



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

---

**ADDITIONAL MATHEMATICS**

**0606/01**

Paper 1

**For Examination from 2013**

SPECIMEN MARK SCHEME

**2 hours**

---

**MAXIMUM MARK: 80**

---

This document consists of **6** printed pages.



**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 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 (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 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 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  $\sqrt{\quad}$ " 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 – usually discussed at a meeting.
- EX –1 Applied to A or B marks when extra solutions are offered to a particular equation. Again, this is usually discussed at the meeting.

<p><b>1</b> (i) correct diagram</p> <p>(ii) correct diagram</p> <p>(iii) correct diagram</p>	<p>B1</p> <p>B1</p> <p>B1 [3]</p>	
<p><b>2</b> <math>(2x + 1)^2 &gt; 8x + 9</math>  <math>4x^2 - 4x - 8 &gt; 0</math>  <math>x^2 - x - 2 &gt; 0</math>  <math>(x + 1)(x - 2) &gt; 0</math>  Leads to critical values <math>x = -1, 2</math>  <math>x &lt; -1</math> and <math>x &gt; 2</math></p>	<p>M1</p> <p>DM1</p> <p>A1</p> <p>√A1 [4]</p>	<p>M1 for simplification to 3 term quadratic</p> <p>DM1 for factorisation</p> <p>A1 for critical values</p> <p>Follow through on their critical values.</p>
<p><b>3</b></p> $\text{LHS} = \frac{\sin^2 A + 1 + \cos^2 A + 2 \cos A}{(1 + \cos A) \sin A}$ $= \frac{2 + 2 \cos A}{(1 + \cos A) \sin A}$ $= \frac{2}{\sin A} \text{ leading to } 2 \cos e c A$	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1 [4]</p>	<p>M1 for attempt to deal with fractions and attempt to obtain numerator</p> <p>A1 correct</p> <p>M1 for use of <math>\sin^2 A + \cos^2 A = 1</math></p>
<p><b>4</b> Substitution of <math>x = 1</math>  leading to <math>a + b + 4 = 0</math></p> <p>Substitution of <math>x = -\frac{1}{2}</math> leading to  <math>-a + 2b - 28 = 0</math></p> <p>Leading to <math>a = -12, b = 8</math></p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1 [5]</p>	<p>M1 for substitution of <math>x = 1</math> and equated to 3</p> <p>M1 for substitution of <math>x = -\frac{1}{2}</math> and equated to 6</p> <p>A1 for both correct</p> <p>M1 for solution</p> <p>A1 for both</p>
<p><b>5</b> (i) <math>2t^2 - 9t - 5 = 0</math>  <math>(2t + 1)(t - 5) = 0</math>  <math>t = \frac{1}{2}, t = 5</math></p> <p>(ii) <math>x^{\frac{1}{2}} = -0.5, 5</math>  <math>x = 0.25, 25</math></p>	<p>M1</p> <p>DM1</p> <p>A1 [3]</p> <p>M1</p> <p>A1, A1 [3]</p>	<p>M1 for attempting to form a quadratic in <math>t</math></p> <p>DM1 for attempt to solve a 3 term quadratic</p> <p>A1 for both</p> <p>M1 for realising that <math>x^{0.5}</math> is equivalent to <math>t</math> (or valid attempt at solution)</p>
<p><b>6</b> (i) <math>\mathbf{a} = \frac{1}{13} (5\mathbf{i} - 12\mathbf{j})</math></p> <p>(ii) <math>q(5\mathbf{i} - 12\mathbf{j}) + p\mathbf{i} + \mathbf{j} = 19\mathbf{i} - 23\mathbf{j}</math>  <math>5q + p = 19</math>  <math>-12q + 1 = -23</math>  Leading to <math>q = 2, p = 9</math></p>	<p>M1, A1 [2]</p> <p>M1</p> <p>M1</p> <p>A1 [3]</p>	<p>M1 for a valid attempt to obtain magnitude.</p> <p>M1 for equating like vectors</p> <p>M1 for solution of (simultaneous) equations</p> <p>A1 for both</p>

<p>7 (i) <math>y = 4x^2 - 12x + 3</math> <math>y = (2x - 3)^2 - 6</math></p> <p>(ii) <math>\left(\frac{3}{2}, -6\right)</math></p> <p>(iii) <math>f \geq -6</math></p>	<p>B1 B1 B1 [3]</p> <p><math>\sqrt{B1}</math>, <math>\sqrt{B1}</math> [2]</p> <p><math>\sqrt{B1}</math> [1]</p>	<p>B1 for 2 (part of linear factor) B1 for -3 (part of linear factor) B1 for -6</p> <p>Follow through on their <math>a</math>, <math>b</math> and <math>c</math> Allow calculus method.</p> <p>Follow through on their <math>c</math></p>
<p>8 <math>\frac{dy}{dx} = -2e^{-2x}(+c)</math></p> <p>When <math>\frac{dy}{dx} = 3, x = 0, \therefore c_1 = 5</math></p> <p><math>\frac{dy}{dx} = -2e^{-2x} + 5</math></p> <p><math>y = e^{-2x} + 5x(+c_2)</math></p> <p>When <math>x = 2, y = e^{-4} \therefore c_2 = -10</math></p> <p><math>y = e^{-2x} + 5x - 10</math></p>	<p>B1</p> <p>M1 A1</p> <p>B1 M1 <math>\sqrt{A1}</math> [6]</p>	<p>B1 for <math>-2e^{-2x}</math></p> <p>M1 for attempt to find <math>c_1</math></p> <p>B1 for <math>-2e^{-2x}</math> M1 for attempt to find <math>c_2</math> <math>\sqrt{-2}</math> times their <math>c_1</math></p>
<p>9 (i) <math>2^5 + {}^5C_1 2^4(-3x) + {}^5C_2 2^3(-3x)^2</math> <math>32 - 240x + 720x^2</math></p> <p>(ii) <math>32a = 64, \quad a = 2</math> <math>32b - 240a = -192,</math> <math>b = 9</math> <math>-240b + 720a = c</math> <math>c = -720</math></p>	<p>B1 B1 B1 [3]</p> <p>B1 M1 A1 M1 A1 [5]</p>	<p>B1 for 32 or <math>2^5</math> B1 for -240 B1 for 720.</p> <p>B1 for <math>a = 2</math> M1 for equation in <math>a</math> and <math>b</math> equated to <math>\pm 192</math> A1 for <math>b = 9</math> M1 for equation in <math>a</math> and <math>b</math> equated to <math>c</math> A1 for <math>c = -720</math></p>
<p>10 (a) (i) <math>fg(x) = f\left(\frac{x}{x+2}\right)</math> <math>= 3 - \frac{x}{x+2}</math></p> <p>(ii) <math>3 - \frac{x}{x+2} = 10</math> leading to <math>x = -1.75</math></p> <p>(b) (i) <math>h(x) &gt; 4</math></p> <p>(ii) <math>h^{-1}(x) = e^{x-4}</math> <math>h^{-1}(9) = e^5 \quad (\approx 148)</math> or <math>4 + \ln x = 9,</math> leading to <math>x = e^5</math></p> <p>(iii) correct graphs</p>	<p>M1</p> <p>A1 [2]</p> <p>DM1 A1 [2]</p> <p>B1 [1]</p> <p>M1 A1 [2]</p> <p>B1 B1 B1 [3]</p>	<p>M1 for order</p> <p>DM1 for dealing with fractions sensibly</p> <p>M1 for attempting to obtain inverse function</p> <p>B1 for each curve B1 for idea of symmetry</p>

<p><b>11</b> (i) <math>\tan^2 2x = 3</math>  <math>\tan 2x = (\pm)\sqrt{3}</math>  <math>2x = 60^\circ, 120^\circ, 240^\circ, 300^\circ</math>  <math>x = 30^\circ, 60^\circ, 120^\circ, 150^\circ</math></p> <p>(ii) <math>2\operatorname{cosec}^2 y + \operatorname{cosec} y - 3 = 0</math>  <math>(2\operatorname{cosec} y + 3)(\operatorname{cosec} y - 1) = 0</math>  <math>\operatorname{cosec} y = -\frac{3}{2}, 1</math>  <math>\sin y = -\frac{2}{3}, 1</math>  <math>y = 221.8^\circ, 318.2^\circ, y = 90^\circ</math></p> <p>(iii) <math>\cos\left(z + \frac{\pi}{2}\right) = -\frac{1}{2}</math>  <math>z + \frac{\pi}{2} = \frac{2\pi}{3}, \frac{4\pi}{3}</math>  <math>z = \frac{\pi}{6}, \frac{5\pi}{6}</math>, allow 0.52, 2.62 rads</p>	<p>M1 DM1 A1, A1 [4]</p> <p>M1, A1 M1 A1, A1 [5]</p> <p>M1 A1, A1 [3]</p>	<p>M1 for an equation in <math>\tan^2 2x</math> M1 for attempt to solve using <math>2x</math> correctly A1 for any pair</p> <p>M1 for correct use of identity or other valid method A1 for a correct quadratic M1 for solution of quadratic and attempt to solve correctly A1 for <math>221.8^\circ, 318.2^\circ</math>, A1 for <math>90^\circ</math></p> <p>M1 for dealing with sec and order of operations A1 for each</p>
<p><b>12</b></p> <p>(i) <math>\frac{dy}{dx} = \frac{(x+1)2x - x^2}{(x+1)^2}</math>  <math>= \frac{x(x+2)}{(x+1)^2}</math>  <math>\frac{dy}{dx} = 0, x = 0, -2</math>  <math>y = 0, -4</math></p> <p>(ii) gradient of normal = <math>-\frac{4}{3}</math>  normal <math>y = -\frac{4}{3}x + \frac{11}{6}</math>, leads to  <math>M (1.375, 0)</math>  <math>N (0, -4)</math>  Area = 2.75</p>	<p>M1 A1 DM1 A1, A1 [5]</p> <p>M1 A1 <math>\sqrt{}</math> B1 B1 M1 <math>\sqrt{}</math> A1 [6]</p>	<p>M1 for attempt to differentiate a quotient A1 correct allow unsimplified</p> <p>DM1 for equating to zero and an attempt to solve A1 for each pair (could be <math>x = 0</math> and <math>x = -2</math>)</p> <p>M1 for attempt to obtain gradient of the normal A1 for a correct (unsimplified) normal equation Follow through on their normal B1 for <math>N</math> M1 for attempt to get area of triangle Ft on their <math>M</math> and <math>N</math> (must be on axes)</p>