

**MARK SCHEME for the May/June 2012 question paper  
for the guidance of teachers**

**9794 MATHEMATICS**

**9794/02**

Paper 2 (Pure Mathematics 2), 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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, Pre-U, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2012	9794	02

<p><b>1 (i)</b> Using the quadratic formula or equivalent,  <math display="block">x = \frac{8 \pm \sqrt{64 - 16}}{2} = 4 \pm 2\sqrt{3}</math></p> <p><b>(ii)</b> <math>(6 + 2\sqrt{3})(2 - \sqrt{3}) = 12 - 6\sqrt{3} + 4\sqrt{3} - 2\sqrt{3}\sqrt{3}</math>  <math display="block">= 12 - 6\sqrt{3} + 4\sqrt{3} - 6</math>  <math display="block">= 6 - 2\sqrt{3}</math></p>	<p>M1 A1 [2]</p> <p>M1 B1 A1 [3]</p>	<p>[5]</p>	<p>up to 1 error</p> <p>Multiply out <math>\sqrt{3}\sqrt{3} = 3</math></p>
<p><b>2 (i) (a)</b> <math>AB = \sqrt{6^2 + 8^2} = 10</math></p> <p><b>(b)</b> Midpoint of <math>AB</math> is <math>(6, -3)</math></p> <p><b>(c)</b> <math>(x - 6)^2 + (y + 3)^2 = 25</math> AEF</p> <p><b>(ii)</b> Gradient of <math>AC</math> is <math>-0.5</math>  Use of <math>y = mx + c</math> or equivalent  Required equation: <math>y = -\frac{1}{2}x + \frac{11}{2}</math></p>	<p>M1 A1 [2]</p> <p>B1 [1]</p> <p><math>\sqrt{B1}</math> <math>\sqrt{B1}</math> <math>\sqrt{B1}</math> [3]</p> <p>M1 M1 A1 [3]</p>	<p>[9]</p>	<p>Use Pythagoras</p> <p>ft <i>their</i> values from <b>(a)</b> + <b>(b)</b></p> <p><math>\frac{\Delta y}{\Delta x}</math></p>
<p><b>3</b> <math>\int_0^1 (e^x - x) dx = [e^x - \frac{1}{2}x^2]_0^1</math>  <math display="block">= e - \frac{3}{2}</math></p>	<p>M1 A1 M1 A1 [4]</p>	<p>[4]</p>	<p><math>ke^x + mx^2</math></p> <p>Use of limits Without <math>+ c</math></p>
<p><b>4</b> Take logarithms and apply log rule  <math>(2x - 1)\log 2 = \log 5</math>  Rearrange to make <math>x</math> the subject  Obtain <math>x = \frac{1}{\log 4} = 1.66096\dots</math> AEF</p>	<p>M1 A1 M1 A1 [4]</p>	<p>[4]</p>	<p>Up to 1 error</p>
<p><b>5 (i)</b> Sine wave through the origin, showing intersections with the <math>x</math>-axis at <math>(0), \pi</math> and <math>2\pi</math>.</p> <p><b>(ii)</b> Sine wave translated in the negative <math>x</math>-direction  <math>x</math>-intercepts <math>\frac{5}{6}\pi, \frac{11}{6}\pi</math>, <math>y</math>-intercept <math>0.5</math> and symmetrical about the <math>x</math>-axis.</p>	<p>B1 [1]</p> <p>M1 A1 [2]</p>	<p>[3]</p>	
<p><b>6 (i) (a)</b> <math>u_1 = 5, u_5 = 37</math> implies <math>4d = 32</math>  <math>d = 8</math>  <math>u_n = 8n - 3</math> AEF ft <i>their</i> <math>d</math></p> <p><b>(b)</b> <math>S_n = \frac{n}{2}(2 + 8n)</math> AEF ft <i>their</i> <math>d</math></p> <p><b>(ii)</b> <math>S_{25} - S_4 = 2525 - 68</math>  <math>= 2457</math></p>	<p>M1 A1 M1 <math>\sqrt{A1}</math> [4]</p> <p>M1 <math>\sqrt{A1}</math> [2]</p> <p>M1 A1 [2]</p>	<p>[8]</p>	<p>seen in either part</p> <p>Or equivalent</p>

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2012	9794	02

<p>7 (i) Attempt product rule  <math>\frac{dy}{dx} = 2e^{-2x} - 2(2x - 3)e^{-2x}</math>  <math>= (8 - 4x)e^{-2x}</math></p> <p>(ii) <math>\frac{dy}{dx} \geq 0</math> seen  <math>y</math> is increasing when <math>x \leq 2</math>.</p>	<p>M1  A1  A1 [3]</p> <p>B1  B1 [2]</p>	<p>[5]</p>	
<p>8 Separate variables, prior to integration:  <math>\int \frac{-1}{y^2} dy = \int x^3 dx</math></p> <p><math>\frac{1}{y} = \frac{1}{4}x^4 \quad (+c)</math>  Subs into expression including <math>c</math> and solve  <math>c = \frac{1}{4}</math> so <math>y = \frac{4}{x^4 + 1}</math> AEF</p>	<p>M1  A1  A1  A1  M1  A1 [6]</p>	<p>[6]</p>	
<p>9 (i) <math>P = 2r + 2rx</math>  <math>A = r^2x</math></p> <p>(ii) <math>P = 20</math> implies <math>r = \frac{10}{1+x}</math>  so <math>A = \left(\frac{10}{1+x}\right)^2 x = \frac{100x}{(1+x)^2}</math> AG</p> <p>(iii) Use quotient rule  <math>\frac{dA}{dx} = \frac{100(1+x)^2 - 200x(1+x)}{(1+x)^4} \left[ = \frac{100(1-x)}{(1+x)^3} \right]</math>  Set equal to zero and find <math>x = 1</math></p> <p>Attempt to show with first differential test that it is max.  Completely correct solution</p>	<p>B1  B1 [2]</p> <p>M1  A1 [2]</p> <p>M1  A1  A1</p> <p>M1  A1 [5]</p>	<p>[9]</p>	<p><math>r = f(x)</math></p> <p>Allow <math>\pm 1</math></p> <p>Or equivalent</p>

<b>Page 4</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Pre-U – May/June 2012</b>	<b>9794</b>	<b>02</b>

<p><b>10 (i) (a)</b> <math>\ln(1 + e^x) + c</math></p> <p><b>(b)</b> <math>\ln(1 + e^{\ln 3}) - \ln(1 + e^0)</math>  <math>= \ln 4 - \ln 2</math>  <i>Use log rule correctly</i>  <math>= \ln 2</math> CAO</p> <p><b>(ii) (a)</b> Make substitution, including attempt at changing dx to du.  Attempt to simplify to obtain...</p> $\int \frac{u-1}{u^2} du$ $= \int \frac{1}{u} - \frac{1}{u^2} du \quad \text{Deal with integrand,}$ $= \ln(u) + \frac{1}{u} + c$ $= \ln(1 + e^x) + \frac{1}{1 + e^x} + c \quad \text{CAO}$ <p><b>(b)</b> <math>V = \pi \int_{-\ln 3}^{\ln 3} \left( \frac{e^x}{1 + e^x} \right)^2 dx</math> and attempt to integrate</p> $= \pi \left[ \ln(1 + e^x) + \frac{1}{1 + e^x} \right]_{-\ln 3}^{\ln 3} = \pi \left( \ln 3 - \frac{1}{2} \right)$	<p>B1 B1 [2]</p> <p>M1</p> <p>M1 A1 [3]</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>√A1</p> <p>A1 [5]</p> <p>M1</p> <p>A1 [2]</p>	<p>[12]</p>	<p>Use of limits</p>
---	--	-------------	----------------------

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2012	9794	02

<p><b>11 (i)</b> <math>\frac{df}{dt} = 2\cos t - 2\sin 2t</math>  <math>= 2\cos t - 4\sin t \cos t</math>  <math>= 2\cos t(1 - 2\sin t)</math></p>	M1  A1 [2]		$k\cos t + m\sin 2t$  AG
<p><b>(ii)</b> Find local maxima/minima  <math>f(x) = 0</math> implies <math>x = \frac{1}{2}\pi, \frac{3}{2}\pi, \frac{1}{6}\pi, \frac{5}{6}\pi</math>  Values of <math>f</math> 1, -3, 1.5, 1.5   Values of <math>f</math> at endpoints  1, 1</p>	M1 A1 A1  B1		Any four All eight
<p>Hence range is <math>[-3, 1.5]</math></p> <p><b>(iii)</b> Substitute for <math>x</math> and <math>y</math>, and multiply out:  <math>(2\cos t + \sin 2t)^2 + (2\sin t + \cos 2t)^2</math>  <math>= 4\cos^2 t + 4\cos t \sin 2t + \sin^2 2t</math>  <math>+ 4\sin^2 t + 4\sin t \cos 2t + \cos^2 2t</math>  <math>= 4(\cos^2 t + \sin^2 t) + (\cos^2 2t + \sin^2 2t)</math>  <math>+ 4(\cos t \sin 2t + \sin t \cos 2t)</math>   <math>= 5 + 4\sin(t + 2t) = 5 + 4\sin 3t</math></p>	A1 [5]   M1  DM1  A1 [3]		Including cross-terms  Pythagorean identity OR addition formula  AG
<p><b>(iv)</b> <math>x^2 + y^2 = r^2</math> is a circle centre the origin  <math>5 + 4\sin 3t \in [1, 9]</math>   so <math>C</math> lies between and on circles of radius 1 and 3.</p>	B 0, 1, 2		Either statement B1 Both and conclusion B2
<p><b>(v)</b> <math>\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}</math>  <math>= \frac{2\cos t - 2\sin 2t}{-2\sin t + 2\cos 2t}</math>  at <math>t = 0</math>, <math>\frac{dy}{dx} = \frac{2 - 0}{-0 + 2} = 1</math></p>	M1  A1  A1 [3]	[15]	$\frac{a\cos t + b\sin 2t}{c\sin t + d\cos 2t}$