CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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International General Certificate of Secondary Education

MARK SCHEME FOR the November 2002 question papers

0606 Additional Mathematics

0606/1 Paper 1, maximum raw mark 80

0606/2 Paper 2, maximum raw mark 80

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 Accuracy 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 is used to indicate that a particular M or B mark is dependent on an earlier M or B 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 √ 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 following abbreviations may be used in a mark scheme or used on the scripts.

  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).
  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).

Penalties.

- MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question are misread. 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.
- OW-1,2 This is deducted from A or B marks when essential working is omitted.
- PA–1 This is deducted from A or B marks in the case of premature approximation.
- S–1 Occasionally used for persistent slackness.
- EX–1 Applied to A or B marks when extra solutions are offered to a particular equation.

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November 2002

INTERNATIONAL GCSE

MARK SCHEME

MAXIMUM MARK : 80

SYLLABUS/COMPONENT : 0606/1

ADDITIONAL MATHEMATICS

(Paper 1)

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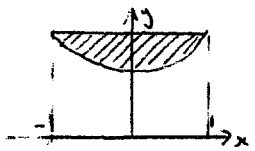
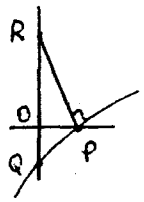
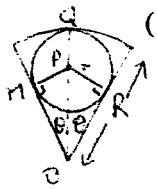
1.	$4\sin\theta+3\cos\theta=0 \Rightarrow \tan\theta = -0.75$ $\theta = 143.1°$ or $323.1°$	M1 A1 A1√ 3	Use of t=s÷c (allow ±4/3 or +¾) Co For 180°+ his value and no other values.
2.	Complete elimination of y (or x) $\rightarrow x^2=4(mx-9)$ Use of b^2-4ac on his quadratic=0 $16m^2=144$ $\rightarrow$ $m=\pm3$	M1 M1 A1 A1√ 4	y or x must go completely or m=½x. quadratic must = 0 m=3 gets A1 only for the – value from $m^2=k$.
3.	$10t-t^2\geq5 \Rightarrow t^2-10t+5\leq0$ Soln of $t^2-10t+5=0$ $\rightarrow t=5\pm\sqrt{20}$ Difference t_2-t_1 = $2\sqrt{20} = 4\sqrt{5}$	M1 DM1 A1 M1 A1 5	Setting quadratic to 0 Correct form of solution for Quad=0. Correct only – decimals ok here. Difference between the 2 values Decimal check is not acceptable.
4.	 $\int e^x+e^{-x}\,dx = e^x - e^{-x}$ Area under curve = $[\ ]_1 - [\ ]_{-1}$ (4.701) Area of rectangle = $2(e+e^{-1})$ (6.172) Req'd area = 1.47 or 1.48 (or $4e^{-1}$)	 M1 A1 DM1 M1 DM1 A1 6	 Knowing to integrate + attempt with "e" co Value at 1 – Value at –1 in his integral Anywhere – numeric or in terms of e Subtraction of two areas – on first M. co.
5.	Large matrix either 3x4 or 4x3 $\begin{pmatrix}3&2&2&0\\2&0&3&3\\0&1&6&3\end{pmatrix}$ or $\begin{pmatrix}3&2&0\\2&0&1\\2&3&6\\0&3&3\end{pmatrix}$ Displayed compatible for ×, with row or col mat Eg (20 30 15) × 1st or 1st × $\begin{pmatrix}30\\40\\50\\80\end{pmatrix}$ Product eg (120 55 220 135) or $\begin{pmatrix}270\\450\\580\end{pmatrix}$ Multiplied by the 3rd matrix $\Rightarrow$ \$27 60	 B1 B1√ M1 A1 M1 B1 6	 Anywhere Or for (30 40 50 80) × 2cnd. Order ok. Or for 2cnd × $\begin{pmatrix}20\\30\\15\end{pmatrix}$. Order ok. Must be compatible for M. co for A. Must be compatible for M. co for B1 – even if no matrices.

6. $y = \int 6(2x-3)^{-2}dx = -3(2x-3)^{-1} \ (+C)$ Passes through (3,5) $\Rightarrow$ C = 6 On x-axis, y=0 $\Rightarrow$ x = 1.75	M1 A1 M1 A1 M1 A1 6	Must be $(2x-3)^k \div k$ - no other f(x). $\div 2$ and k=−1. Uses both coordinates in an integral. Puts y=0 into his equation obtained by integration.
7. (i) $y=x^3+x-1 \Rightarrow dy/dx = 3x^2+1$ Puts dy/dx=0 – realises there is no solution And therefore no max or min. Realises the function is 1 to 1 and f^{-1}exists. (ii) $f^{-1}(9)$ is value of x such that $x^3+x-1=9$ Search – finds x=2.	M1 DM1 A1 A1√ M1 M1 A1 7	Knows to use calculus for M. Puts dy/dx=0 + attempt to solve. Correct conclusion from $3x^2+1=0$ only. Realises link between no soln and 1:1 – only from kx^2+1. Realises need to solve f(x)=9 Tries values for M. Correct answer.
8. (i) $e^x=k \Rightarrow k(2k-1)=10$ $2k^2-k-10=0 \Rightarrow k=2.5$ (or −2) Soln of $e^x = 2.5$ $\Rightarrow x = \ln 2.5 = 0.92$ ok (ii) RHS = 2 = $\log_5 25$ LHS = $\log_5[(8y-6)\div(y-5)]$ Soln of $[(8y-6)\div(y-5)] = 25 \Rightarrow y = 7$	M1 DM1 A1 B1 B1 M1 A1 7	Realisation that eqn is quadratic in e^x Solution of quadratic Co ln2.5 is enough. Ignore soln from −2. co. co. Putting the two logs together. co.
9. Eliminate x or y $\Rightarrow 3x^2-6x-24=0$ or $2y^2+6y-36=0$ Solution $\rightarrow$ (4,3) and (−2,−6) Gradient of line joining = $\frac{3}{2}$ Gradient of perpendicular = $-\frac{2}{3}$ Midpoint = $(1, -\frac{3}{2})$ Eqn of perp bisector $y+\frac{3}{2} = -\frac{2}{3}(x-1)$	M1 A1 DM1 A1 M1 M1 M1A1 8	Needs complete elimination. Correct equation . Method of solution=0. (needs 3 term) Co – all 4 values. Use of $m_1m_2=-1$ Uses $(\frac{1}{2}(x_1+x_2), \frac{1}{2}(y_1+y_2))$ In any form – unsimplified or 6y+4x+5=0. (no mid-point or no perp – max 5/8)
10. (i) $r_P = t(20i+10j) + 50j$ $r_Q = t(-10i+30j) + 80i + 20j$ (ii) t=2 $\Rightarrow$ PQ = (60i+80j) − (40i+70j) = 20i+10j $\lvert PQ\rvert = 10\sqrt{5} = 22.4$ km. (iii) across $20t = -10t + 80$ $t = 2\frac{2}{3}$ up $10t+50=30t+20$ $t = \frac{3}{2}$ Therefore no interception.	M1 DM1 A1 M1 M1 A1 M1 A1 8	M1 for t×velocity vector in either Adding on constant vector in either For both expressions. Knowing to subtract, with or without t=2. Use of Pythagoras. co. Any valid method – could find t form one and substitute into the other.

11. (i) $\frac{dy}{dx} = \frac{(x+2)2-(2x-6)1}{(x+2)^2}$	M1 A1	Must use correct formula for quotient or product. A mark for unsimplified.
$= \frac{10}{(x+2)^2}$ k= 10	A1	co.
(ii) Q is (0,-3) P) is (3,0) 	B1 B1	Both these anywhere in the question.
gradient at x=3 is 2/5 gradient of normal = -5/2	M1	Getting the perpendicular gradient- but must be using - 1÷dy/dx
Eqn of normal is y=-5/2(x-3)	M1	Correct unsimplified. – needs use of x=0
R is (0, 7½) |RQ| = 10½	A1 B1√ 9	A1 for 7½. B1√ for "his 7½ – "his –3". Allow ±10.5
12. **EITHER**		
 (i) OPQ bisects angle MON anglePMO=anglePNO=90°	B1 B1	Used somewhere – on diagram ok Used somewhere – on diagram ok
$R = OP + PQ = \frac{r}{\sin\theta} + r$	M1 A1	OP needs to be trig function with sinθ
(ii) θ=30° ⇒ R = 3r	B1	Co – in (ii) only or at end of (i)
Total area = ½R²×(π/3) = $\frac{3}{2}\pi r^2$	M1	Use of ½r²θ with his R and his θ
Fraction with roses = $(\pi r^2) \div (\frac{3}{2}\pi r^2)$ = ⅔	M1A1	Needs πr² and a ratio.
(iii) Arc MN = 5×2π/3 OM=ON=5÷tan30 or √75	M1 M1	Use of s=rθ with his r and his θ For r÷ tan(hisθ) or Pythagoras etc
Perimeter = 10(⅓π+□3) = 27.8m	A1 11	co
12. **OR**		

x	50	100	150	200	250
y/x	74	110	144	180	214

(i) Plotting y/x against x Accuracy and line	M1 A1A1	Knowing what to do A1 accuracy. A1 line.
(ii) y=x(Ax+B) ⇒ y/x = Ax + B ⇒ A = gradient, B=intercept Intercept 38→40 Gradient 0.68 to 0.72	B1B1 B1B1	Stating m=A and c=B. For numerical values of m and c only.
(iii) Line of y/x against x drawn on the graph. Value of x at point of intersection makes the rectangle into a square.	M1 A1 B1	M1 line of gradient 1 A1 accurately drawn Square or sides of rectangle equal.
(iv) As x→∞, ratio of 2 sides →A or 1/A ie 0.7 or 1.43	B1√ 11	For his gradient or reciprocal of gradient.