

# Mark Scheme (Results) Summer 2010

GCE

## Further Pure Mathematics FP3 (6669)

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Question Number	Scheme	Marks
<b>1.</b>	$\pm \frac{a}{e} = 8, \quad \pm ae = 2$ $\frac{a}{e} \times ae = a^2 = 16$ $a = 4$ $b^2 = a^2(1 - e^2) = a^2 - a^2e^2$ $\Rightarrow b^2 = 16 - 4 = 12$ $\Rightarrow b = \sqrt{12} = 2\sqrt{3}$	B1, B1  B1  M1 A1  (5)  <b>5</b>

Question Number	Scheme	Marks
2.	$x^2 + 4x + 13 = (x + 2)^2 + 9$ $\int \frac{1}{(x + 2)^2 + 9} dx = \frac{1}{3} \arctan\left(\frac{x + 2}{3}\right)$ $\left[\frac{1}{3} \arctan\left(\frac{x + 2}{3}\right)\right]_{-2}^1 = \frac{1}{3}(\arctan 1 - \arctan 0)$ $= \frac{\pi}{12}$	B1 M1 A1 M1 A1 (5) <b>5</b>







Question Number	Scheme	Marks
<p><b>6(a)</b></p> <p><b>(b)</b></p> <p><b>(c)</b></p> <p><b>(d)</b></p>	$\begin{pmatrix} 1 & 0 & 3 \\ 0 & -2 & 1 \\ k & 0 & 1 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix} = \lambda \begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix}$ $\begin{pmatrix} 24 \\ 4 \\ 6k+6 \end{pmatrix} = \begin{pmatrix} 6\lambda \\ \lambda \\ 6\lambda \end{pmatrix}$ <p>Uses the first or second row to obtain <math>\lambda = 4</math></p> <p>Uses the third row and their <math>\lambda = 4</math> to obtain <math>6k + 6 = 24 \Rightarrow k = 3</math> *</p> $\begin{vmatrix} 1-\lambda & 0 & 3 \\ 0 & -2-\lambda & 1 \\ 3 & 0 & 1-\lambda \end{vmatrix} = 0$ $\Rightarrow (1-\lambda)((-2-\lambda)(1-\lambda)-0) - 0(0(1-\lambda)-3) + 3(0-3(-2-\lambda)) = 0$ $\Rightarrow (1-\lambda)(-2-\lambda)(1-\lambda) + 9(2+\lambda) = (2+\lambda)(9-(1-\lambda)^2) = 0$ $(\lambda^3 - 12\lambda - 16 = 0)$ $\Rightarrow (\lambda + 2)(\lambda^2 - 2\lambda - 8) = 0$ $\Rightarrow (\lambda + 2)(\lambda + 2)(\lambda - 4) = 0$ $\lambda = -2, 4$ <p>Parametric form of <math>l_1 : (t+2, -3t, 4t-1)</math></p> $\begin{pmatrix} 1 & 0 & 3 \\ 0 & -2 & 1 \\ 3 & 0 & 1 \end{pmatrix} \begin{pmatrix} t+2 \\ -3t \\ 4t-1 \end{pmatrix} = \begin{pmatrix} 13t-1 \\ 10t-1 \\ 7t+5 \end{pmatrix}$ <p>Cartesian equations of <math>l_2 : \frac{x+1}{13} = \frac{y+1}{10} = \frac{z-5}{7}</math></p>	<p>M1A1 (2)</p> <p>M1 A1 (2)</p> <p>M1 A1</p> <p>M1 A1 (4) M1</p> <p>M1 A1</p> <p>ddM1A1(5)</p> <p><b>13</b></p>



Question Number	Scheme	Marks
7(a)	$\begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ -4 & 1 & 0 \\ 6 & -2 & 1 \end{vmatrix} = \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix}$ $\begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix} \cdot \begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix} = 5$ $\mathbf{r} \cdot \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix} = 5$	M1 A2(1,0)  M1A1 (5)
(b)	<p>Equation of <math>l</math> is <math>\mathbf{r} = \begin{pmatrix} 6 \\ 13 \\ 5 \end{pmatrix} + t \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix}</math></p> <p>At intersection <math>\begin{pmatrix} 6+t \\ 13+4t \\ 5+2t \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 4 \\ 2 \end{pmatrix} = 5</math></p> $\Rightarrow 6+t+4(13+4t)+2(5+2t)=5 \Rightarrow t=-3$ <p>N is <math>(3,1,-1)</math> *</p>	M1  M1  M1  A1 (4)
(c)	$\overrightarrow{PN} \cdot \overrightarrow{PR} = (-3\mathbf{i} - 12\mathbf{j} - 6\mathbf{k}) \cdot (-5\mathbf{i} - 13\mathbf{j} - 3\mathbf{k}) = 189$ $\sqrt{9+144+36}\sqrt{25+169+9} \cos NPR = 189$ $NX = NP \sin NPR = \sqrt{189} \sin NPR = 3.61$	M1 A1ft  A1  M1A1 (5) <b>14</b>

Question Number	Scheme	Marks
<p><b>8(a)</b></p> <p><b>(b)</b></p>	$\frac{dx}{dt} = 4 \sec t \tan t \quad \frac{dy}{dt} = 2 \sec^2 t$ $\frac{dy}{dx} = \frac{2 \sec^2 t}{4 \sec t \tan t} \quad \left( = \frac{1}{2 \sin t} \right)$ $y - 2 \tan t = \frac{1}{2 \sin t} (x - 4 \sec t)$ $2y \sin t - \frac{4 \sin^2 t}{\cos t} = x - \frac{4}{\cos t}$ $2y \sin t = x - \frac{4 - 4 \sin^2 t}{\cos t} = x - 4 \cos t \quad *$ <p>Gradient of <math>l_2</math> is <math>-2 \sin t</math></p> $y = -2x \sin t \quad (2)$ $2(-2x \sin t) \sin t = x - 4 \cos t \Rightarrow x = \frac{4 \cos t}{1 + 4 \sin^2 t} \quad (1)$ $y = \frac{-8 \sin t \cos t}{1 + 4 \sin^2 t}$ $(x^2 + y^2)^2 = \left( \frac{16 \cos^2 t}{(1 + 4 \sin^2 t)^2} + \frac{64 \sin^2 t \cos^2 t}{(1 + 4 \sin^2 t)^2} \right)^2$ $= \frac{256 \cos^4 t}{(1 + 4 \sin^2 t)^4} (1 + 4 \sin^2 t)^2 = \frac{256 \cos^4 t}{(1 + 4 \sin^2 t)^2}$ $16x^2 - 4y^2 = \frac{256 \cos^2 t}{(1 + 4 \sin^2 t)^2} - \frac{256 \sin^2 t \cos^2 t}{(1 + 4 \sin^2 t)^2} = \frac{256 \cos^4 t}{(1 + 4 \sin^2 t)^2}$	<p>B1 (both)</p> <p>M1</p> <p>M1 A1</p> <p>A1 (5)</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>M1 A1</p> <p>M1</p> <p>A1 (8)</p> <p><b>13</b></p>



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