General Certificate of Education
Advanced Level Examination
June 2012

Mathematics MFP4

Unit Further Pure 4

Friday 22 June 2012 1.30 pm to 3.00 pm

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

1 Find the value of the constant p for which the vectors

$$\mathbf{u} = 3\mathbf{i} + 2\mathbf{j} + p\mathbf{k}, \quad \mathbf{v} = 7\mathbf{i} - \mathbf{j} + 6\mathbf{k} \quad \text{and} \quad \mathbf{w} = 2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$$

are linearly dependent. *(3 marks)*

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2 A line has vector equation $\left(\mathbf{r} - \begin{bmatrix} 3 \\ -2 \\ 6 \end{bmatrix}\right) \times \begin{bmatrix} 4 \\ 7 \\ -4 \end{bmatrix} = \mathbf{0}$.

(a) Determine the direction cosines of this line. *(3 marks)*

(b) Explain the geometrical significance of the direction cosines in relation to the line. *(1 mark)*

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3 Let $\Delta = \begin{vmatrix} yz & xz & xy \\ x & y & z \\ x^2 & -y^2 & z^2 \end{vmatrix}$.

(a) Show that $(y + z)$ is a factor of Δ. *(2 marks)*

(b) Factorise Δ as completely as possible. *(4 marks)*

4 The lines L_1 and L_2 have equations

$$\mathbf{r} = \begin{bmatrix} 7 \\ -25 \\ 9 \end{bmatrix} + \alpha \begin{bmatrix} 3 \\ -4 \\ 7 \end{bmatrix} \quad \text{and} \quad \mathbf{r} = \begin{bmatrix} 7 \\ 19 \\ -2 \end{bmatrix} + \beta \begin{bmatrix} 2 \\ -2 \\ 3 \end{bmatrix}$$

respectively.

(a) Determine a vector, $\mathbf{n}$, which is perpendicular to both lines. *(2 marks)*

(b) (i) The point A on L_1 and the point B on L_2 are such that $\overrightarrow{AB} = \lambda\mathbf{n}$ for some constant λ.

Show that

$$\begin{aligned} 3\alpha - 2\beta + 2\lambda &= 0 \\ 4\alpha - 2\beta - 5\lambda &= -44 \\ 7\alpha - 3\beta + 2\lambda &= -11 \end{aligned}$$

(3 marks)

(ii) Find the position vectors of A and B. *(3 marks)*

(iii) Deduce the shortest distance between L_1 and L_2. *(2 marks)*

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5 The matrix $\mathbf{M} = \begin{bmatrix} -11 & 9 \\ -16 & 13 \end{bmatrix}$ represents the plane transformation T.

(a) (i) Determine the eigenvalue, and a corresponding eigenvector, of $\mathbf{M}$. *(4 marks)*

(ii) Hence write down the value of m for which $y = mx$ is the invariant line of T which passes through the origin, and explain why it is actually a line of invariant points. *(2 marks)*

(iii) Show that, for this value of m, all lines with equations $y = mx + c$ are invariant lines of T. *(3 marks)*

(b) Given that T is a shear, give a full geometrical description of this transformation. *(2 marks)*

(c) Give a full geometrical description of the plane transformation represented by the matrix $\mathbf{M}^{-1}$. *(2 marks)*

6 The planes Π_1, Π_2 and Π_3 have cartesian equations

$$\begin{aligned} 2x + \ \ y - z &= \ 3 \\ 3x - 2y + z &= \ 5 \\ 12x - \ \ y - z &= 40 \end{aligned}$$

respectively.

(a) Find, in the form $\mathbf{r} = \mathbf{a} + \lambda\mathbf{d}$, a vector equation for the line L which is the intersection of Π_1 and Π_2. *(5 marks)*

(b) (i) Determine whether L meets Π_3, and use your answer to decide whether the system given by the equations of these three planes is consistent or inconsistent. *(3 marks)*

(ii) Describe geometrically the arrangement of the three planes. *(1 mark)*

(c) (i) Find the coordinates of a common point of Π_2 and Π_3. *(3 marks)*

(ii) **Deduce** a vector equation for the line of intersection of Π_2 and Π_3. *(1 mark)*

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7 The matrix $\mathbf{A} = \begin{bmatrix} k & 1 & 2 \\ 2 & k & 1 \\ 1 & 2 & k \end{bmatrix}$, where k is a real constant.

(a) (i) Show that there is a value of k for which

$$\mathbf{A}\mathbf{A}^{\mathrm{T}} = m\mathbf{I}$$

where m is a rational number to be determined and $\mathbf{I}$ is the 3×3 identity matrix. *(6 marks)*

(ii) Deduce the inverse matrix, $\mathbf{A}^{-1}$, of $\mathbf{A}$ for this value of k. *(1 mark)*

(b) (i) Find $\det \mathbf{A}$ in terms of k. *(2 marks)*

(ii) In the case when $\mathbf{A}$ is singular, find the integer value of k and show that there are no other possible real values of k. *(3 marks)*

(iii) Find the value of k for which $\lambda = 7$ is a real eigenvalue of $\mathbf{A}$. *(2 marks)*

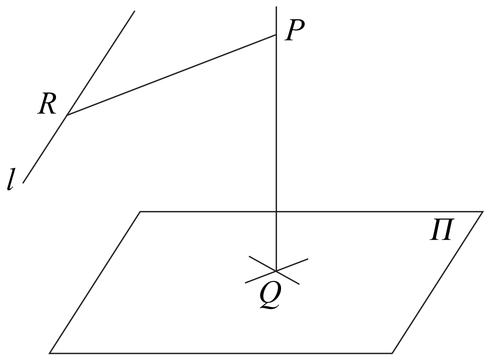
8 The point Q has position vector $\mathbf{q} = \begin{bmatrix} 7 \\ 4 \\ 6 \end{bmatrix}$, the plane Π has equation $\mathbf{r} \cdot \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix} = 36$,

and the line l has equation $\mathbf{r} = \begin{bmatrix} 20 \\ -8 \\ 1 \end{bmatrix} + \mu \begin{bmatrix} -7 \\ 5 \\ 3 \end{bmatrix}$.

(a) Show that Q lies in Π. *(1 mark)*

(b) Show also that l is parallel to Π. *(2 marks)*

(c) The diagram shows the point P, which lies on the normal to Π that passes through Q. The point R is the point on l which is closest to P, and $PQ = PR$.



Determine the coordinates of P. *(9 marks)*

Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
√or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
$-x$ EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Q	Solution	Marks	Total	Comments
1	Attempt at $\begin{vmatrix} 3 & 2 & p \\ 7 & -1 & 6 \\ 2 & 1 & 3 \end{vmatrix} = 0$	M1		
	Solving a linear equation in p $p = 5$	M1 A1	3	
	ALT Lin.dep. iff $\exists$ constants a and b s.t. $a\mathbf{u} + b\mathbf{v} = \mathbf{w}$			
	Solving simultaneously $3a + 7b = 2$ and $2a - b = 1$ M1 $a = \frac{9}{17}$, $b = \frac{1}{17}$ A1 **S**ubstituting back into **k** component ($ap + 6b = 3$) to find "their" p correctly A1F			(from **i** and **j** components)
	Total		**3**	
2(a)	Choice of $\begin{pmatrix} 4 \\ 7 \\ -4 \end{pmatrix}$ as direction vector	B1		
	$\sqrt{4^2 + 7^2 + 4^2}$ or $\sqrt{3^2 + 2^2 + 6^2}$	M1		Either attempted
	$\frac{4}{9}$, $\frac{7}{9}$, $-\frac{4}{9}$ or $\frac{3}{7}$, $-\frac{2}{7}$, $\frac{6}{7}$	A1	3	ft their chosen direction vector
(b)	Direction cosines are the **cosines** of the angles between the line and the coordinate axes	B1	1	
	Total		**4**	
3(a)	eg $\begin{vmatrix} yz & x(y+z) & xy \\ x & y+z & z \\ x^2 & z^2 - y^2 & z^2 \end{vmatrix}$	M1		$C_2{'} = C_2 + C_3$
	$= (y+z)\begin{vmatrix} yz & x & xy \\ x & 1 & z \\ x^2 & z-y & z^2 \end{vmatrix}$	A1	2	
(b)	eg $(y+z)\begin{vmatrix} y(z-x) & x & xy \\ x-z & 1 & z \\ x^2 - z^2 & z-y & z^2 \end{vmatrix}$ $C_1{'} = C_1 - C_3$	M1		Attempt at a second linear factor
	$= (x-z)(y+z)\begin{vmatrix} -y & x & xy \\ 1 & 1 & z \\ x+z & z-y & z^2 \end{vmatrix}$	A1		
	$= (x-z)(y+z)\begin{vmatrix} -(x+y) & x & xy \\ 0 & 1 & z \\ x+y & z-y & z^2 \end{vmatrix}$	M1		$C_1{'} = C_1 - C_2$ Complete attempt at remaining factors (M0 if they just expand and can do nothing with it)
	$= (x-z)(y+z)(x+y)\left(xz - xy - yz\right)$	A1	4	
	Total		**6**	

Q	Solution	Marks	Total	Comments
4(a)	$\begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 3 & -4 & 7 \\ 2 & -2 & 3 \end{vmatrix} = \begin{bmatrix} 2 \\ 5 \\ 2 \end{bmatrix}$	M1		Attempt at the vector product of the 2 d.v.s **OR** two scalar products = 0 and some manipulation attempt
		A1	2	
(b)(i)	$\overrightarrow{AB} = \begin{bmatrix} 2\beta + 7 \\ 19 - 2\beta \\ 3\beta - 2 \end{bmatrix} - \begin{bmatrix} 3\alpha + 7 \\ -25 - 4\alpha \\ 7\alpha + 9 \end{bmatrix}$			
	$= \begin{bmatrix} 2\beta - 3\alpha \\ 44 - 2\beta + 4\alpha \\ -11 + 3\beta - 7\alpha \end{bmatrix}$	M1		Good attempt
	$\overrightarrow{AB} = \lambda\mathbf{n} = \begin{bmatrix} 2\lambda \\ 5\lambda \\ 2\lambda \end{bmatrix}$	M1		With their $\overrightarrow{AB}$ (involving α and β) and their **n**
	Legitimately getting given system of equations: $3\alpha - 2\beta + 2\lambda = 0$ $4\alpha - 2\beta - 5\lambda = -44$ $7\alpha - 3\beta + 2\lambda = -11$	A1	3	
(ii)	Solving this 3 × 3 system in α, β and λ (possibly just λ given or both α, β)	M1		
	For $\alpha = -2$, $\beta = 3$ $(\lambda = 6)$	A1		
	$A = (1, -17, -5)$ and $B = (13, 13, 7)$	A1	3	Give one A1 for a correct pair (α, A) or (β, B) **SC**: allow all 3 marks ft for misreads of the signs (44 and/or 11 only)
(iii)	Shortest distance $= \sqrt{12^2 + 30^2 + 12^2}$ or $\lvert \lambda \rvert \lvert \mathbf{n} \rvert = 6\sqrt{2^2 + 5^2 + 2^2}$	M1		Allow also for the shortest distance formula $\lvert(\mathbf{b} - \mathbf{a}) \cdot \hat{\mathbf{n}}\rvert$
	$6\sqrt{33}$, $\frac{198}{\sqrt{33}}$, $\sqrt{1188}$ or AWRT 34.5	A1	2	CAO
	Total		**10**	

Q	Solution	Marks	Total	Comments
5(a)(i)	Char. eqn. is $\lambda^2 - 2\lambda + 1 = 0$	M1		Written down or attempted via determinant
	$\lambda = 1$ (twice)	A1		
	Substituting $\lambda = 1 \Rightarrow -12x + 9y = 0$ and/or $-16x + 12y = 0$	M1		
	Eigenvector(s) $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$	A1	4	Any non-zero multiple will do
(ii)	$m = \frac{4}{3}$	B1		ft
	LOIPs since $\lambda = 1$ (or full description)	B1	2	
(iii)	$\begin{bmatrix} -11 & 9 \\ -16 & 13 \end{bmatrix}\begin{bmatrix} x \\ \frac{4}{3}x + c \end{bmatrix}$	M1		*m* must be their numerical value
	$= \begin{bmatrix} -11x + 9\left(\frac{4}{3}x + c\right) \\ -16x + 13\left(\frac{4}{3}x + c\right) \end{bmatrix}$ or $\begin{bmatrix} x + 9c \\ \frac{4}{3}x + 13c \end{bmatrix}$	A1		ft
	For showing $y' = \frac{4}{3}x' + c$	B1	3	Impossible without correct prior working
(b)	... parallel to $y = \frac{4}{3}x$"	B1		ft their *m*
	For mapping any one point to a correct image point, eg (1, 0) to (–11, –16), (0, 1) to (9, 13) or (1, 1) to (–2, –3)	B1	2	If they cite multiple points, including incorrect ones, then B0
(c)	Shear parallel to $y = \frac{4}{3}x$	M1		MUST be the same LOIPs as in (b)
	For mapping any one point to a correct image point	A1	2	ft incorrect ones ONLY if they are the reverse of those cited in (b)
	Total		**13**	

Q	Solution	Marks	Total	Comments
6(a)	For attempt at/getting normal d.v. $\begin{bmatrix}1\\5\\7\end{bmatrix}$	M1 A1		
	For getting a point on the line eg (0, –8, –11)	M1 A1		
	For line equation: (**r** =) (their point) + λ (their d.v.)	B1	5	Condone lack of r or **r** here
	ALT eg Adding Π_1 and Π_2 M1 $\Rightarrow$ $5x - y = 8$ A1 Setting (eg) $x=\lambda$ and getting y, z in terms of λ: $y = 5\lambda - 8$, $z = 7\lambda - 11$ M1 Turning this into a vector equation of the given form M1 (**r** =) $\begin{bmatrix}0\\-8\\-11\end{bmatrix} + \lambda\begin{bmatrix}1\\5\\7\end{bmatrix}$ A1			
(b)(i)	Substituting their x, y, z in terms of λ into Π_3's equation ($12x - y - z = 40$)	M1		
	For correct statement with no λ's in: (19 = 40)	A1		ft on incorrect values from their "point"
	Correct conclusion, from valid working, that the system is inconsistent	B1	3	or "consistent" if it genuinely yields 40 = 40
(ii)	The three planes form a (triangular) prism – allow clear diagram	B1	1	ft "sheaf" from a "consistent" conclusion
(c)(i)	e.g. $\Pi_2 + \Pi_3$ $\Rightarrow$ $15x - 3y = 45$ Setting $x = 0$ (eg)	M1 M1		
	Any correct point, eg (0, –15, –25), (3, 0, –4), $\left(\frac{25}{7}, \frac{20}{7}, 0\right)$, (4, 5, 3) etc	A1	3	
(ii)	$\mathbf{r} = \begin{bmatrix}3\\0\\-4\end{bmatrix} + \lambda\begin{bmatrix}1\\5\\7\end{bmatrix}$	B1	1	ft their common point and d.v. from (a) Penalise missing r or **r** here
			13	

Q	Solution	Marks	Total	Comments
7(a)(i)	$\mathbf{A}^{\mathrm{T}} = \begin{bmatrix} k & 2 & 1 \\ 1 & k & 2 \\ 2 & 1 & k \end{bmatrix}$	B1		
	Good multiplication attempt at $\mathbf{A}\,\mathbf{A}^{\mathrm{T}}$	M1		
	$= \begin{bmatrix} k^2+5 & 3k+2 & 3k+2 \\ 3k+2 & k^2+5 & 3k+2 \\ 3k+2 & 3k+2 & k^2+5 \end{bmatrix}$	A1 A1		Main diagonal correct All others correct
	$k = -\frac{2}{3}$ $\quad m = 5\frac{4}{9}$ or $\frac{49}{9}$	A1A1	6	
				If they multiply $\mathbf{A}^{\mathrm{T}}\,\mathbf{A}$ instead, they can score B1 M1 A0 A0 A1 A1
(ii)	$\begin{bmatrix} -\frac{2}{3} & 1 & 2 \\ 2 & -\frac{2}{3} & 1 \\ 1 & 2 & -\frac{2}{3} \end{bmatrix}^{-1} = \frac{9}{49}\begin{bmatrix} -\frac{2}{3} & 2 & 1 \\ 1 & -\frac{2}{3} & 2 \\ 2 & 1 & -\frac{2}{3} \end{bmatrix}$	B1	1	ft $\dfrac{1}{\text{their } m}$ and their k
	Accept $\frac{9}{49}\begin{bmatrix} k & 2 & 1 \\ 1 & k & 2 \\ 2 & 1 & k \end{bmatrix}$ since the value of k is now known, but not just $\frac{9}{49}\mathbf{A}^{\mathrm{T}}$			
	Decimal version (correct to at least 3sf) is also ok: $\begin{bmatrix} -0.122 & 0.367 & 0.184 \\ 0.184 & -0.122 & 0.367 \\ 0.367 & 0.184 & -0.122 \end{bmatrix}$			
(b)(i)	det $\mathbf{A} = k^3 - 6k + 9$	M1 A1	2	Good attempt (cubic)
(ii)	det $\mathbf{A} = (k+3)(k^2 - 3k + 3)$ $k = -3$ $\Delta = 9 - 12 < 0 \Rightarrow$ no further real roots	M1 A1 B1	3	Factorisation attempt **Special Cases** $k = -3$ but no working B1 For all 3 roots, -3 and $\dfrac{3 \pm i\sqrt{3}}{2}$ given with no supporting working B3
(iii)	Replacing k by $(k-7)$ $k = 4$ (however obtained)	M1 A1	2	NOT just in the determinant form (ie starting again) ft their previous $k + 7$
			14	

Q	Solution	Marks	Total	Comments
8(a)	$\begin{bmatrix}7\\4\\6\end{bmatrix}\cdot\begin{bmatrix}2\\1\\3\end{bmatrix} = 14 + 4 + 18 = 36 \Rightarrow Q$ in Π	B1	1	
(b)	$\begin{bmatrix}-7\\5\\3\end{bmatrix}\cdot\begin{bmatrix}2\\1\\3\end{bmatrix} = -14 + 5 + 9 = 0$	B1		Shown
	Explanation that l is perpendicular to Π's normal $\Rightarrow$ l is parallel to Π	B1	2	
	ALT $\begin{bmatrix}20-7\mu\\5\mu-8\\3\mu+1\end{bmatrix}\cdot\begin{bmatrix}2\\1\\3\end{bmatrix} = 35\ \ (+\ 0\mu)$ B1 Explanation that, since this $\neq 36$ (and constant), l does not intersect Π and must therefore be parallel to it B1			
(c)	**Mark according to whichever scheme gives the greatest credit**			
	MARK SCHEME I			
	For $\mathbf{p} = \mathbf{q} + \lambda\,\mathbf{n} = \begin{bmatrix}7+2\lambda\\4+\lambda\\6+3\lambda\end{bmatrix}$ for some λ	B1		
	For $PQ = \lvert\lambda\rvert\sqrt{14}$ or equivalent	B1		
	$\overrightarrow{PR} = \mathbf{r} - \mathbf{p} = \begin{bmatrix}20-7\mu\\5\mu-8\\3\mu+1\end{bmatrix} - \begin{bmatrix}7+2\lambda\\4+\lambda\\6+3\lambda\end{bmatrix}$	M1		
	$= \begin{bmatrix}-7\mu-2\lambda+13\\5\mu-\lambda-12\\3\mu-3\lambda-5\end{bmatrix}$	A1		
	Setting $\overrightarrow{PR}\cdot\begin{bmatrix}-7\\5\\3\end{bmatrix} = 0$	M1		
	Solving linear equation for λ	M1		$\Rightarrow 83\mu - 166 = 0$ ultimately
	$\mu = 2$ and/or $\overrightarrow{PR} = \begin{bmatrix}-(2\lambda+1)\\-(\lambda+2)\\1-3\lambda\end{bmatrix}$	A1		
	$PR^2 = PQ^2$	M1		$(1 + 2\lambda)^2 + (2 + \lambda)^2 + (1 - 3\lambda)^2 = 14\lambda^2$
	$(\lambda = -3)$ $\quad P = (1, 1, -3)$	A1	9	

Q	Solution	Marks	Total	Comments
8(c) cont	**MARK SCHEME II**			
	For $\mathbf{p} = \mathbf{q} + \lambda\,\mathbf{n} = \begin{bmatrix} 7+2\lambda \\ 4+\lambda \\ 6+3\lambda \end{bmatrix}$ for some λ	B1		
	For $PQ^2 = 14\lambda^2$	B1		
	$\overrightarrow{PR} = \mathbf{r} - \mathbf{p} = \begin{bmatrix} 20-7\mu \\ 5\mu-8 \\ 3\mu+1 \end{bmatrix} - \begin{bmatrix} 7+2\lambda \\ 4+\lambda \\ 6+3\lambda \end{bmatrix}$	M1		
	$= \begin{bmatrix} -7\mu-2\lambda+13 \\ 5\mu-\lambda-12 \\ 3\mu-3\lambda-5 \end{bmatrix}$	A1		
	$PR^2 = (-13 + 7\mu + 2\lambda)^2$ $+ (12 - 5\mu + \lambda)^2 + (5 - 3\mu + 3\lambda)$	M1		
	Setting $PR^2 = PQ^2$	M1		
	$\Rightarrow\ 83\mu^2 - 332\mu + 338 + 2\lambda = 0$	A1		Correct quadratic in μ
	Considering discriminant = 0 or $83(\mu - 2)^2 = -2(\lambda + 3)$	M1		
	$\mu = 2$, $\lambda = -3$ and $P = (1, 1, -3)$	A1	(9)	
	MARK SCHEME III			
	For $\mathbf{p} = \mathbf{q} + \lambda\,\mathbf{n} = \begin{bmatrix} 7+2\lambda \\ 4+\lambda \\ 6+3\lambda \end{bmatrix}$ for some λ	B1		
	For $PQ^2 = 14\lambda^2$	B1		
	For $\mathbf{r} = \begin{bmatrix} 20-7\mu \\ 5\mu-8 \\ 3\mu+1 \end{bmatrix}$	B1		
	For $QR^2 =$ $(13 - 7\mu)^2 + (5\mu - 12)^2 + (3\mu - 5)^2$ $= 83\mu^2 - 332\mu + 338 = 83(\mu - 2)^2 + 6$	M1		
	For R closest to Q when $\mu = 2$,	M1		
	$R = (6, 2, 7)$	A1		
	Then $\overrightarrow{RP} = \begin{bmatrix} 1+2\lambda \\ 2+\lambda \\ 3\lambda-1 \end{bmatrix}$	B1		ft
	Setting $PR^2 = PQ^2$ $\Rightarrow\ (1 + 2\lambda)^2 + (2 + \lambda)^2 + (3\lambda - 1)^2 = 14\lambda^2$	M1		
	$(\lambda = -3)$ $P = (1, 1, -3)$	A1	(9)	
	Total		**12**	
	TOTAL		**75**	

Scaled mark unit grade boundaries - June 2012 exams

A-level

Code	Title	Max. Scaled Mark	A*	A	B	C	D	E
MD01	MATHEMATICS UNIT MD01	75	-	60	55	50	45	40
MD02	MATHEMATICS UNIT MD02	75	68	61	53	45	38	31
MFP1	MATHEMATICS UNIT MFP1	75	-	61	54	47	41	35
MFP2	MATHEMATICS UNIT MFP2	75	68	63	56	49	42	35
MFP3	MATHEMATICS UNIT MFP3	75	70	65	57	49	41	33
MFP4	MATHEMATICS UNIT MFP4	75	61	55	48	41	34	28
MM1A	MATHEMATICS UNIT MM1A	100	-	79	69	59	49	39
MM1A/W	*MATHEMATICS UNIT MM1A - WRITTEN*	*75*		*59*				*29*
MM1A/C	*MATHEMATICS UNIT MM1A - COURSEWORK*	*25*		*20*				*10*
MM1B	MATHEMATICS UNIT MM1B	75	-	57	49	41	33	26
MM2B	MATHEMATICS UNIT MM2B	75	69	63	55	48	41	34
MM03	MATHEMATICS UNIT MM03	75	62	55	48	41	34	27
MM04	MATHEMATICS UNIT MM04	75	67	60	52	44	37	30
MM05	MATHEMATICS UNIT MM05	75	67	60	52	44	37	30
MPC1	MATHEMATICS UNIT MPC1	75	-	58	51	44	37	30
MPC2	MATHEMATICS UNIT MPC2	75	-	51	46	41	36	31
MPC3	MATHEMATICS UNIT MPC3	75	67	61	55	49	43	38
MPC4	MATHEMATICS UNIT MPC4	75	59	53	47	41	36	31
MS1A	MATHEMATICS UNIT MS1A	100	-	76	67	59	51	43