

## Topic X1 Matrices (Pre-TT B) [43] MARKSCHEME

1.

(i) $a = -3$	B1	1	State correct value
(ii) $2a - 3 = 7$ or $3a - 6 = 9$	M1		Sensible attempt at multiplication
$a = 5$	A1	2	Obtain correct answer
		<b>3</b>	

2.

$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$	B1 M1 A1 A1	4 4	State or use correct result Combine matrix and its inverse Obtain I or I <sup>2</sup> but not 1 Obtain zero matrix but not 0 S.C. If 0/4, B1 for $AA^{-1} = I$
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3.

(i) $2 \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} - 1 \begin{bmatrix} 1 & 1 \\ 1 & 3 \end{bmatrix} + 3 \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$ $2 \times 5 - 1 \times 2 + 3 \times -1$ 5	M1  A1 A1 B1ft	3 1 <b>4</b>	Show correct expansion process, allow sign slips  Obtain correct (unsimplified) expression Obtain correct answer State that M is non-singular as det M non-zero, ft their determinant
(ii)			

4.

(i)		B1 B1 B1 [3]	Shear, must be shear (only) otherwise 0/3 $x$ -axis invariant, allow parallel to or along $x$ -axis, in $x$ direction ( not in $x$ -axis ) Image of e.g. (0, 1) is (5,1) or column vectors allow $0.197^\circ$ , $11.3^\circ$ , $\tan^{-1}(1/5)$ or the complement, ignore scale factor if all OK otherwise
(ii)	$\begin{pmatrix} 1 & 0 \\ 0 & 4 \end{pmatrix}$	B1 B1 [2]	Each column correct
(iii)	$\begin{pmatrix} 1 & 5 \\ 0 & 4 \end{pmatrix}$	M1 A1ft [2]	Multiply matrices in correct order, or consider image of columns of P under Q Obtain correct answer, ft their (ii)
iv)	(Area =) 4	M1 A1ft [2]	Find the determinant of a relevant matrix Obtain correct answer, ft their (iii) N.B. it is possible to consider scale factor for each transformation or draw a diagram

5.

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$k^2 - 16$			B1	Obtain correct det
$k = \pm 4$			M1	Equate their det to 0
			A1	Obtain correct answers
			<b>3</b>	

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6.

<p>(i) <math>\begin{pmatrix} 0 \\ 0 \end{pmatrix} \begin{pmatrix} 0 \\ -1 \end{pmatrix} \begin{pmatrix} 3 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ -1 \end{pmatrix}</math></p>	<p>M1 A1</p>	<p>2</p>	<p>For at least two correct images For correct diagram, co-ords. clearly written down</p>
<p>(ii) 90° clockwise, centre origin</p> $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	<p>B1 B1  B1</p>	<p>3</p>	<p>Or equivalent correct description Correct matrix, not in trig form</p>
<p>(iii) Stretch parallel to x-axis, s.f. 3</p> $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$	<p>B1 B1  B1 B1</p>	<p>4  9</p>	<p>Or equivalent correct description, but must be a stretch for 2<sup>nd</sup> B1  Each correct column</p>

7.

<p>(i)</p> $\Delta = \det \mathbf{D} = 3a - 6$ $\mathbf{D}^{-1} = \frac{1}{\Delta} \begin{pmatrix} 3 & -2 & 4 \\ -3 & a & -2a \\ -3 & a & a-6 \end{pmatrix}$	<p>M1 M1 A1 M1 A1 B1 A1</p>	<p>7</p>	<p>Show correct expansion process for 3 x 3 Correct evaluation of any 2 x 2 det Obtain correct answer Show correct process for adjoint entries Obtain at least 4 correct entries in adjoint</p>
<p>(ii) <math>\frac{1}{\Delta} \begin{pmatrix} 5 \\ 2a-9 \\ 5a-15 \end{pmatrix}</math></p>	<p>M1 A1A1A1 ft all 3</p>	<p>4  11</p>	<p>Divide by their determinant Obtain completely correct answer  Attempt product of form <math>\mathbf{D}^{-1}\mathbf{C}</math>, or eliminate to get 2 equations and solve Obtain correct answers, ft their inverse</p>