4.2 Matrices and Geometric Transformations: Test Pack

AQA 8365 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 P = [[4, -1], [2, 3]] and Q = [[-2, 5], [1, -4]].

(a) Write down the order of matrix P. **(1)**

.....

(b) Find P + Q. **(2)**

.....

(c) Find 2P - Q. **(3)**

.....

(Total for Question 1 is 6 marks)

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2 Four matrices are shown below.

A = [[1, 0], [0, -1]]

B = [[-1, 0], [0, 1]]

C = [[0, 1], [1, 0]]

D = [[-1, 0], [0, -1]]

Which matrix represents a reflection in the x-axis?

- ☐ A) A
- ☐ B) B
- ☐ C) C
- ☐ D) D

(Total for Question 2 is 1 mark)

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3 Point P has coordinates (3, -2).

(a) Write down the matrix representing a rotation of 90 degrees anticlockwise about the origin. **(1)**

.....

(b) Write down the matrix representing a rotation of 180 degrees about the origin. **(1)**

.....

(c) Point P is rotated 90 degrees clockwise about the origin. Find the coordinates of the image. **(3)**

.....

(Total for Question 3 is 5 marks)

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4 Three matrices are given:

M1 = [[0, 1], [1, 0]]

M2 = [[-1, 0], [0, -1]]

M3 = [[0, -1], [-1, 0]]

(a) Describe fully the transformation represented by M1. **(2)**

(b) Describe fully the transformation represented by M2. **(2)**

(c) Describe fully the transformation represented by M3. **(2)**

(Total for Question 4 is 6 marks)

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5 The matrix [[0, 4], [-4, 0]] maps the points P(-3, -3) and Q(-2, 1) to P' and Q'. Find the coordinates of P' and Q'.

(Total for Question 5 is 3 marks)

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6 The matrix [[1, 5], [-1, -3]] maps the point A to the point (-25, 17). Find the coordinates of A.

(Total for Question 6 is 3 marks)

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7 The matrix [[-2, 0], [0, -2]] represents a single transformation. Describe the transformation fully.

(Total for Question 7 is 2 marks)

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8 The matrix [[0, -1], [1, 0]] represents a single transformation. Describe the transformation fully.

(Total for Question 8 is 2 marks)

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9 A transformation maps (1, 0) to (0, -3) and (0, 1) to (-1, 3). Write down the matrix of the transformation and find the image of the point (3, -3).

(Total for Question 9 is 4 marks)

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10 The matrix [[-2, -2], [0, 2]] maps triangle T, of area 6 square units, onto triangle T'. Work out the area of T'.

(Total for Question 10 is 4 marks)

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11 Transformation A is a rotation of 90 degrees anticlockwise about the origin, represented by matrix R = [[0, -1], [1, 0]]. Transformation B is a reflection in the line y = -x, represented by matrix F = [[0, -1], [-1, 0]].

(a) Find the matrix representing transformation A followed by transformation B. **(2)**

(b) Describe fully the single transformation equivalent to the combined transformation in part (a). **(2)**

(c) The point (4, -1) undergoes transformation A followed by transformation B. Use your matrix from part (a) to find the coordinates of the image. **(2)**

(d) Triangle PQR has area 9 cm². Find the area of its image after the combined transformation in part (a), giving a reason. **(2)**

(Total for Question 11 is 8 marks)

12 A transformation is represented by matrix M = [[5, -2], [4, -1]]. A line through the origin with equation y = mx is invariant under this transformation.

(a) Show that m satisfies the equation $m^2 - 3m + 2 = 0$. **(3)**

(b) Hence find the equations of the two invariant lines through the origin. **(3)**

(Total for Question 12 is 6 marks)

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Mark scheme · 4.2 Matrices and Geometric Transformations: Test Pack

Question 1

(a) 2 x 2 cao **B1**

(a) Answer: 2 x 2

(b) adds corresponding entries, with at least two correct **M1**

(b) [[2, 4], [3, -1]] cao **A1**

(b) Answer: [[2, 4], [3, -1]]

(c) finds 2P = [[8, -2], [4, 6]] **M1**

(c) subtracts Q from 2P entrywise **M1**

(c) [[10, -7], [3, 10]] cao **A1**

(c) Answer: [[10, -7], [3, 10]]

Question 2

A cao **B1**

Answer: A) A

Question 3

(a) [[0, -1], [1, 0]] cao **B1**

(a) Answer: [[0, -1], [1, 0]]

(b) [[-1, 0], [0, -1]] cao **B1**

(b) Answer: [[-1, 0], [0, -1]]

(c) uses the rotation matrix [[0, 1], [-1, 0]] for a 90 degree clockwise rotation **M1**

(c) correct multiplication **M1**

(c) (-2, -3) cao **A1**

(c) Answer: (-2, -3)

Question 4

(a) reflection **B1**

(a) in the line y = x **B1**

(a) Answer: Reflection in the line y = x

(b) rotation **B1**

(b) 180 degrees about the origin oe (e.g. enlargement, scale factor -1) **B1**

(b) Answer: Rotation of 180 degrees about the origin

(c) reflection **B1**

(c) in the line y = -x **B1**

(c) Answer: Reflection in the line y = -x

Question 5

multiplies the matrix by a position vector **M1**

P' correct **A1**

Q' correct **A1**

Answer: P' = (-12, 12), Q' = (4, 8)

Question 6

finds the inverse matrix or sets up simultaneous equations **M1**

det = 2 or one equation correct **A1**

(-5, -4) cao **A1**

Answer: (-5, -4)

Question 7

uses the images of (1, 0) and (0, 1) from the columns **M1**

enlargement with scale factor -2 and centre the origin cao **A1**

Answer: enlargement with scale factor -2 and centre the origin

Question 8

uses the images of (1, 0) and (0, 1) from the columns **M1**

rotation of 90 degrees anticlockwise about the origin cao **A1**

Answer: rotation of 90 degrees anticlockwise about the origin

Question 9

columns are the images of (1, 0) and (0, 1) **B1**

[[0, -1], [-3, 3]] **B1**

multiplies matrix by position vector **M1**

(3, -18) **A1**

Answer: [[0, -1], [-3, 3]], image (3, -18)

Question 10

uses the determinant as the area scale factor **M1**

determinant = -4 **A1**

|-4| x 6 **M1**

24 square units cao **A1**

Answer: 24 square units

Question 11

(a) forms F x R with a correct multiplication attempt **M1**

(a) [[-1, 0], [0, 1]] cao **A1**

(a) Answer: [[-1, 0], [0, 1]]

(b) reflection **B1**

(b) in the y-axis **B1**

(b) Answer: Reflection in the y-axis

(c) correct multiplication set up **M1**

(c) (-4, -1) cao **A1**

(c) Answer: (-4, -1)

(d) |det| = 1, since the combined transformation is a reflection, which preserves area **M1**

(d) 9 cm², with correct reason **A1**

(d) Answer: 9 cm^2 (area unchanged since |det| = 1)

Question 12

(a) applies M to the general point (x, mx) to get (5x - 2mx, 4x - mx) **M1**

(a) sets the image's y-coordinate equal to m times its x-coordinate, 4x - mx = m(5x - 2mx), and divides by x **M1**

(a) correctly rearranges to m^2 - 3m + 2 = 0 (answer printed) **A1**

(a) Answer: m^2 - 3m + 2 = 0 (shown)

(b) factorises (m - 1)(m - 2) = 0 or uses the quadratic formula **M1**

(b) m = 1, giving y = x **A1**

(b) m = 2, giving y = 2x **A1**

(b) Answer: y = x and y = 2x

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