2x2 Matrix Transformations MS (From OCR 4755)

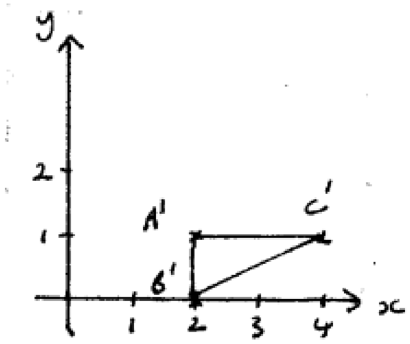
Q1, (Jan 2005, Q1)

Det $\mathbf{M} = 8$	B1	
$\mathbf{M}^{-1} = \frac{1}{8}\begin{pmatrix} 1 & -3 \\ 2 & 2 \end{pmatrix}$	B1	
Area = 16 square units	B1 **[3]**	

Q2, (Jun 2006, Q2)

(i)	Reflection in the x-axis.	B1 **[1]**	
(ii)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	B1 **[1]**	
(iii)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$	M1 A1 c.a.o. **[2]**	Multiplication of their matrices in the correct order or B2 for correct matrix without working

Q3, (Jan 2007, Q3)

(i)		B3 B1	Points correctly plotted Points correctly labelled
	$\begin{pmatrix} 2 & 0 \\ 0 & \frac{1}{2} \end{pmatrix}\begin{pmatrix} 1 & 1 & 2 \\ 2 & 0 & 2 \end{pmatrix} = \begin{pmatrix} 2 & 2 & 4 \\ 1 & 0 & 1 \end{pmatrix}$	***ELSE*** M1 A1 **[4]**	Applying matrix to points Minus 1 each error
ii)	Stretch, factor 2 in x-direction, stretch factor half in y-direction.	B1 B1 B1 **[3]**	1 mark for stretch (withhold if rotation, reflection or translation mentioned incorrectly) 1 mark for each factor and direction

Q4, (Jun 2011, Q1)

(i)	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	B1	Accept expressions in sin and cos
(ii)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	B1	
(iii)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}=\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	M1 A1ft	Ans (ii) x Ans (i) attempt evaluation
(iv)	Reflection in the x axis	B1	
		[5]	

Q5, (Jan 2009, Q3)

(i)	$\begin{pmatrix} 2 & 1 \\ 0 & 2 \end{pmatrix}$	B1 **[1]**	
(ii)	$\begin{pmatrix} 2 & -1 \\ 0 & 3 \end{pmatrix}\begin{pmatrix} 0 & 2 & 3 & 1 \\ 0 & 0 & 2 & 2 \end{pmatrix}=\begin{pmatrix} 0 & 4 & 4 & 0 \\ 0 & 0 & 6 & 6 \end{pmatrix}$ $\Rightarrow A''=(4,\ 0),\ B''=(4,\ 6),\ C''=(0,\ 6)$	M1 A1 **[2]**	Applying matrix to column vectors, with a result. All correct
(iii)	Stretch factor 4 in x-direction. Stretch factor 6 in y-direction	B1 B1 **[2]**	Both factor and direction for each mark. SC1 for "enlargement", not stretch.

Q6, (Jun 2010, Q9)

(i)	P is a rotation through 90 degrees about the origin in a clockwise direction.	B1 B1	Rotation about origin 90 degrees clockwise, or equivalent
	Q is a stretch factor 2 parallel to the x-axis	B1 B1 **[4]**	Stretch factor 2 Parallel to the x-axis
ii)	$\mathbf{QP}=\begin{pmatrix}2&0\\0&1\end{pmatrix}\begin{pmatrix}0&1\\-1&0\end{pmatrix}=\begin{pmatrix}0&2\\-1&0\end{pmatrix}$	M1 A1 **[2]**	Correct order c.a.o.
iii)	$\begin{pmatrix}0&2\\-1&0\end{pmatrix}\begin{pmatrix}2&1&3\\0&2&1\end{pmatrix}=\begin{pmatrix}0&4&2\\-2&-1&-3\end{pmatrix}$	M1	Pre-multiply by their **QP** - may be implied
	$A'=(0,\ -2),\ B'=(4,\ -1),\ C'=(2,\ -3)$	A1(ft) **[2]**	For all three points
iv)	$\mathbf{R}=\begin{pmatrix}0&-1\\-1&0\end{pmatrix}$	B1 B1 **[2]**	One for each correct column
(v)	$\mathbf{RQP}=\begin{pmatrix}0&-1\\-1&0\end{pmatrix}\begin{pmatrix}0&2\\-1&0\end{pmatrix}=\begin{pmatrix}1&0\\0&-2\end{pmatrix}$	M1 A1(ft)	Multiplication of their matrices in correct order
	$(\mathbf{RQP})^{-1}=\frac{-1}{2}\begin{pmatrix}-2&0\\0&1\end{pmatrix}$	M1 A1 **[4]**	Attempt to calculate inverse of their **RQP** c.a.o.

Q7, (Jan 2011, Q2)

(i)	$\det\mathbf{M}=4\times3-(-1)\times0$	M1	oe www
	Area $=12\times3=36$ square units	A1 **[2]**	
(ii)	$\mathbf{M}^{-1}=\frac{1}{12}\begin{pmatrix}3&0\\1&4\end{pmatrix}$	M1 A1	division by their det **M** cao condone decimals 3sf or better
	$\det\mathbf{M}^{-1}=\frac{1}{12}$	B1 **[3]**	cao condone decimal 3sf or better
iii)	$\det\mathbf{M}\times\det\mathbf{M}^{-1}=12\times\frac{1}{12}=1$	B1	Seen or implied
	The inverse 'undoes' the transformation, so the composite of **M** and its inverse must leave a shape unchanged, meaning the area scale factor of the composite transformation must be 1 and so the determinant is 1.	E1 **[2]**	Any valid explanation involving transformations and unchanged area

Q8, (Jun 2014, Q2)

(i)		$\begin{pmatrix} -3 & -2 \\ -2 & 1 \end{pmatrix}$	B1,B1 **[2]**
(ii)		$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B1 **[1]**
(iii)		$\begin{pmatrix} -3 & -2 \\ 2 & -1 \end{pmatrix}$	B1,B1 **[2]**