow f(x) = -3/2$. Imposs from (ii)] (iv) $y = 2x + 3$ correct line on diagram Either inverse as mirror image in $y=x$ or $y = g^{-1}(x) = \frac{1}{2}(x-3)$ drawn	M1 A1 A1 [3] M1 A1 A1 [4] M1 M1 A1 [3] B2,1,0 [2]	Equation set to 0 and solved. Correct end-points, however used Co-inequalities – not $\leq$ or $\geq$ Any valid complete method for x value Correct only Correct for his value of "x" – must be $\geq$ Any valid statement. Must be gf not fg – for unsimplified ans. Used on quadratic=0, even if fg used. Must be using gf and correct assumption and statement needed. 3 things needed – B1 if one missing. • g correct, • g^{-1} correct – not parallel to g • $y=x$ drawn or statement re symmetry
DM1 for quadratic equation. Equation must be set to 0. Formula $\rightarrow$ must be correct and correctly used – allow for numerical errors though in b^2 and $-4ac$. Factors $\rightarrow$ attempt to find 2 brackets. Each bracket then solved to 0.		