CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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

MARK SCHEME FOR the November 2002 question papers

9709 MATHEMATICS

9709 /1	Paper 1 (Pure 1), maximum raw mark 75
9709 /2	Paper 2 (Pure 2), maximum raw mark 50
9709 /3 **8719 /3**	Paper 3 (Pure 3), maximum raw mark 75
9709 /4	Paper 4 (Mechanics 1), maximum raw mark 50
9709 /5 **8719 /5**	Paper 5 (Mechanics 2), maximum raw mark 50
9709 /6 **0390 /6**	Paper 6 (Probability and Statistics 1), maximum raw mark 50
9709 /7 **8719 /7**	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 2002 question papers for most IGCSE, Advanced Subsidiary (AS) Level and Advanced Level syllabuses.

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- 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✓" 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 2002

GCE Advanced Subsidiary Level

MARK SCHEME

MAXIMUM MARK : 75

SYLLABUS/COMPONENT :9709 /1

MATHEMATICS
(Pure 1)

UNIVERSITY of CAMBRIDGE
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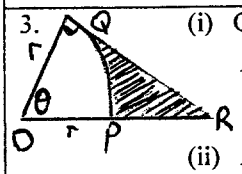
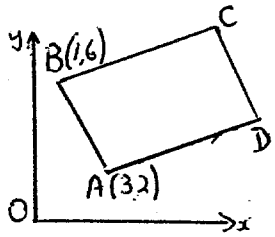
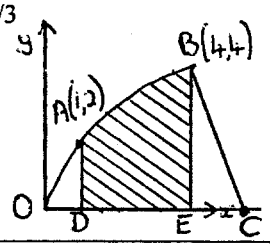
1. $r = 4-r$ $r=2$ Term is ${}_4C_2 \times (3)^2$ $= 54$	B1 B1 B1 3	Guessing or attempt at $r=2$ For correct ${}_4C_2 \times (3)^r$ for his r. Correct only –isolated from expansion.
2. (i) $ar=18$ and $ar^3=8$ Solution to give $r=2/3$ $a=18\div r = 27.0$ (ii) Sum to infinity $= a\div(1-r)$ Answer = 81.0	M1 DM1 A1 3 M1 A1√ 2	Any 2 equations of type ar^n Correct method on correct 2 equations. For his $18\div r$ Correct formula applied – even if $r>1$. Follow through provided $r<1$. (ignore $r=\pm 2/3$)
3.  (i) $QR = r\tan\theta$ Area shaded $= \frac{1}{2}r^2\tan\theta - \frac{1}{2}r^2\theta$ (ii) Arc PQ $= 15 \times 0.8 = 12$ $OR = r\div\cos\theta$ (21.53) Perimeter $= r\tan\theta$ + arc PQ $+ (r - r\div\cos\theta)$ $= 34.0$ (33.9 ok)	B1 B1 2 B1 M1 M1 A1 4	Correct somewhere – in (ii) ok. All correct – answer given, beware fortuitous. Anywhere (could be implied) Must be correct with r and θ or Pythagoras. Putting 4 things together – even if algebraic Correct only.
4. (i) $y = (1+2x)^{3/2} \div (3/2) \div 2$ (+C) use of (4,11) to find C $C = 2$. (ii) If $x=0$, $y = 7/3$	M1 A1 M1 A1 4 M1 A1√ 2	Attempt at $\int n$. Needs $(\ )^k \div k$ A1 for $\div 2$ and $k=\frac{3}{2}$. Attempt to use (4,11) Correct only. Use of $x=0$ providing there is some integration

5. (i) $3\tan\theta=2\cos\theta$ $\quad 3\sin\theta\div\cos\theta=2\cos\theta$ $3\sin\theta=2\cos^2\theta = 2(1-\sin^2\theta)$ $3s=2(1-s^2)$.	M1 M1 A1 3	Use of $t=s\div c$ Use of $s^2+c^2=1$ Everything correct – answer given.
(ii) Soln of $2s^2+3s-2=0$ $s=0.5$ or -2	M1	Correct method of solution
$\theta = 30^\circ$ or 150°	A1 A1√ 3	Correct only, then √ for 180 – first answer or consistent with his cosine-loses √ mark if extra solutions.
6. (i) $AC = l\cos30 = l\sqrt{3}/2$ $BC = 2l\sin30 = l$ $AB = \sqrt{(l^2+3l^2/4)} = \frac{1}{2}l\sqrt{7}$	B1 B1 M1 A1 4	Correct only – not decimal Correct only Use of Pythagoras. Correct only. Answer given. Could be cosine rule.
(ii) $\tan(x+30) = BC\div AC = l \div (l\sqrt{3}/2)$ $x = \tan^{-1}(2/\sqrt{3}) - 30$	M1 A1 2	Use of tangent in 90° triangle – tan=opp/adj. x the subject – beware fortuitous answers.
7. (i) $\mathbf{a}.\mathbf{b}= 4 -12 +3 = -5$ $\mathbf{a}.\mathbf{b} = \sqrt{9}\ \sqrt{49}\cos\theta$ $\theta = 103.8°$ or 1.81 radians.	M1 M1M1 A1 4	Use of $a_1b_1+a_2b_2+a_3b_3$ Use of a.b.cosθ + Use of $\sqrt{(a_1^2+a_2^2+a_3^2)}$ Correct only
(ii) Dot product = $11p+3$ Dot product = 0 $P = -3/11$	M1 DM1 A1 3	Use of $a_1b_1+a_2b_2+a_3b_3$ =0 used correct only.
8. (i) $dy/dx = 3x^2+6x-9$	B2,1 2	One off for each error including +k left.
(ii) $= 0$ when $(x+3)(x-1)=0$ $x=-3$ or $x=1$	M1 A1 2	Use of $dy/dx=0$ Both values somewhere
(iii) Subbing the values into $y=0$. $k= -27$ or $k = 5$.	M1 DM1 A1 3	Using $y=0$ at least once. Subbing his values for x into $y=0$ + soln. Both correct.

9. (i) m of AB = -2 m of BC = -1 (m) = ½ equation of BC y-6=½(x-1) or 2y=x+11	B1 M1 DM1 A1√ 4	Correct only Used correctly Correct formula needed to be used. A√ mark for any correct equation.
(ii) Sim eqns y=x-1 and answer above Solution C (13,12)	M1 A1 2	Correct method Correct only
(iii) AB = √20 and BC = √180 perimeter = 2×√20 + 2×√180 = 35.8 or 35.7 or 16√5 or √1280  	M1 DM1 A1 3	Use of Pythagoras once - √20 ok Use of 2a + 2b – with Pythagoras twice. Correct only.
10 (i)y=2√x. dy/dx = $x^{-½}$ If x=4, m = ½ Perpendicular = - 2 Eqn of y= -2x +12 or y-4=−2(x−4)	M1 A1 DM1 A1 4	Realising the need to differentiate + use. Correct only m_1m_2=-1 numerical needed correct only
(ii) Area P = ∫2√x dx=$2x^{1.5}$/1.5 Evaluated from 1 to 4 Answer = 32/3 – 4/3 = 28/3  	M1 A1 DM1 A1 4	Knowing to integrate. Correct unsimplified. Correct use of 1 to 4 – not for 2 to 4. Correct only.
11 (i) $2x^2+8x-10 = 2(x+2)^2 + c$ c= -18	B1 B1 B1 3	a=2 gets B1, b=2 gets B1 correct only
(ii) Least value = -18 when x=-2	B1√B1√ 2	follow through for c and for –b. Calculus ok.
(iii) $2x^2+8x-10≥14$ or $2(x+2)^2$ -18θ14 $x^2+4x-12=0$ or $(x+2)^2=16$ Limit points 2 and – 6 x ≥2 and x ≤ -6	M1 A1 A1 3	setting the inequality to 0 correct only – irrespective of what they do correct only (condone > or <)
(iv) Smallest k is –2	B1□ 1	Follow through.
(v) Makes x the subject and replaces x by y $f^{-1}(x) = \sqrt{\frac{x+18}{2}} - 2.$	M1 M1 A1√ 3	x the subject – reasonable attempt from completion of square. x,y interchanged. Correct form his answer to (i).