A Level · Edexcel · Further Maths

29 mins 4 questions

2.2 Transformations using Matrices

2.2.1 Transformations using a Matrix / 2.2.2 Geometric Transformations with Matrices / 2.2.3 Invariant Points & Lines

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Total Marks	**/29**

1 (a)

$$\mathbf{M} = \begin{pmatrix} 1 & -\sqrt{3} \\ \sqrt{3} & 1 \end{pmatrix}$$

a) Show that $\mathbf{M}$ is non-singular.

(2 marks)

(b) The hexagon R is transformed to the hexagon S by the transformation represented by the matrix $\mathbf{M}$.

Given that the area of hexagon R is 5 square units,

(b) find the area of hexagon S.

(1 mark)

(c) The matrix $\mathbf{M}$ represents an enlargement, with centre (0, 0) and scale factor k, where $k > 0$, followed by a rotation anti clockwise through an angle θ about (0, 0).

(c) Find the value of k.

(2 marks)

(d) (d) Find the value of θ.

(2 marks)

2 (a)

$$\mathbf{A} = \begin{pmatrix} 2 & a \\ a-4 & b \end{pmatrix}$$

where a and b are non-zero constants.

Given that the matrix $\mathbf{A}$ is self-inverse,

(a) determine the value of b and the possible values for a.

(5 marks)

(b) The matrix $\mathbf{A}$ represents a linear transformation M.

Using the smaller value of a from part (a),

(b) show that the invariant points of the linear transformation M form a line, stating the equation of this line.

(3 marks)

3 (a)

$$\mathbf{P} = \begin{pmatrix} p & 2p \\ -1 & 3p \end{pmatrix}$$

where p is a positive constant.

The matrix $\mathbf{P}$ represents a linear transformation U.

The triangle T has vertices at the points with coordinates (1, 2), (3, 2) and (2, 5).

The area of the image of T under the linear transformation U is 15

(a) Determine the value of p.

(4 marks)

(b) The transformation V consists of a stretch scale factor 3 parallel to the x-axis with the y-axis invariant followed by a stretch scale factor –2 parallel to the y-axis with the x-axis invariant. The transformation V is represented by the matrix $\mathbf{Q}$.

(b) Write down the matrix $\mathbf{Q}$.

(2 marks)

(c) Given that U followed by V is the transformation W, which is represented by the matrix $\mathbf{R}$,

(c) find the matrix $\mathbf{R}$.

(2 marks)

4 (a)

$$\mathbf{M} = \begin{pmatrix} 4 & -5 \\ 2 & -7 \end{pmatrix}$$

(a) Show that the matrix $\mathbf{M}$ is non-singular.

(2 marks)

(b) The transformation T of the plane is represented by the matrix $\mathbf{M}$.

The triangle R is transformed to the triangle S by the transformation T.

Given that the area of S is 63 square units,

(b) find the area of R.

(2 marks)

(c) (c) Show that the line $y = 2x$ is invariant under the transformation T.

(2 marks)