CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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GCE Advanced Subsidiary Level

MARK SCHEME FOR the November 2001 question papers

8709 MATHEMATICS

8709/1	Paper 1 (Pure 1), maximum raw mark 75
8709/2	Paper 2 (Pure 2), maximum raw mark 50
8709/4	Paper 4 (Mechanics 1), maximum raw mark 50
8709/6	Paper 6 (Probability and Statistics 1), 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 2001 question papers for most IGCSE and GCE Advanced Subsidiary (AS) 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.

  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.

  The marks indicated in the scheme may not be subdivided. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular M or B mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, 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 and B marks are given for correct work only — differences in notation are of course permitted. A and B marks are not given for 'correct' answers or results obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable.

- The following abbreviations may be used in a mark scheme.

  AEF Any Equivalent Form (of answer or result is equally acceptable).

  AG Answer Given on the question paper (so extra care is needed in checking that the detailed working leading to the result is valid).

  BOD Benefit Of Doubt (allowed for work whose validity may not be absolutely plain).

  CAO Correct Answer Only (emphasising that no 'follow through' from a previous error is allowed).

  ISW Ignore Subsequent Working.

  MR Misread.

  PA Premature Approximation (resulting in basically correct work that is numerically 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).

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INTERNATIONAL EXAMINATIONS

NOVEMBER 2001

ADVANCED SUBSIDIARY LEVEL

MARK SCHEME

MAXIMUM MARK : 75

SYLLABUS/COMPONENT : 8709/1

MATHEMATICS

UNIVERSITY of CAMBRIDGE
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Mark Scheme

1	$k - 2x = x^2 - 6x + 14$ $\rightarrow x^2 - 4x + (14 - k) = 0$ Use of $b^2 - 4ac$ $16 = 4(14 - k)$ (or $dy/dx = 2x - 6$, $x = 2$, $y = 6$, $k = 10$) $k = 10$	M1 A1 M1 A1 4	Equating y – or eliminating y (or x) Must be = 0 Any use of $b^2 - 4ac$, even if < or > Co
2 (i)	$2x^2 - 12x + 11 = 2(x^2 - 6x) + 11$ $= 2[(x - 3)^2 - 9] + 11$ $= 2(x - 3)^2 - 7$	B1 M1 A1	For a = 2 $(x - 3)^2$ Everything OK.
(ii)	$f:x \mapsto 2(x - 3)^2 - 7$ Min when x = 3, f(x) = – 7 Range $f(x) \geq -7$ (or $f'(x) = 4x - 12 \rightarrow x = 3 \rightarrow -7$)	M1 A1 5	Realising that f(x) = c is the minimum value Everything OK (M1 – complete method → – 7, A1 as above) (f(x) > – 7 gets one mark only)
3 (i)	Graph of y = cosx y = cos3x, 3 cycles Both between – 1 and 1	B1 B1 B1	Clear on his diagram that cos graph is correct Must be 3 cycles for $0 \leq x \leq 2\pi$ Co (loses this if on separate diagram)
(ii)	Largest k corresponds to the point P on the diagram ½ of $2\pi = \pi$	M1 A1 5	Or any valid method Co (k = 180 gets M1)

4		Arc PXQ = $12 \times \frac{1}{3}\pi$	M1	Use of $s = r\theta$ with radians
		$= 4\pi$	A1	Co (12.6 OK)
		Sine Rule (or other)	M1	Any valid method - degrees OK
		$PS/\sin\pi/6 = 12/\sin\frac{2}{3}\pi$	A1	Correct un-simplified with radians
		PS (or OS or QS) = $12/\sqrt{3}$		Co (6.93 OK)
		(or $\cos\pi/6 = 6 \div$ OS $\rightarrow$ OS = $6 \div (\sqrt{3}/2)$)		
		Perimeter = $4\pi + 24/\sqrt{3}$	M1	Perimeter = OP + OQ + arc length
		$= 4\pi + 8\sqrt{3}$	A1	Co – either of these forms is acceptable
			6	
5	(i)	$A = 2(x^2 + 3x^2 + 3x^2)$	M1	Reasonable attempt at 6 (or 3) areas
		$A = 14x^2$	A1	Co
		$dA/dx = 28x$	B1√	Allow providing power of $x \geq 2$
	(ii)	$dA/dt = \pm 0.14$	B1	Co
		$dx/dt = dx/dA \times dA/dt$	M1	Correct relationship between required rates
		$= (-)\ 0.0025$	A1	Co – allow ±
			6	
6		(2,5) to (10,9) $m = \frac{1}{2}$	B1	Co
		Eqn of L_1 use of $y = mx + c$	M1	Any correct use of a line equation
		or $y - k = m(x - h)$		
		$2y = x + 8$	A1	Doesn't need to be simplified
		Gradient of $L_2 = -2$	M1	Use of $m_1m_2 = -1$
		Equation of L_2 is $y = -2x + 14$	A1	Co
		Sim Eqns for intersection	M1	Must be two linear equations
		$\rightarrow x = 4 \rightarrow (4,6)$	A1	Co
			7	

7 **(i)**	$a^2 = 4s^2 + c^2 + 4sc$ and $b^2 = 4c^2 + s^2 - 4sc$	**B1**	Both expressions correct.
	$a^2 + b^2 = 5c^2 + 5c^2$		
	But $c^2 + s^2 = 1$	**M1**	Use of $s^2 + c^2 = 1$
	$= 5$	**A1**	Co (beware of omission of 4sc and – 4sc terms)
(ii)	$2(2s + c) = 3(2c - s) \rightarrow$	**M1**	Collection of s and c + use of t = s/c
	$4s + 2c = 6c - 3s$		
	$7s = 4c \rightarrow \tan\theta = 4/7$	**A1**	For t = 4/7 or decimal equivalent
	$\theta = 29.7°$	**B1**	Co
	or $\theta = 209.7°$	**B1√**	For 180+, providing tangent is used. (S-1 for excess ans in range from B1√ only)
		7	
8	a = 2000, r = 0.9		
(i)	$ar^9 = 2000 \times (0.9)^9$	**M1**	Correct ar^9 used.
	$= 775$ kg	**A1**	Co
(ii)	$2000(1 - 0.9^{20}) \div (1 - 0.9)$	**M1**	Correct formula.
	$= 17600$ kg	**A1**	Co
(iii)	r = 0.9	**B1**	Anywhere in the question
	$S_\infty = 2000 \div (1 - 0.9)$	**M1**	Correct formula – needs $\|r\| < 1$.
	$= 20000$ kg	**A1**	Co
		7	

9			
(i)	$\int(24/x^3 - 3) = 24x^{-2} \div -2 - 3x\ (+ C)$	**B1B1**	For the integration only (ignore C) – anywhere in the question, including part **(ii)**
	Substitute (1,16), $y = -12x^{-2} - 3x + 31$	**M1**	Attempt at + C – only in part **(i)**
		A1	Correct only
(ii)	$dy/dx = 0 \quad \rightarrow x = 2$	**M1A1**	$dy/dx = 0$ used. Correct x value. Ignore $x = -2$.
	If $x = 2$, then $y = 22$	**DM1A1**	Substitute back into the curve eqn.
		8	
10			
(i)	**OM** = $\begin{pmatrix}6\\8\\0\end{pmatrix}$ **MN** = $\begin{pmatrix}-3\\-8\\4\end{pmatrix}$	**M1**	Correct method for one of **MN** or **MD**
		A1	Correct **MN**
	ON = $\begin{pmatrix}3\\0\\4\end{pmatrix}$ **MD** = $\begin{pmatrix}-6\\8\\8\end{pmatrix}$	**M1**	Correct **MD**
		A1	
(ii)	**MN.MD** $= 18 - 64 + 32$	**M1**	Triple product and scalar
	$= -14$	**A1**	Co
	$= \sqrt{(8^2 + 3^2 + 4^2)}\sqrt{(8^2 + 6^2 + 8^2)}\cos\theta$	**M1**	One modulus needs to be correct
		M1	Product of moduli and cos θ
	$\theta = 97°$	**A1**	Co – accept to one dec place
		9	

11	(i)	$dy/dx = \frac{1}{2}.8.(8x+1)^{-\frac{1}{2}}$	M1	Needs to be using chain rule – not for $\frac{1}{2}(\ )^{-1}$
		$= 0.8$ or $\frac{4}{5}$	A1	Co
		Eqn of tangent $y - 5 = \frac{4}{5}(x - 3)$	M1A1	Needs correct form of line equation and needs calculus for M1.
	(ii)	Put $x = 0$ $y = 2.6$ or $13/5$	B1√	Follow through on his linear equation
	(iii)	$\int_0^3 \sqrt{8x+1}\,dx = (8x+1)^{3/2} \div 3/2 \div 8$	M1	Must be integrating to $(8x+1)^k \div k$
			A1	Needs ÷ 8 here
		$= 125/12 - 1/12 = 124/12$	DM1	Correct use of limits – must have value at "0"
		Area of trapezium = ½(5+2.6)x3 = 11.4	M1	Complete method for trapezium
		Required area = difference	M1	Plan mark - for difference of 2 areas
		= 16/15 or 1.07	A1	Co
			11	