

**MARK SCHEME for the May/June 2011 question paper  
for the guidance of teachers**

**9794 MATHEMATICS**

**9794/01**

Paper 1 (Pure Mathematics and Probability),  
maximum raw mark 120

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.

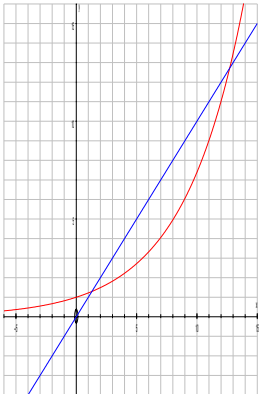
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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9794	01

<p><b>1 (i)</b> Gradient = - 2</p> <p>Attempt eqn of line  <math>y = -2x + 1</math></p>	<p>B1</p> <p>M1</p> <p>A1     <b>[3]</b></p>	<p>Accept aef or method  e.g sim eqns <math>5 = -2m + c</math> and  <math>-7 = 4m + c</math> and substitution for <math>c</math></p> <p>Accept any simplified form</p>
<p><b>2 (i)</b> State <math>2r + r\theta = 18</math>  Obtain correctly <math>\theta = \frac{18 - 2r}{r}</math> AG</p> <p><b>(ii)</b> Substitute <math>S = \frac{1}{2} r^2 \left( \frac{18 - 2r}{r} \right)</math></p> <p>Obtain <math>9r - r^2</math></p>	<p>B1</p> <p>A1</p> <p>M1</p> <p>A1     <b>[4]</b></p>	<p>Accept work in degrees. Formula must be correct</p> <p>Accept work in degrees.  Award for substituting for <math>\theta</math> in correct expression for S.</p>
<p><b>3</b> Method for modulus eqn, maybe implied.</p> <p>State <math>x = 5</math>  State <math>x = \frac{2}{3}</math></p>	<p>M1</p> <p>B1</p> <p>B1     <b>[3]</b></p>	<p>e.g graphical or if algebraic, must consider <math>3 + 2x = 7 - 4x</math> and  <math>3 + 2x = 4x - 7</math>  Ignore <math>y</math> co-ordinates  Accept unsimplified</p>
<p><b>4 (i)</b> <math>\ln x^4 - \ln(3x - 2) - \ln x^2</math></p> <p><math>\ln \frac{x^2}{3x - 2}</math></p> <p><b>(ii)</b> <math>\frac{x^2}{3x - 2} = 1</math>  <math>x^2 - 3x + 2 = 0</math>  <math>x = 2</math> or <math>x = 1</math></p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1     <b>[6]</b></p>	<p>Use power law at least once  Use division or multiplication law at least once  AG so NIS</p> <p>Use <math>e^0 = 1</math> or state <math>x^2 = 3x - 2</math> from  <math>\ln x^2 = \ln(3x - 2)</math>  Attempt soln of 3 term quadratic  Obtain 2 and 1</p>
<p><b>5</b> Attempt use of <math>(\pi) \int (16 - x^2) dx</math>  Attempt integration</p> <p>Obtain <math>(\pi) \left[ 16x - \frac{1}{3} x^3 \right]</math>  Use of correct limits in correct order  Obtain <math>\frac{41\pi}{3}</math> or 42.9 or better</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1     <b>[5]</b></p>	<p>At least one power must rise in their single variable integral</p>

<p><b>6 (i)</b></p>  <p><b>(ii)</b> <math display="block">x_{n+1} = x_n - \frac{e^{0.2x} - x}{0.2e^{0.2x} - 1}</math></p> <p>0, 1.25, 1.2958, 1.2959</p>	<p>B1</p> <p>B1</p> <p>B1*</p> <p>M1</p> <p>B1</p> <p>M1*</p> <p>A1</p> <p><b>[7]</b></p>	<p>A positive exponential graph</p> <p>Straight line with positive slope</p> <p>Show or state two intersections or roots</p> <p>Use correct NR formula</p> <p>Correct derivative</p> <p>Starts at 0 and states at least two iterates</p> <p>States 1.296</p>
<p><b>7 (i)</b></p> <p><math>2 - 3\lambda = 2 - \mu</math>  <math>-3 + \lambda = 4 - 2\mu</math></p> <p>Obtain <math>\lambda = 1</math> <math>\mu = 3</math></p> <p>Obtain <math>a = 3</math> and <math>b = 1</math></p> <p><b>(ii)</b> <math>\begin{pmatrix} -1 \\ -2 \\ 1 \end{pmatrix}</math> and <math>\begin{pmatrix} -3 \\ 1 \\ 1 \end{pmatrix}</math></p> <p><math display="block">\frac{(-3)(-1) + 1(-2) + 1(1)}{(\sqrt{11})(\sqrt{6})}</math></p> <p><math display="block">= \frac{2}{\sqrt{66}} (= 0.246)</math></p> <p>Obtain <math>75.7^\circ</math></p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>B1</p> <p>A1</p> <p><b>[7]</b></p>	<p>Obtain correct eqns</p> <p>Use correct vectors aef</p> <p>Use correct dot product formula</p> <p>Find the length of any vector</p> <p>Obtain acute answer only cao</p>

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9794	01

<p><b>8 (i)</b> <math>(1 - 4a)^{\frac{1}{2}} = 1 + \frac{1}{2}(-4a) + \frac{\left(\frac{1}{2}\right)\left(\frac{-1}{2}\right)}{2}(-4a)^2</math>  <math>= 1 - 2a - 2a^2</math></p> <p><b>(ii)</b> <math>x = \frac{1 \pm \sqrt{1 - 4a}}{2}</math></p> <p><math>x = \frac{1 \pm (1 - 2a - 2a^2)}{2}</math></p> <p><math>x = 1 - a - a^2</math></p> <p><math>x = a + a^2</math></p>	<p>M1 A1 M1 A1</p> <p>B1</p> <p>M1 A1 A1</p> <p><b>[8]</b></p>	<p>Attempt first two terms State <math>1 - 2a</math> Attempt third term Obtain <math>-2a^2</math></p> <p>State <math>\frac{1 \pm \sqrt{1 - 4a}}{2}</math></p> <p>Substitute answer to (i) for discriminant</p> <p>Obtain <math>x = 1 - a - a^2</math> AG Obtain <math>x = a + a^2</math> AG</p>
<p><b>9 (i)</b> <math>\sin 3\theta = \sin(2\theta + \theta)</math>  <math>= \sin 2\theta \cos \theta + \cos 2\theta \sin \theta</math></p> <p><math>= 2 \sin \theta \cos^2 \theta + (1 - 2\sin^2 \theta) \sin \theta</math></p> <p><math>= 2 \sin \theta (1 - \sin^2 \theta) + (1 - 2\sin^2 \theta) \sin \theta</math></p> <p><math>= 3 \sin \theta - 4 \sin^3 \theta</math></p> <p><math>\sin \theta + \sin 3\theta</math>  <math>= 4 \sin \theta - 4 \sin^3 \theta</math>  <math>= 4 \sin \theta (1 - \sin^2 \theta)</math>  <math>= 4 \sin \theta \cos^2 \theta</math></p> <p><b>(ii)</b> <math>\frac{\cos^2 \theta}{\sin^2 \theta} = 4 \sin \theta \cos^2 \theta</math></p> <p><math>\frac{1}{4} = \sin^3 \theta</math></p> <p><math>\theta = 39.0</math> or <math>141.0</math></p>	<p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p><b>[9]</b></p>	<p>Attempt <math>\sin(2\theta + \theta)</math>. Needs two terms but may be incorrect</p> <p>Use any <math>\cos 2\theta</math> or <math>\sin 2\theta</math> identity</p> <p>Use <math>\cos^2 \theta = 1 - \sin^2 \theta</math> anywhere Obtain the AG NIS</p> <p>Factorise <math>4 \sin \theta</math> or <math>\sin \theta</math> and correctly obtain the AG</p> <p>Identify <math>\frac{\cos^2 \theta}{\sin^2 \theta} = \cot^2 \theta</math></p> <p>Attempt to solve for <math>\theta</math></p> <p>Obtain <math>39.0</math> and <math>141.0</math></p> <p>Recognise <math>\cos^2 \theta = 0</math> and state <math>90^\circ</math></p>
<p><b>10 (a)</b> <math>\operatorname{Re} z = -1</math> <math>\operatorname{Im} z = -\sqrt{3}</math></p> <p><b>(b)</b> <math>uv = (1 + ia)(b - i)</math>  <math>a + b = 7</math></p> <p><math>ab - 1 = 9</math></p> <p><math>a^2 - 7a + 10 = 0</math></p> <p><math>(a - 2)(a - 5)</math>  <math>a = 2</math> <math>b = 5</math></p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p><b>[9]</b></p>	<p>State <math>-1</math></p> <p>State with or without <math>i</math>, <math>-\sqrt{3}</math></p> <p>State <math>uv</math></p> <p>Attempt to equate real and imaginary parts Allow aef</p> <p>Solve simultaneous eqns to obtain a quadratic Obtain <math>a^2 - 7a + 10</math> Attempt soln of quadratic Obtain <math>a = 2</math> and <math>b = 5</math></p>

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9794	01

<p><b>11 (i)</b> <math>a, a + 8d</math> and <math>a + 13d</math></p> $a + 8d = ar$ $a + 13d = ar^2$ $r = \frac{a + 13d}{a + 8d} \text{ or } \frac{a + 8d}{a}$ $a(a + 13d) = (a + 8d)^2$ $(a = \frac{-64d}{3})$ $d = \frac{-3a}{64}$ $r = \frac{5}{8}$ <p><b>(ii)</b> <math>S = \frac{8a}{3}</math></p>	<p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>[9]</p>	<p>State <math>n</math>th term of an A.P for at least one term. Must be correct formula Equate to <math>ar</math> and <math>ar^2</math></p> <p>State an expression for <math>r, d</math> or <math>r^2</math></p> <p>Equate 2 expressions and make at least one step to solve</p> <p>Obtain an expression for <math>d</math> or <math>a</math></p> <p>Substitute their value for <math>d</math> or <math>a</math> to find <math>r</math></p> <p>Obtain <math>\frac{5}{8}</math></p> <p>Substitute any <math>r</math> into <math>\frac{a}{1-r}</math></p> <p>Obtain <math>S</math></p>
<p><b>12</b> Attempt to separate variables Attempt to use partial fractions of the form</p> $\frac{A}{x} + \frac{Bx + c}{1 + x^2}$ $A = 1$ $B = -1$ $C = 0$ <p>Obtain <math>\ln y</math> Obtain <math>\ln x - \frac{1}{2}\ln(1 + x^2)</math></p> <p>Attempt to combine logs Attempt to deal with <math>+c</math></p> <p>Obtain <math>y = \frac{Cx}{\sqrt{1 + x^2}}</math></p>	<p>M1*</p> <p>M1*</p> <p>A1</p> <p>A1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>M1*</p> <p>M1*</p> <p>A1</p> <p>[10]</p>	<p>Attempt to find an eqn not including logs Must be valid use of log or its inverse</p>

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9794	01

<p><b>13 (a) (i)</b> Boys mean = 14.8 Girls mean = 14.7</p> <p>Boys sd = 1.21 Girls sd = 2.29</p> <p><b>(ii)</b> Almost the same mean but ages more spread for girls.</p> <p><b>(b)</b> Permutations of DFATD = <math>\frac{5!}{2!} = 60</math> E's can be inserted in 3 of 6 positions <math>{}^6C_3 = 20</math> No of permutations = <math>20 \times 60 = 1200</math></p>	B1	Allow better 14.8013 and 14.6996 or rounding to 14.8 and 14.7
	B1 B1	Allow answers in range [ 1.21, 1.23] or 2.29
	B1	Award only for correct mean and sd. Comment must be made on mean and sd.
	B1	Sight of 60 or $\frac{5!}{2!}$
	B1 B1	20 seen or ${}^6C_3$ Accept 1200 or $20 \times 60$
<p><b>14 (a) (i)</b> <math>A(A - 1) + A(A + 3) + 50 + 2 = 92</math> <math>A^2 + A - 20 = 0</math> or equiv</p> <p><math>A = 4</math></p> <p><b>(ii)</b> The points exactly lie on a straight line</p> <p><b>(b) (i)</b> <math>240 - x + x + 100 - x = 250</math></p> <p><math>X</math> or <math>P(A \cap B) = 90</math> <math>\frac{150}{300}</math></p> <p><b>(ii)</b> <math>\frac{90}{100}</math></p>	M1 A1	Attempt $xy$ products Obtain $A^2 + A - 20 = 0$ or equiv 3 termed expression State $A = 4$ only
	A1	
	B1	The line is $3y - x = 5$
	M1	Valid method seen
	A1	Award if 90 seen in the diagram
	A1	State $\frac{150}{300}$ aef
	M1	Use conditional probability $\frac{\text{their } x}{300} / \frac{100}{300}$
	B1	Obtain 0.9 or equiv
	[7]	
	[9]	

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9794	01

<p><b>15 (i)</b> <math>z = \frac{114 - 120}{6} = -1</math>  <math>P(X &gt; 114) = P(Z &gt; -1)</math>  <math>= 0.8413</math>  Expected profit = <math>15 \times 0.8413</math>  <math>= 12.6195p = \text{£}12.62</math></p> <p><b>(ii)</b> <math>20P(X &gt; x) + 3P(X \leq x) = 19.17</math>  <math>20(1 - P(X \leq x)) + 3P(X \leq x) = 19.17</math></p> $P(X \leq x) = 0.04882$ $(1 - 0.04882) = 0.9512$ $\Phi^{-1}(0.9512) = 1.657$ so $z = -1.657$ . $\frac{x - 120}{6} = -1.657$ or equiv negative version $x = 110$	<p>B1</p> <p>M1 A1 M1 A1</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>M1 B1</p> <p>A1</p> <p><b>[12]</b></p>	<p>State or imply <math>z = \pm 1</math></p> <p>Attempts <math>P(Z &gt; \pm 1)</math>  Concludes 0.8413  Uses Profit = Number <math>\times</math> Prob anywhere  <math>\text{£}12.62</math> or equiv 84.13 (= <math>100 \times 0.8413</math>)  seen. No units seen A0</p> <p>State probabilities (may be wrong way  round) and make one further step to  reduce to a single probability  Obtain 0.04882 or 0.9512</p> <p>Use <math>\Phi^{-1}(0.9512)</math>  Allow <math>\pm [1.655, 1.660]</math></p> <p>Award for sight of <math>\frac{x - 120}{6} = \pm</math> (their)  <math>z</math> value  Obtain 110 (= 110.058)</p>
<p><b>16 (i)</b> <math>P(X = 0) = p^8</math> where <math>X</math> is the number of faulty  chips  <math>P(\text{accept when } X = 1) = 8qp^7 \times p^4</math></p> $= 8qp^{11}$ $P(\text{accept}) = p^8 + 8p^{11} - 8p^{12}$ $= p^8 (1 + 8p^3 - 8p^4)$ <p><b>(ii)</b> +8 seen in their <math>E(X)</math>  <math>P(\text{selecting } 12)</math> involving <math>qp^7</math> or equiv  <math>= 8qp^7</math> or <math>(8p^7 - 8p^8)</math>  <math>E(X) = 8P(8) + 4P(12)</math>  <math>E(X) = 8 + 32qp^7</math>  <math>E(X) = 9.07</math></p>	<p>B1</p> <p>M1 A1 M1 M1 A1</p> <p>B1 M1 A1 M1 A1</p> <p><b>[12]</b></p>	<p>State <math>p^8</math> or <math>(1 - q)^8</math></p> <p>Attempt product of two binomial terms  of correct form  Correct simplified form seen  Use <math>q = 1 - p</math> to write their expression  in terms of <math>p</math>.  Sum their <math>P(X = 0)</math> and <math>P(X = 1)</math>  Obtain given answer</p> <p>Accept <math>P(\text{selecting } 8) = 1</math>  Recognize that <math>P(12)</math> required.  Obtain correct expression  Attempt sum of their two <math>np</math>'s</p> <p>Obtain 9.07 (= 9.06787)</p>