

CAMBRIDGE INTERNATIONAL EXAMINATIONS  
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  $\surd$  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 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).

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**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  $\sqrt{\phantom{x}}$ ” 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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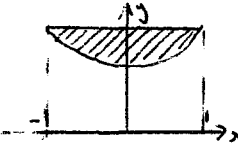
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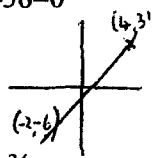
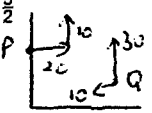
<b>MARK SCHEME</b>
<b>MAXIMUM MARK : 80</b>
<b>SYLLABUS/COMPONENT : 0606/1</b> <b>ADDITIONAL MATHEMATICS</b> <b>(Paper 1)</b>



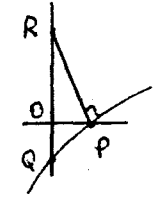
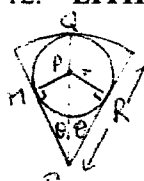
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<p>1. <math>4\sin\theta + 3\cos\theta = 0 \Rightarrow \tan\theta = -0.75</math></p> <p><math>\theta = 143.1^\circ</math> or <math>323.1^\circ</math></p>	<p>M1</p> <p>A1 A1√ 3</p>	<p>Use of <math>t=s\div c</math> (allow <math>\pm 4/3</math> or <math>\pm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

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<p>6.</p> <p><math>y = \int 6(2x-3)^{-2} dx = -3(2x-3)^{-1} (+C)</math></p> <p>Passes through (3,5) <math>\Rightarrow C = 6</math></p> <p>On x-axis, <math>y=0 \Rightarrow x = 1.75</math></p>	<p>M1 A1 M1 A1</p> <p>M1 A1 6</p>	<p>Must be <math>(2x-3)^k \div k</math> - no other <math>f(x)</math>. <math>\div 2</math> and <math>k=-1</math>.</p> <p>Uses <u>both</u> coordinates in an integral.</p> <p>Puts <math>y=0</math> into his equation obtained by integration.</p>
<p>7.</p> <p>(i) <math>y=x^3+x-1 \Rightarrow dy/dx = 3x^2+1</math> Puts <math>dy/dx=0</math> - realises there is no solution And therefore no max or min.</p> <p>Realises the function is 1 to 1 and <math>f^{-1}</math> exists.</p> <p>(ii) <math>f^{-1}(9)</math> is value of <math>x</math> such that <math>x^3+x-1=9</math> Search - finds <math>x=2</math>.</p>	<p>M1 DM1 A1</p> <p>A1√</p> <p>M1 M1 A1 7</p>	<p>Knows to use calculus for M. Puts <math>dy/dx=0</math> + attempt to solve. Correct conclusion from <math>3x^2+1=0</math> only.</p> <p>Realises link between no soln and 1:1 - only from <math>kx^2+1</math>.</p> <p>Realises need to solve <math>f(x)=9</math> Tries values for M. Correct answer.</p>
<p>8.</p> <p>(i) <math>e^x=k \Rightarrow k(2k-1)=10</math> <math>2k^2-k-10=0 \Rightarrow k=2.5</math> (or -2) Soln of <math>e^x = 2.5</math> <math>\Rightarrow x = \ln 2.5 = 0.92</math> ok</p> <p>(ii) <math>RHS = 2 = \log_5 25</math> <math>LHS = \log_5 [(8y-6) \div (y-5)]</math> Soln of <math>[(8y-6) \div (y-5)] = 25 \Rightarrow y = 7</math></p>	<p>M1 DM1</p> <p>A1</p> <p>B1 B1 M1 A1 7</p>	<p>Realisation that eqn is quadratic in <math>e^x</math> Solution of quadratic</p> <p>Co <math>\ln 2.5</math> is enough. Ignore soln from -2.</p> <p>co. co. Putting the two logs together. co.</p>
<p>9.</p> <p>Eliminate <math>x</math> or <math>y</math> <math>\Rightarrow 3x^2-6x-24=0</math> or <math>2y^2+6y-36=0</math> Solution <math>\rightarrow (4,3)</math> and <math>(-2,-6)</math></p>  <p>Gradient of line joining <math>= \frac{3}{2}</math> Gradient of perpendicular <math>= -\frac{2}{3}</math></p> <p>Midpoint <math>= (1, -\frac{3}{2})</math> Eqn of perp bisector <math>y + \frac{3}{2} = -\frac{2}{3}(x - 1)</math></p>	<p>M1 A1 DM1 A1</p> <p>M1</p> <p>M1 M1 A1 8</p>	<p>Needs complete elimination. Correct equation . Method of solution = 0. (needs 3 term) Co - all 4 values.</p> <p>Use of <math>m_1 m_2 = -1</math></p> <p>Uses <math>(\frac{1}{2}(x_1+x_2), \frac{1}{2}(y_1+y_2))</math> In any form - unsimplified or <math>6y+4x+5=0</math>. (no mid-point or no perp - max 5/8)</p>
<p>10.</p> <p>(i) <math>r_P = t(20i+10j) + 50j</math> <math>r_Q = t(-10i+30j) + 80i + 20j</math></p> <p>(ii) <math>t=2 \Rightarrow PQ = (60i+80j) - (40i+70j)</math> <math>= 20i+10j</math> <math> PQ  = 10\sqrt{5} = 22.4</math> km.</p> <p>(iii) across <math>20t = -10t + 80 \quad t = 2\frac{2}{3}</math> up <math>10t + 50 = 30t + 20 \quad t = \frac{3}{2}</math> Therefore no interception.</p> 	<p>M1 DM1 A1</p> <p>M1</p> <p>M1 A1</p> <p>M1 A1 8</p>	<p>M1 for <math>t \times</math> velocity vector in either Adding on constant vector in either For both expressions.</p> <p>Knowing to subtract, with or without <math>t=2</math>.</p> <p>Use of Pythagoras. co.</p> <p>Any valid method - could find <math>t</math> from one and substitute into the other.</p>

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<p>11. (i) <math>\frac{dy}{dx} = \frac{(x+2)2 - (2x-6)1}{(x+2)^2}</math>  <math>= \frac{10}{(x+2)^2} \quad k=10</math></p> <p>(ii) Q is (0, -3) P is (3,0)</p> <p>gradient at x=3 is 2/5          gradient of normal = -5/2</p> <p>Eqn of normal is <math>y = -5/2(x-3)</math></p> <p>R is (0, 7½)  RQ  = 10½</p> 	<p>M1 A1 A1 B1 B1 M1 M1 A1 B1√ 9</p>	<p>Must use correct formula for quotient or product. A mark for unsimplified. co.</p> <p>Both these anywhere in the question.</p> <p>Getting the perpendicular gradient- but must be using <math>-1 \div dy/dx</math>          Correct unsimplified. – needs use of <math>x=0</math></p> <p>A1 for 7½.          B1√ for “his 7½ – “his -3”. Allow <math>\pm 10.5</math></p>												
<p>12. EITHER</p>  <p>(i) OPQ bisects angle MON          anglePMO = anglePNO = 90°  <math>R = OP + PQ = \frac{r}{\sin \theta} + r</math></p> <p>(ii) <math>\theta = 30^\circ \Rightarrow R = 3r</math></p> <p>Total area = <math>\frac{1}{2}R^2 \times (\pi/3) = \frac{3}{2}\pi r^2</math></p> <p>Fraction with roses = <math>(\pi r^2) \div (\frac{3}{2}\pi r^2) = \frac{2}{3}</math></p> <p>(iii) Arc MN = <math>5 \times 2\pi/3</math>          OM = ON = <math>5 + \tan 30</math> or <math>\sqrt{75}</math></p> <p>Perimeter = <math>10(\frac{1}{3}\pi + \sqrt{3}) = 27.8m</math></p>	<p>B1 B1 M1 A1 B1 M1 M1A1 M1 M1 A1 11</p>	<p>Used somewhere – on diagram ok          Used somewhere – on diagram ok</p> <p>OP needs to be trig function with <math>\sin \theta</math></p> <p>Co – in (ii) only or at end of (i)</p> <p>Use of <math>\frac{1}{2}r^2\theta</math> with his R and his <math>\theta</math></p> <p>Needs <math>\pi r^2</math> and a ratio.</p> <p>Use of <math>s=r\theta</math> with his r and his <math>\theta</math>          For <math>r = \tan(\text{his } \theta)</math> or Pythagoras etc</p> <p>co</p>												
<p>12. OR</p> <table border="1" data-bbox="175 1411 766 1489"> <tr> <td>x</td> <td>50</td> <td>100</td> <td>150</td> <td>200</td> <td>250</td> </tr> <tr> <td>y/x</td> <td>74</td> <td>110</td> <td>144</td> <td>180</td> <td>214</td> </tr> </table> <p>(i) Plotting y/x against x          Accuracy and line</p> <p>(ii) <math>y = x(Ax+B) \Rightarrow y/x = Ax + B</math>  <math>\Rightarrow A = \text{gradient}, B = \text{intercept}</math>          Intercept 38 → 40 Gradient 0.68 to 0.72</p> <p>(iii) Line of y/x against x drawn on the graph.          Value of x at point of intersection makes the rectangle into a square.</p> <p>(iv) As <math>x \rightarrow \infty</math>, ratio of 2 sides → A or 1/A          ie 0.7 or 1.43</p>	x	50	100	150	200	250	y/x	74	110	144	180	214	<p>M1 A1A1 B1B1 B1B1 M1 A1 B1 B1√ 11</p>	<p>Knowing what to do          A1 accuracy. A1 line.</p> <p>Stating <math>m=A</math> and <math>c=B</math>.          For numerical values of m and c only.</p> <p>M1 line of gradient 1          A1 accurately drawn          Square or sides of rectangle equal.</p> <p>For his gradient or reciprocal of gradient.</p>
x	50	100	150	200	250									
y/x	74	110	144	180	214									