

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2014 series**

**0606 ADDITIONAL MATHEMATICS**

**0606/11**

Paper 1, maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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4	(i) $5y^2 - 7y + 2 = 0$  (ii) $(5y - 2)(y - 1) = 0$ $y = \frac{2}{5}, x = \frac{\ln 0.4}{\ln 5}$  $x = -0.569$  $y = 1, x = 0$	<b>B1, B1</b>  <b>M1</b> <b>M1</b> <b>A1</b> <b>B1</b>	<b>B1</b> for 5, <b>B1</b> for $-7$  for solution of quadratic equation from (i) for use of logarithms to solve equation of the type $5^x = k$ must be evaluated to 3sf or better
5	(i) $\frac{dy}{dx} = 3x^2 - \frac{1}{x}$ When $x = 1, y = 1$ and $\frac{dy}{dx} = 2$ Tangent: $y - 1 = 2(x - 1)$  $(y = 2x - 1)$  (ii) Mid-point (5, 9) $9 = 2(5) - 1$  Alternative Method: Tangent equation $y = 2x - 1$ Equation of line joining $(-2, 16)$ and $(12, 2)$ $y = -x + 14$ Solve simultaneously $x = 5, y = 9$  Mid-point (5, 9)	<b>M1</b> <b>B1</b> <b>DM1</b> <b>A1</b>  <b>B1</b> <b>B1</b>  <b>B1</b> <b>B1</b>	for attempt to differentiate for $y = 1$ for attempt to find equation of tangent allow equation unsimplified  for midpoint from given coordinates for checking the mid-point lies on tangent  for a complete method to find the coordinates of the point of intersection for midpoint from given coordinates
6	(i) $(2 + px)^6 = 64 + 192px + 240p^2x^2 \dots$  $240p^2 = 60$ $p = \frac{1}{2}$  (ii) $(3 - x)(64 + 192px + 240p^2x^2 \dots)$  Coefficient of $x^2$ is $180 - 192p$ $= 84$	<b>B1</b>  <b>M1</b> <b>A1</b>  <b>B1 ft</b>  <b>M1</b> <b>A1</b>	for $240p^2$ or $240p^2x^2$ or ${}^6C_2 \times 2^4 \times (px)^2$ or ${}^6C_2 \times 2^4 \times p^2$ or ${}^6C_2 \times 2^4 \times p^2x^2$  for equating <i>their</i> term in $x^2$ to 60 and attempt to solve  <b>ft</b> for $192p, 96$ or $192 \times \text{their } p$  for $180 - 192p$

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<p>7 (i)</p> <p>(ii)</p>	$\mathbf{A}^{-1} = \frac{1}{5ab} \begin{pmatrix} b & -2b \\ a & 3a \end{pmatrix}$ $\mathbf{X} = \mathbf{BA}^{-1}$ $= \begin{pmatrix} -a & b \\ 2a & 2b \end{pmatrix} \begin{pmatrix} \frac{1}{5a} & -\frac{2}{5a} \\ \frac{1}{5b} & \frac{3}{5b} \end{pmatrix}$ $= \begin{pmatrix} 0 & 1 \\ \frac{4}{5} & \frac{2}{5} \end{pmatrix}$	<p><b>B1, B1</b></p> <p><b>M1</b></p> <p><b>DM1</b></p> <p><b>A1</b></p> <p><b>A1</b></p>	<p><b>B1</b> for <math>\frac{1}{5ab}</math>, <b>B1</b> for <math>\begin{pmatrix} b &amp; -2b \\ a &amp; 3a \end{pmatrix}</math></p> <p>for post-multiplication by inverse matrix</p> <p>for correct attempt at matrix multiplication, needs at least one term correct for their <math>\mathbf{BA}^{-1}</math> (allow unsimplified)</p> <p>for each correct pair of elements, must be simplified</p>
<p>8 (i)</p> <p>(ii)</p> <p>(iii)</p>	<p><math>\overline{AB} = \begin{pmatrix} 12 \\ 16 \end{pmatrix}</math>, at <math>P</math>, <math>x = -2 + \frac{1}{4}(12)</math>  so at <math>P</math>, <math>x = 1</math>  <math>y = 3 + \frac{1}{4}(16)</math>, <math>y = 7</math></p> <p>Gradient of <math>AB = \frac{16}{12}</math>, so perp gradient = <math>-\frac{3}{4}</math></p> <p>Perp line: <math>y - 7 = -\frac{3}{4}(x - 1)</math>  <math>(3x + 4y = 31)</math></p> <p><math>Q\left(0, \frac{31}{4}\right)</math></p> <p>Area <math>AQB = 12.5</math></p>	<p><b>B1</b></p> <p><b>B1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>B1 ft</b></p> <p><b>M1</b></p> <p><b>A1</b></p>	<p>for convincing argument for <math>x = 1</math></p> <p>for <math>y = 7</math></p> <p>for finding gradient of perpendicular</p> <p>for equation of perpendicular through their <math>P</math></p> <p>Allow unsimplified</p> <p><b>ft</b> on their perpendicular line, may be implied</p> <p>for any valid method of finding the area of the correct triangle, allow use of <i>their</i> <math>Q</math>; must be in the form <math>(0, q)</math>.</p>

9	(i)	$\log y = \log a + x \log b$ <table border="1" style="margin: 10px 0;"> <tr> <td><math>x</math></td> <td>2</td> <td>2.5</td> <td>3</td> <td>3.5</td> <td>4</td> </tr> <tr> <td><math>\lg y</math></td> <td>1.27</td> <td>1.47</td> <td>1.67</td> <td>1.87</td> <td>2.07</td> </tr> </table> <table border="1" style="margin: 10px 0;"> <tr> <td></td> <td>2</td> <td>2.5</td> <td>3</td> <td>3.5</td> <td>4</td> </tr> <tr> <td><math>\ln y</math></td> <td>2.93</td> <td>3.39</td> <td>3.84</td> <td>4.31</td> <td>4.76</td> </tr> </table> <div style="margin: 10px 0;"> </div>	$x$	2	2.5	3	3.5	4	$\lg y$	1.27	1.47	1.67	1.87	2.07		2	2.5	3	3.5	4	$\ln y$	2.93	3.39	3.84	4.31	4.76	<p><b>B1</b> for the statement, may be seen or implied in later work,</p> <p><b>M1</b> for attempt to draw graph of <math>x</math> against <math>\log y</math></p> <p><b>A2,1,0</b> –1 each error in points plotted</p>
	$x$	2	2.5	3	3.5	4																					
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$\ln y$	2.93	3.39	3.84	4.31	4.76																						
(ii)	<p>Gradient = <math>\log b</math>  <math>\lg b = 0.4</math> or <math>\ln b = 0.92</math></p> <p><math>b = 2.5</math> (allow 2.4 to 2.6)</p> <p>Intercept = <math>\log a</math>  <math>\lg a = 0.47</math> or <math>\ln a = 1.10</math></p> <p><math>a = 3</math> (allow 2.8 to 3.2)</p> <p>Alternative method:  Simultaneous equations may be used provided points that are on the plotted straight line are used.</p> <p><math>a = 3</math> (allow 2.8 to 3.2)  <math>b = 2.5</math> (allow 2.4 to 2.6)</p>	<p><b>DM1</b> for attempt to find gradient and equate it to <math>\log b</math>, dependent on <b>M1</b> in (i)</p> <p><b>A1</b></p> <p><b>DM1</b> for attempt to equate <math>y</math>-intercept to <math>\log a</math> or use <i>their</i> equation with <i>their</i> gradient and a point on the line, dependent on <b>M1</b> in (i)</p> <p><b>A1</b></p> <p><b>DM1</b> for a pair of equations using points on the line, dependent on <b>M1</b> in (i)</p> <p><b>DM1</b> for solution of these equations, dependent on <b>M1</b> in (i)</p> <p><b>A1</b> <b>A1</b> for each</p>																									

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<p><b>10 (a) (i)</b> <b>(ii)</b> <b>(iii)</b></p> <p><b>(b) (i)</b></p> <p><b>(ii)</b></p>	<p>360 60 36</p> <p><math>{}^8C_5 \times {}^{12}C_5</math></p> <p><math>56 \times 792 = 44352</math></p> <p>4 places are accounted for Gender no longer 'important'</p> <p>Need <math>{}^{16}C_6 = 8008</math></p> <p>Alternative Method <math>({}^6C_6 \times {}^{10}C_0) + ({}^6C_5 \times {}^{10}C_1) \dots ({}^6C_0 \times {}^{10}C_6)</math> <math>1 + 60 + 675 + 2400 + 3150 + 1512 + 210 = 8008</math></p>	<p><b>B1</b> <b>B1</b> <b>B1</b></p> <p><b>B1, B1</b></p> <p><b>B1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> <p><b>M1</b> <b>A1</b></p>	<p><b>B1</b> for each, allow unevaluated with no extra terms</p> <p><b>B1</b> Final answer must be evaluated and from multiplication</p> <p><b>M1</b> for realising that 4 places are accounted or that gender is no longer important</p> <p><b>A1</b> for 8008</p> <p><b>M1</b> for at least 5 of the 7 cases, allow unsimplified</p>
<p><b>11 (a)</b></p> <p><b>(b)</b></p>	<p><math>2 \cos 3x - \frac{\cos 3x}{\sin 3x} = 0</math></p> <p><math>\cos 3x \left( 2 - \frac{1}{\sin 3x} \right) = 0</math></p> <p>Leading to <math>\cos 3x = 0</math>, <math>3x = 90^\circ, 270^\circ</math></p> <p style="text-align: right;"><math>x = 30^\circ, 90^\circ</math></p> <p>and <math>\sin 3x = \frac{1}{2}</math>, <math>3x = 30^\circ, 150^\circ</math></p> <p style="text-align: right;"><math>x = 10^\circ, 50^\circ</math></p> <p><math>\cos \left( y + \frac{\pi}{2} \right) = -\frac{1}{2}</math></p> <p><math>y + \frac{\pi}{2} = \frac{2\pi}{3}, \frac{4\pi}{3}</math></p> <p>so <math>y = \frac{\pi}{6}, \frac{5\pi}{6}</math> (0.524, 2.62)</p>	<p><b>M1</b></p> <p><b>DM1</b></p> <p><b>A1</b></p> <p><b>DM1</b></p> <p><b>A1</b></p> <p><b>M1</b></p> <p><b>DM1</b></p> <p><b>A1, A1</b></p>	<p>for use of <math>\cot 3x = \frac{\cos 3x}{\sin 3x}</math>, may be implied</p> <p>for attempt to solve <math>\cos 3x = 0</math> correctly from correct factorisation to obtain <math>x</math></p> <p><b>A1</b> for both, no excess solutions in the range</p> <p>for attempt to solve <math>\sin 3x = \frac{1}{2}</math> correctly to obtain <math>x</math></p> <p><b>A1</b> for both, condone excess solutions</p> <p>for dealing with <math>\sec \left( y + \frac{\pi}{2} \right)</math> correctly</p> <p>for correct order of operations, must not mix degrees and radians</p>

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12 (i)	$\overline{AQ} = \lambda \mathbf{b} - \mathbf{a}$	<b>B1</b>	
(ii)	$\overline{BP} = \mu \mathbf{a} - \mathbf{b}$	<b>B1</b>	
(iii)	$\overline{OR} = \mathbf{a} + \frac{1}{3}(\lambda \mathbf{b} - \mathbf{a})$ or $\lambda \mathbf{b} - \frac{2}{3}(\lambda \mathbf{b} - \mathbf{a})$ $= \frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda \mathbf{b}$	<b>M1</b> <b>A1</b>	for $\mathbf{a} + \frac{1}{3}$ their (i) Allow unsimplified
(iv)	$\overline{OR} = \mathbf{b} + \frac{7}{8}(\mu \mathbf{a} - \mathbf{b})$ or $\mu \mathbf{a} - \frac{1}{8}(\mu \mathbf{a} - \mathbf{b})$ $= \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu \mathbf{a}$	<b>M1</b> <b>A1</b>	for $\mathbf{b} + \frac{7}{8}$ their (ii) Allow unsimplified
(v)	$\frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda \mathbf{b} = \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu \mathbf{a}$ $\frac{2}{3} = \frac{7}{8}\mu, \mu = \frac{16}{21}$ Allow 0.762 $\frac{1}{3}\lambda = \frac{1}{8}, \lambda = \frac{3}{8}$ Allow 0.375	<b>M1</b> <b>A1</b> <b>A1</b>	for equating (iii) and (iv) and then equating like vectors