2.3 Matrices and Matrix Transformations: Test Pack

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Allow 60 minutes.

1 In the context of matrix arithmetic for a plotting task, calculate the sum of the 2x2 matrices A = [[2, -1], [3, 4]] and B = [[1, 5], [-2, 0]].

(Total for Question 1 is 1 mark)

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2 A shape is transformed by the matrix [[-1, 0], [2, -2]]. The area of the image is 6 cm².
Work out the area of the original shape.

(Total for Question 2 is 3 marks)

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3 Triangle ABC has vertices A(3, 4), B(-2, -3), C(3, -1).
The matrix [[0, -3], [4, -3]] transforms triangle ABC onto triangle A'B'C'.
Find the coordinates of A', B' and C'.

(Total for Question 3 is 3 marks)

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4 A transformation is represented by a 2 x 2 matrix M. It maps the point (1, 0) to (6, 4) and the point (0, 1) to (6, 3).
Write down M.

(Total for Question 4 is 2 marks)

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5 A = [[2, 3], [1, -1]] and B = [[-3, -3], [3, -4]]
Work out AB.

(Total for Question 5 is 3 marks)

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6 A shape is transformed by the matrix [[2, 2], [4, 0]]. The area of the image is 80 cm².
Work out the area of the original shape.

(Total for Question 6 is 3 marks)

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7 The matrix P represents: reflection in the line y = x.
The matrix Q represents: reflection in the y-axis.
P = [[0, 1], [1, 0]] and Q = [[-1, 0], [0, 1]].
Work out the single matrix that represents the transformation P followed by the transformation Q.

(Total for Question 7 is 3 marks)

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8 For a 2x2 matrix used in area-scaling, calculate the determinant of M = [[5, 2], [1, 3]]. State the determinant value which indicates area scale factor.

(Total for Question 8 is 2 marks)

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9 Triangle ABC has vertices A(1, 1), B(5, 5), C(3, -4).
The matrix [[2, 1], [3, 0]] transforms triangle ABC onto triangle A'B'C'.
Find the coordinates of A', B' and C'.

(Total for Question 9 is 3 marks)

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10 Determine whether the 2x2 matrix S = [[2, 4], [1, 2]] is singular, for a coordinate transform used by Priya. If singular, give a brief reason.

(Total for Question 10 is 3 marks)

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11 A map on the plane is represented by the matrix P = [[-1, 0], [0, 1]] followed by the translation vector u = [[2], [0]]. Describe fully the single transformation performed, and give the image of point (3, -1).

(Total for Question 11 is 5 marks)

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12 Find the 2x2 matrix which represents a rotation of 180 degrees about the origin, and then use it to find the image of point with position vector r = [[-2], [5]].

(Total for Question 12 is 3 marks)

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13 Combine two 2x2 linear transformations. Let A = [[0, 1], [1, 0]] (reflection in the line y = x) and B = [[2, 0], [0, 1]] (horizontal stretch by factor 2). Calculate the single 2x2 matrix that is equivalent to doing B then A (i.e. compute A B).

(Total for Question 13 is 4 marks)

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14 Describe fully the single transformation that maps the square with vertices at (1,1), (2,1), (2,2), (1,2) to the square with vertices at (-2, -2), (-4, -2), (-4, -4), (-2, -4). Give the transformation as a combination of standard terms (scale factor, centre, rotation angle, reflection as appropriate) and any translation vector.

(Total for Question 14 is 4 marks)

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Mark scheme · 2.3 Matrices and Matrix Transformations: Test Pack

Question 1

A + B = [[3, 4], [1, 4]] cao **B1**

Answer: [[3, 4], [1, 4]]

Question 2

determinant = 2, so the area scale factor is 2 **M1**

original area = 6 / 2 **M1**

3 cm² **A1**

Answer: 3 cm^2

Question 3

multiplies the matrix by the column vector of one vertex **M1**

two image points correct, e.g. A' = (-12, 0) **A1**

A'(-12, 0), B'(9, 1), C'(3, 15) **A1**

Answer: A'(-12, 0), B'(9, 1), C'(3, 15)

Question 4

the images of (1, 0) and (0, 1) are the first and second columns of M **M1**

M = [[6, 6], [4, 3]] **A1**

Answer: [[6, 6], [4, 3]]

Question 5

multiplies rows of the first matrix by columns of the second (at least two entries attempted) **M1**

at least two entries correct **A1**

[[3, -18], [-6, 1]] **A1**

Answer: [[3, -18], [-6, 1]]

Question 6

determinant = -8, so the area scale factor is 8 **M1**

original area = 80 / 8 **M1**

10 cm² **A1**

Answer: 10 cm^2

Question 7

recognises the matrix for P followed by Q is QP (not PQ) **M1**

multiplies Q by P correctly (at least two entries correct) **M1**

[[0, -1], [1, 0]] **A1**

Answer: [[0, -1], [1, 0]]

Question 8

uses ad - bc method correctly **M1**

determinant = 13 cao **A1**

Answer: 13

Question 9

multiplies the matrix by the column vector of one vertex **M1**

two image points correct, e.g. A' = (3, 3) **A1**

A'(3, 3), B'(15, 15), C'(2, 9) **A1**

Answer: A'(3, 3), B'(15, 15), C'(2, 9)

Question 10

calculates determinant correctly using ad - bc **M1**

states determinant = 0 or shows rows are proportional **M1**

concludes S is singular with correct reason, e.g. det = 0 so no inverse exists **A1**

Answer: Singular, because determinant = 2*2 - 4*1 = 4 - 4 = 0

Question 11

identifies P as reflection in the y-axis **M1**

applies reflection to point (3, -1) to get (-3, -1) **M1**

applies translation vector u to give final image (-1, -1) **M1**

states combined transformation fully as reflection in the y-axis then translation by (2,0) and notes it is not a single 2x2 linear map **M1**

final image given and description complete, e.g. image of (3, -1) is (-1, -1) and the transformation is reflect in the y-axis then translate by (2,0) **A1**

Question 12

states or writes rotation by 180 degrees matrix as [[-1, 0], [0, -1]] **M1**

multiplies matrix by the column vector r **M1**

image = [[2], [-5]] cao **A1**

Answer: [[2], [-5]]

Question 13

multiplies A and B in the correct order A B **M1**

computes entries correctly for first row **M1**

computes entries correctly for second row **M1**

A B = [[0, 1], [2, 0]] cao **A1**

Answer: [[0, 1], [2, 0]]

Question 14

identifies change in size: scale factor 2 or 2x enlargement or reduction **M1**

identifies orientation change: rotation by 180 degrees or reflection equivalent **M1**

gives correct centre or translation vector, e.g. maps centre (1.5,1.5) to centre (-3, -3) so translation vector is (-4.5, -4.5) or states combined as enlargement with negative scale about origin **M1**

fully correct description, for example: enlargement by scale factor 2 with centre at the origin combined with a reflection through the origin, equivalent to a rotation by 180 degrees and then scale factor 2, which maps the small square to the large one; or concise equivalent description with correct translation vector **A1**

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