

Topic X1 Matrices (Post-TT A) [40] MARKSCHEME

1.

(i)	$\begin{pmatrix} 4 & 4a \\ 12 & 0 \end{pmatrix}$	B1 B1 B1	3 3	3B seen or implied 2 elements correct Other 2 elements correct, a.e.f., including brackets
(ii)	$\begin{pmatrix} 4 + 4a & 3a \\ 4 & 1 \end{pmatrix}$	M1 A1	2	Sensible attempt at matrix multiplication for AB or BA Obtain correct answer

5

2.

1		M1	Show correct expansion process for 3×3	Condone sign errors for first M1 M2 for the "diagonal" method
	$2a^2 + 6a - 15$	M1 A1 [3]	Correct evaluation of any 2×2 Obtain correct answer i.s.w.	Det = $1/(2a^2 + 6a - 15)$ only A0

3.

(i)	$\begin{pmatrix} -13 \\ 1 \\ -10 \end{pmatrix}$	B1 B1	2	4B seen or implied or 2 elements correct Obtain correct answer
(ii)	$\begin{pmatrix} 8 & 16 & -4 \\ 0 & 0 & 0 \\ 6 & 12 & -3 \end{pmatrix}$	M1 A1A1A1	4	Obtain a 3×3 matrix Each row (or column) correct
(iii)	(8)	M1 A1	2 8	Obtain a single value Obtain correct answer, must have matrix

4.

(i)	Let x , y and z be the amount invested in each account $\begin{pmatrix} 1 & 1 & 1 \\ 0.025 & 0.037 & 0.049 \\ 1 & -2 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 2000 \\ 92 \\ 0 \end{pmatrix}$	B2 [2]	1.1 3.1b	B1 for writing down matrix alone	OR B2 Let s be the amount invested in the savings account $(0.025 \ 0.037 \ 0.049) \begin{pmatrix} 2s \\ s \\ 2000 - 3s \end{pmatrix} = 92$
(ii)	$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 & 1 & 1 \\ 0.025 & 0.037 & 0.049 \\ 1 & -2 & 0 \end{pmatrix}^{-1} \begin{pmatrix} 2000 \\ 92 \\ 0 \end{pmatrix}$ $x = 200$, $y = 100$, $z = 1700$ so he invests £200 in the current account £100 in the savings account £1700 in the supersaver account	M1 A1 [2]	3.1a 1.1	Attempt to find x , y , z BC Interpret in context	M1 by multiplying out and solving for s . A1 $s = 100$ so he invests £200 in the current account £100 in the savings account £1700 in the supersaver account
(iii)	The 92 in part (ii) should be 92 ± 0.5 , therefore giving a range of answers for each account	E1 E1 [2]	3.1b 3.2b		

5.

Let the invariant lines be $y = mx + c$, so a point on the line is $(x, mx + c)$

$$\begin{pmatrix} -1 & 1 \\ -4 & 3 \end{pmatrix} \begin{pmatrix} x \\ mx + c \end{pmatrix} = \begin{pmatrix} -x + mx + c \\ -4x + 3mx + 3c \end{pmatrix} \quad [\text{M1}, \text{A1}]$$

This image point must lie on the line $y = mx + c$, so

$$-4x + 3mx + 3c = m(-x + mx + c) + c \text{ must be true for all values of } x \text{ and } c \quad [\text{M1}]$$

$$\text{Equating coefficients of } x: \quad -4 + 3m = -m + m^2 \quad [\text{M1}]$$

$$\text{So:} \quad m^2 - 4m + 4 = 0 \quad [\text{A1}]$$

$$m = 2$$

$$\text{Equating coefficients of } c: \quad 3 = m + 1$$

$$\text{So:} \quad m = 2 \quad [\text{M1}]$$

This is true for $m = 2$ so $y = 2x + c$ is the only invariant line [A1]

6.

(i)	B1 B1 B1	3	Find coordinates (0, 0) (3, 1) (2, 1) (5, 2) found Accurate diagram sketched
(ii) $\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$	B1 B1	2	Each column correct
(iii) <i>Either</i> $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$	B1 M1		Correct inverse for their (ii) stated Post multiply C by inverse of (ii)
Or	A1ft M1 A2ft		Correct answer found Set up 4 equations for elements from correct matrix multiplication All elements correct, -1 each error
	B1 B1 B1	6 11	Shear, x axis invariant or parallel to x -axis eg image of (1, 1) is (3, 1) SR allow s.f. 2 or shearing angle of correct angle to appropriate axis