

Guidance for tutors

Outcome	SA9	Student can consistently:	Understand and solve problems involving matrices.
How the topic is examined	<ul style="list-style-type: none"> This topic is not currently examined on GCSE but is on Level 2 Further Maths, AS/A2 mathematics and additional maths qualifications. It is likely that students would have a calculator to solve these problems, but it is not necessary. Questions may ask students <ul style="list-style-type: none"> Multiply a 2 x 2 matrix by 2 x 2 or 2 x 1 matrix Understand the identity matrix I Carry out transformations using a matrix 		
Prior knowledge	<ul style="list-style-type: none"> Students should be confident with: <ul style="list-style-type: none"> Basic numbers Transformations (SA4) In addition questions involving this topic can have links to: <ul style="list-style-type: none"> Vectors (SA8) Simultaneous equations (AEq8) 		
Suggested tuition approaches	<ul style="list-style-type: none"> Students should understand the basic principles of a matrix and be introduced to its applications. There are some key calculations that students should be able to perform. <p>1) Matrix multiplication</p> <p>For matrix multiplication, $M \times N$ is only possible if the number of columns in M is equal to the number of rows in N. For a 2 x 2 matrix multiplied by a 2 x 2 matrix you get.</p> $M = \begin{bmatrix} a & c \\ b & d \end{bmatrix} \quad N = \begin{bmatrix} p & r \\ q & s \end{bmatrix} \quad MN = \begin{bmatrix} ap + cq & ar + cs \\ bp + dq & br + ds \end{bmatrix}$		

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2) Identify matrix

Denoted by I , such that $MI = IM = M$

$$I_1 = [1], \quad I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \quad I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \text{ etc....}$$

3) Inverse matrix

If M & N are square matrices and $MN=I$ then $N = M^{-1}$

M^{-1} is the inverse matrix.

$$MM^{-1} = I$$

When

$$M = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$$

$$M^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -c \\ -b & a \end{bmatrix}$$

$ad - bc$ is known as the determinant of the matrix M , denoted by $\begin{vmatrix} a & c \\ b & d \end{vmatrix}$

If $ad - bc = 0$, the inverse matrix doesn't exist. M is said to be singular

If $ad - bc \neq 0$ the inverse exists. M is said to be non-singular

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	<p>4) Matrix transformations</p> <p>Matrices can be used to find the image points of points on a shape on a grid after a certain transformation has been applied.</p> <p>For a detailed explanation and the matrices for different transformations see the following link. It also contains videos of how to perform a matrix transformation.</p> <p>http://www.mathplanet.com/education/geometry/transformations/transformation-using-matrices</p>
Common errors and misconceptions	<ul style="list-style-type: none"> • Students make basic errors in number calculations. • Students forget to multiply a row by column and just multiply the corresponding elements together • The identify matrix is difficult to memorise. • Matrix transformation can be difficult to apply. • Working out/remembering the transformation matrices can be issues. Plenty of practice is often the best way to help students.
Suggested resources	<ul style="list-style-type: none"> • Questions <ul style="list-style-type: none"> ◦ http://www.cimt.org.uk/projects/mepres/alevel/fpure_ch9.pdf • Past GCSE Questions <ul style="list-style-type: none"> ◦ https://www.examsolutions.net/tutorials/exam-questions-matrix-transformations/ • Video tutorials <ul style="list-style-type: none"> ◦ https://www.khanacademy.org/math/precalculus/precalc-matrices