HIGHER

2.3 Matrices and Matrix Transformations: 2-hour Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 120 minutes

Name: _____ Date: ____ / ____ / _____

Allow 120 minutes.

1 The matrix M = [[4x, 2], [2, 4]] has determinant 28.
Find the value of x.

(Total for Question 1 is 3 marks)

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2 Triangle PQR has vertices P(2, -4), Q(-4, 4), R(0, 0).
The matrix [[1, -2], [3, 2]] transforms triangle PQR onto triangle P'Q'R'.
Find the coordinates of P', Q' and R'.

(Total for Question 2 is 3 marks)

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3 A transformation is represented by a 2 x 2 matrix M. It maps the point (1, 0) to (-5, 5) and the point (1, 1) to (-1, 1).
Find M.

(Total for Question 3 is 3 marks)

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4 A = [[1, 1], [4, -3]] and v = [0; 1]
Work out Av.

(Total for Question 4 is 3 marks)

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5 The matrix P represents: reflection in the x-axis.
The matrix Q represents: rotation of 90 degrees clockwise about the origin.
P = [[1, 0], [0, -1]] and Q = [[0, 1], [-1, 0]].
Work out the single matrix that represents the transformation P followed by the transformation Q.

(Total for Question 5 is 3 marks)

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

(Total for Question 6 is 2 marks)

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7 The matrix M = [[3x, 0], [3, 1]] has determinant 15.
Find the value of x.

(Total for Question 7 is 3 marks)

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8 Triangle PQR has vertices P(0, -2), Q(3, 3), R(-2, 5).
The matrix [[2, -3], [1, 3]] transforms triangle PQR onto triangle P'Q'R'.
Find the coordinates of P', Q' and R'.

(Total for Question 8 is 3 marks)

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9 A transformation is represented by a 2 x 2 matrix M. It maps the point (1, 0) to (-2, -1) and the point (1, 1) to (3, 3).
Find M.

(Total for Question 9 is 3 marks)

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10 A = [[5, -2], [0, -2]] and B = [[5, -4], [-2, 4]]
Work out AB.

(Total for Question 10 is 3 marks)

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11 A shape is transformed by the matrix [[5, 0], [4, -2]]. The area of the image is 80 cm².
Work out the area of the original shape.

(Total for Question 11 is 3 marks)

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12 The matrix M = [[4x, -3], [4, 1]] has determinant 20.
Find the value of x.

(Total for Question 12 is 3 marks)

---

13 Triangle PQR has vertices P(-3, 1), Q(-4, 4), R(-3, 4).
The matrix [[-1, 0], [-2, -2]] transforms triangle PQR onto triangle P'Q'R'.
Find the coordinates of P', Q' and R'.

(Total for Question 13 is 3 marks)

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14 A transformation is represented by a 2 x 2 matrix M. It maps the point (1, 0) to (-3, 4) and the point (0, 1) to (5, 3).
Write down M.

(Total for Question 14 is 2 marks)

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15 A = [[4, -4], [-2, 0]] and B = [[0, 3], [5, -3]]
Work out AB.

(Total for Question 15 is 3 marks)

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16 A shape is transformed by the matrix [[4, 4], [-1, 5]]. The area of the image is 144 cm^2.
Work out the area of the original shape.

(Total for Question 16 is 3 marks)

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17 The matrix P represents: reflection in the line y = x.
The matrix Q represents: rotation of 90 degrees clockwise about the origin.
P = [[0, 1], [1, 0]] and Q = [[0, 1], [-1, 0]].
Work out the single matrix that represents the transformation P followed by the transformation Q.

(Total for Question 17 is 3 marks)

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18 The matrix M = [[2x, 5], [4, 5]] has determinant -50.
Find the value of x.

(Total for Question 18 is 3 marks)

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19 Triangle XYZ has vertices X(5, -1), Y(4, 1), Z(4, 0).
The matrix [[4, 3], [-2, 3]] transforms triangle XYZ onto triangle X'Y'Z'.
Find the coordinates of X', Y' and Z'.

(Total for Question 19 is 3 marks)

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

(Total for Question 20 is 2 marks)

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21 A = [[2, 4], [3, -4]] and v = [3; 6]
Work out Av.

(Total for Question 21 is 3 marks)

---

22 A shape is transformed by the matrix [[4, 0], [2, 2]]. The area of the image is 32 cm².
Work out the area of the original shape.

(Total for Question 22 is 3 marks)

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

(Total for Question 23 is 3 marks)

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24 Write down the matrix that represents: reflection in the y-axis.

(Total for Question 24 is 2 marks)

---

25 The matrix M = [[3x, 1], [5, 6]] has determinant 49.
Find the value of x.

(Total for Question 25 is 3 marks)

---

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

(Total for Question 26 is 2 marks)

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

(Total for Question 27 is 3 marks)

---

28 A shape is transformed by the matrix [[5, 4], [5, 5]]. The area of the image is 15 cm^2.
Work out the area of the original shape.

(Total for Question 28 is 3 marks)

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29 Calculate the product of a 2x2 transformation matrix and a column vector. Let U = [[0, -1], [1, 0]] (a rotation by 90 degrees) and q = [[4], [1]]. Find U q, the image of q under this rotation.

(Total for Question 29 is 2 marks)

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30 Calculate the 2x2 matrix that represents a combined transformation of first scaling by 3 in all directions, then reflecting in the x-axis. Use matrices S = [[3, 0], [0, 3]] for enlargement and R = [[1, 0], [0, -1]] for reflection. Find the matrix product R S which maps a point after both transformations.

(Total for Question 30 is 2 marks)

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Mark scheme · 2.3 Matrices and Matrix Transformations: 2-hour Pack

Question 1

det M = 4x x 4 - 2 x 2	**M1**
sets 16x - 4 = 28	**M1**
x = 2	**A1**

Answer: x = 2

Question 2

multiplies the matrix by the column vector of one vertex	**M1**
two image points correct, e.g. P' = (10, -2)	**A1**
P'(10, -2), Q'(-12, -4), R'(0, 0)	**A1**

Answer: P'(10, -2), Q'(-12, -4), R'(0, 0)

Question 3

first column of M is the image of (1, 0)	**M1**
second column = image of (1, 1) minus image of (1, 0) = (4, -4)	**M1**
M = [[-5, 4], [5, -4]]	**A1**

Answer: [[-5, 4], [5, -4]]

Question 4

multiplies row 1 of A by the column vector	**M1**
first component 1	**A1**
Av = [1; -3]	**A1**

Answer: [1; -3]

Question 5

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 6

finds the image of the points (1, 0) and (0, 1), which are the columns of the matrix	**M1**
Reflection in the line y = -x	**A1**

Answer: Reflection in the line y = -x

Question 7

det M = 3x x 1 - 0 x 3	**M1**
sets 3x = 15	**M1**
x = 5	**A1**

Answer: x = 5

Question 8

multiplies the matrix by the column vector of one vertex	**M1**
two image points correct, e.g. P' = (6, -6)	**A1**
P'(6, -6), Q'(-3, 12), R'(-19, 13)	**A1**

Answer: P'(6, -6), Q'(-3, 12), R'(-19, 13)

Question 9

first column of M is the image of (1, 0)	**M1**
second column = image of (1, 1) minus image of (1, 0) = (5, 4)	**M1**
M = [[-2, 5], [-1, 4]]	**A1**

Answer: [[-2, 5], [-1, 4]]

Question 10

multiplies rows of the first matrix by columns of the second (at least two entries attempted)	**M1**
at least two entries correct	**A1**
[[29, -28], [4, -8]]	**A1**

Answer: [[29, -28], [4, -8]]

Question 11

determinant = -10, so the area scale factor is 10	**M1**
original area = 80 / 10	**M1**
8 cm²	**A1**

Answer: 8 cm^2

Question 12

det M = 4x x 1 + 3 x 4	**M1**
sets 4x + 12 = 20	**M1**
x = 2	**A1**

Answer: x = 2

Question 13

multiplies the matrix by the column vector of one vertex	**M1**
two image points correct, e.g. P' = (3, 4)	**A1**
P'(3, 4), Q'(4, 0), R'(3, -2)	**A1**

Answer: P'(3, 4), Q'(4, 0), R'(3, -2)

Question 14

the images of (1, 0) and (0, 1) are the first and second columns of M	**M1**
M = [[-3, 5], [4, 3]]	**A1**

Answer: [[-3, 5], [4, 3]]

Question 15

multiplies rows of the first matrix by columns of the second (at least two entries attempted)	**M1**
at least two entries correct	**A1**
[[-20, 24], [0, -6]]	**A1**

Answer: [[-20, 24], [0, -6]]

Question 16

determinant = 24, so the area scale factor is 24	**M1**
original area = 144 / 24	**M1**
6 cm²	**A1**

Answer: 6 cm^2

Question 17

recognises the matrix for P followed by Q is QP (not PQ)	**M1**
multiplies Q by P correctly (at least two entries correct)	**M1**
[[1, 0], [0, -1]]	**A1**

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

Question 18

det M = 2x x 5 - 5 x 4	**M1**
sets 10x - 20 = -50	**M1**
x = -3	**A1**

Answer: x = -3

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Question 19

multiplies the matrix by the column vector of one vertex	**M1**
two image points correct, e.g. X' = (17, -13)	**A1**
X'(17, -13), Y'(19, -5), Z'(16, -8)	**A1**

Answer: X'(17, -13), Y'(19, -5), Z'(16, -8)

Question 20

the images of (1, 0) and (0, 1) are the first and second columns of M	**M1**
M = [[-4, 0], [3, -4]]	**A1**

Answer: [[-4, 0], [3, -4]]

Question 21

multiplies row 1 of A by the column vector	**M1**
first component 30	**A1**
Av = [30; -15]	**A1**

Answer: [30; -15]

Question 22

determinant = 8, so the area scale factor is 8	**M1**
original area = 32 / 8	**M1**
4 cm²	**A1**

Answer: 4 cm^2

Question 23

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 24

uses the images of (1, 0) and (0, 1) as the columns of the matrix	**M1**
[[-1, 0], [0, 1]]	**A1**

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

Question 25

det M = 3x x 6 - 1 x 5	**M1**
sets 18x - 5 = 49	**M1**
x = 3	**A1**

Answer: x = 3

Question 26

the images of (1, 0) and (0, 1) are the first and second columns of M	**M1**
M = [[2, 4], [-1, 4]]	**A1**

Answer: [[2, 4], [-1, 4]]

Question 27

multiplies rows of the first matrix by columns of the second (at least two entries attempted)	**M1**
at least two entries correct	**A1**
[[28, 9], [-12, -7]]	**A1**

Answer: [[28, 9], [-12, -7]]

Question 28

determinant = 5, so the area scale factor is 5	**M1**
original area = 15 / 5	**M1**
3 cm²	**A1**

Answer: 3 cm^2

Question 29

performs correct multiplication of U and q	**M1**
U q = [[-1], [4]] cao	**A1**

Answer: [[-1], [4]]

Question 30

multiplies R and S in correct order R S	**M1**
R S = [[3, 0], [0, -3]] cao	**A1**

Answer: [[3, 0], [0, -3]]

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