

CAMBRIDGE INTERNATIONAL EXAMINATIONS

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

MARK SCHEME for the November 2003 question papers

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 discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the November 2003 question papers for most IGCSE and GCE Advanced 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 $\sqrt{}$ " 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.

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE A AND AS LEVEL

MARK SCHEME

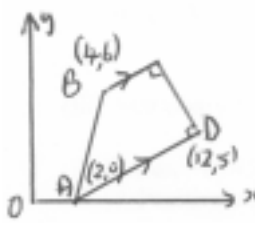
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SYLLABUS/COMPONENT: 9709/01

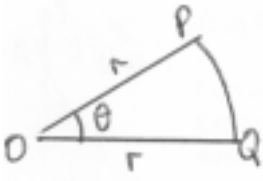
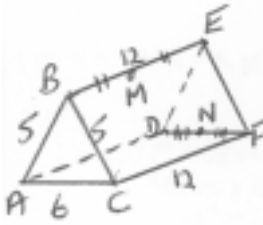
MATHEMATICS
Pure Mathematics : Paper One



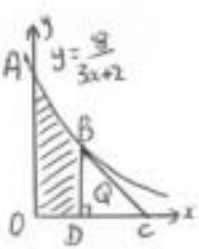
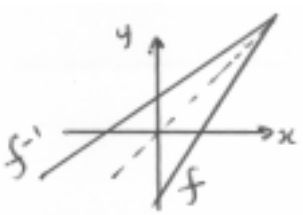
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1	$x(11-2x) = 12$ $2x^2 - 11x + 12 = 0$ Solution of quadratic $\rightarrow (1\frac{1}{2}, 8)$ and $(4, 3)$	M1 A1 DM1 A1 [4]	Complete elimination of x, or of y. Correct quadratic. (or $y^2 - 11y + 24 = 0$) Correct method of solution $\rightarrow$ 2 values All correct (guesswork or TI B1 for one pair of values, full marks for both)
2	(i) $4s^4 + 5 = 7(1-s^2) \rightarrow 4x^2 + 7x - 2 = 0$ (ii) $4s^4 + 7s^2 - 2 = 0$ $\rightarrow s^2 = \frac{1}{4}$ or $s^2 = -2$ $\rightarrow \sin\theta = \pm\frac{1}{2}$ $\rightarrow \theta = 30^\circ$ and 150° and $\theta = 210^\circ$ and 330°	B1 [1] M1 A1A1✓ A1✓ [4]	Use of $s^2 + c^2 = 1$. Answer given. Recognition of quadratic in s^2 Co. For 180° - "his value" For other 2 answers from "his value", providing no extra answers in the range or answers from $s^2 = -1$
3	(a) $a=60, n=48, S_n=3726$ S_n formula used $\rightarrow d = \$0.75$ 3^{rd} term $= a + 2d = \$61.50$ (b) $a=6, ar=4 \therefore r=\frac{2}{3}$ $S_\infty = a/(1-r) = 18$	M1 A1 A1✓ [3] M1 M1A1 [3]	Correct formula (M0 if nth term used) Co Use of $a+2d$ with his d. 61.5 ok. a, ar correct, and r evaluated Correct formula used, but needs $r < 1$ for M mark
4	(i) $y = x^3 - 2x^2 + x (+c)$ $(1, 5)$ used to give $c = 5$ (ii) $3x^2 - 4x + 1 > 0$ $\rightarrow$ end values of 1 and $\frac{1}{3}$ $\rightarrow x < \frac{1}{3}$ and $x > 1$	B2, 1, 0 B1✓ [3] M1 A1 A1 [3]	Co - unsimplified ok. Must have integrated + use of $x=1$ and $y=5$ for c Set to 0 and attempt to solve. Co for end values – even if $<, >, =$, etc Co (allow $\leq$ and $\geq$). Allow $1 < x < \frac{1}{3}$
5	 (i) m of BC $= \frac{1}{2}$ Eqn BC $y - 6 = \frac{1}{2}(x - 4)$ m of CD $= -2$ eqn CD $y - 5 = -2(x - 12)$ (ii) Sim eqns $2y = x + 8$ and $y + 2x = 29$ $\rightarrow C(10, 9)$	B1 M1A1✓ M1 A1✓ [5] M1 A1 [2]	Co Correct form of eqn. ✓ on $m = \frac{1}{2}$. Use of $m_1 m_2 = -1$ ✓ on his " $\frac{1}{2}$ " but needs both M marks. Method for solving Co Diagram only for (ii), allow B1 for (10, 9)

Page 2	Mark Scheme	Syllabus	Paper
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6  (i) $20 = 2r + r\theta$ $\rightarrow \theta = (20/r) - 2$ (ii) $A = \frac{1}{2}r^2\theta$ $\rightarrow A = 10r - r^2$ (iii) Cos rule $PQ^2 = 8^2 + 8^2 - 2 \cdot 8 \cdot 8 \cos 0.5$ Or trig $PQ = 2 \times 8 \sin 0.25$ $\rightarrow PQ = 3.96$ (allow 3.95).	M1 A1 [2] M1 A1 [2] M1 A1 A1 [3]	Eqn formed + use of $r\theta$ + at least one r Answer given. Appropriate use of $\frac{1}{2}r^2\theta$ Co – but ok unsimplified – eg $\frac{1}{2}r^2(20/r) - 2$ Recognition of “chord” + any attempt at trigonometry in triangle. Correct expression for PQ or PQ^2. Co
7  (i) Height = 4 (ii) $\mathbf{MC} = 3\mathbf{i} - 6\mathbf{j} - 4\mathbf{k}$ $\mathbf{MN} = 6\mathbf{j} - 4\mathbf{k}$ (iii) $\mathbf{MC} \cdot \mathbf{MN} = -36 + 16 = -20$ $\mathbf{MC} \cdot \mathbf{MN} = \sqrt{61}\sqrt{52} \cos \theta$ $\rightarrow \theta = 111^\circ$	B1 [1] B2,1√ B1√ [3] M1A1√ M1 A1 [4]	Pythagoras or guess – anywhere, 4k ok. √ for “4”. Special case B1 for $-3\mathbf{i} + 6\mathbf{j} + 4\mathbf{k}$ √ on “4”. Accept column vectors. (nb if (ii) incorrect, but answers are correct in (iii) allow feedback). Use of $x_1y_1 + x_2y_2 + x_3y_3$. √ on $\mathbf{MC}$ and $\mathbf{MN}$ Product of two moduli and $\cos \theta$. Co. Nb If both $\mathbf{MC}$ and $\mathbf{MN}$ “reversed”, allow 111° for full marks.
8 (i) $y = 72 \div (2x^2)$ or $36 \div x^2$ $A = 4x^2 + 6xy$ $\rightarrow A = 4x^2 + 216 \div x$ (ii) $dA/dx = 8x - 216 \div x^2$ $= 0$ when $8x^3 = 216$ $\rightarrow x = 3$ (iii) Stationary value = 108 cm^2 $d^2A/dx^2 = 8 + 432 \div x^3$ $\rightarrow$ Positive when $x = 3$ Minimum.	B1 M1 A1 [3] M1 DM1 A1 [3] A1√ M1 A1 [3]	Co from volume = lbh . Attempts most of the faces (4 or more) Co – answer was given. Reasonable attempt at differentiation. Sets his differential to 0 and uses. Co. (answer = ± 3 loses last A mark) For putting his x into his A. Allow in (ii). Correct method – could be signs of dA/dx A mark needs d^2A/dx^2 correct algebraically, + $x = 3$ + minimum. It does not need “24”.

Page 3	Mark Scheme	Syllabus	Paper
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9  (i) $\frac{dy}{dx} = -\frac{24}{(3x+2)^2}$ Eqn of tangent $y-1 = -\frac{3}{8}(x-2)$ Cuts $y=0$ when $x=4\frac{2}{3}$ Area of Q = $\frac{1}{2} \times 2\frac{2}{3} \times 1 = \frac{4}{3}$ (ii) $\text{Vol} = \pi \int y^2 dx = \pi \int 64(3x+2)^{-2} dx$ $= \pi [-64(3x+2)^{-1} \div 3]$ Limits from 0 to 2 $\rightarrow 8\pi$	M1A1 Use of fn of fn. Needs $\times 3$ for M mark. Co. M1A1$\sqrt{}$ Use of line form with $\frac{dy}{dx}$. Must use calculus. $\sqrt{}$ on his $\frac{dy}{dx}$. Normal M0. M1A1 [6] Needs $y=0$ and $\frac{1}{2}bh$ for M mark. (beware fortuitous answers) M1 Uses $\int y^2 +$ some integration $\rightarrow (3x+2)^k$. A1A1 A1 without the $\div 3$. A1 for $\div 3$ and π DM1 Correct use of 0 and 2. DMO if 0 ignored. A1 Co. Beware fortuitous answers. [5]
10 (i) $fg(x) = g$ first, then f $= 8/(2-x) - 5 = 7$ $\rightarrow x = 1\frac{1}{3}$ (or $f(A)=7$, $A = 6$, $g(x) = 6$, $\rightarrow x = 1\frac{1}{3}$) (ii) $f^{-1} = \frac{1}{2}(x+5)$ Makes y the subject $y = 4 \div (2-x)$ $\rightarrow g^{-1} = 2 - (4 \div x)$ (iii) $2-4/x = \frac{1}{2}(x+5)$ $\rightarrow x^2+x+8=0$ Use of $b^2-4ac \rightarrow$ Negative value $\rightarrow$ No roots. (iv) 	M1 Correct order - g first, then into f. DM1 Correct method of solution of $fg=7$. A1 Co. (nb gf gets $0/3$) [3] (M1 for 6. M1 for $g(x)=6$. A1) B1 Anywhere in the question. M1 For changing the subject. A1 Co – any correct answer. (A0 if $f(y)$.) [3] M1 Algebra leading to a quadratic. M1 Quadratic=0 + use of b^2-4ac. A1 Correct deduction from correct quadratic. [3] B1 Sketch of f B1 Sketch of f^{-1} B1 Evidence of symmetry about $y=x$. [3]