4.1 Matrix Operations: Addition, Subtraction and Multiplication: Test Pack

AQA 8365 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 P = [[3, -1, 2], [0, 5, 4]] and Q = [[7], [2], [-3]].

(a) State the order of matrix P. **(1)**

(b) State the order of matrix Q. **(1)**

(c) Explain whether the product PQ can be calculated. If it can, state the order of PQ. **(2)**

(Total for Question 1 is 4 marks)

2 J = [[2, 0, -1], [3, 4, 1]] and K = [[1, 2], [0, -3], [5, 1]].

(a) State the order of the matrix JK. **(1)**

(b) Calculate JK. **(4)**

(Total for Question 2 is 5 marks)

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3 Four matrices are given below.

W = [[2, 1, 0], [3, -1, 4]]

X = [[5], [2], [-1]]

Y = [[1, 2], [3, 4], [0, -2]]

Z = [[6, 7]]

Which matrix has order 3 x 2 (that is, 3 rows and 2 columns)?

- ☐ A) W
- ☐ B) X
- ☐ C) Y
- ☐ D) Z

(Total for Question 3 is 1 mark)

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4 A market stall sells three types of scarf: plain, striped and patterned. The number sold by two stallholders, Priya and Tom, is given by Q = [[12, 5, 8], [7, 10, 3]], where the rows represent Priya and Tom, and the columns represent plain, striped and patterned scarves. The prices in £ are given by the column matrix P = [[1.20], [1.50], [0.90]].

(a) Explain why the calculation QP can be carried out but PQ cannot. **(2)**

(b) Calculate QP, showing your method. **(4)**

(c) Interpret the two entries of QP in the context of the stallholders' sales. **(2)**

(Total for Question 4 is 8 marks)

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5 A = [[2, -1], [3, 0]]. Find A^2 (that is, A x A).

(Total for Question 5 is 3 marks)

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6 Matrix P = [[7, 15, 5]] gives the prices, in pounds, of apples, pears and plums. Matrix Q = [[11], [9], [17]] gives the number of each item bought. Work out PQ and say what the answer represents.

(Total for Question 6 is 4 marks)

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7 A = [[2, 2], [3, -3]]. Work out A^2.

(Total for Question 7 is 3 marks)

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8 Matrix P gives the prices, in pounds, of pens, pencils and rulers at two shops: P = [[2, 11, 6], [3, 13, 7]]. Matrix Q = [[8], [17], [10]] gives the numbers of each item bought. Work out PQ and say what its entries represent.

(Total for Question 8 is 4 marks)

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9 A = [[-2, 1], [1, 5]]. Find the inverse matrix A^{-1}.

(Total for Question 9 is 4 marks)

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10 A = [[0, 1], [1, -1]]. Find the inverse matrix A^{-1}.

(Total for Question 10 is 4 marks)

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11 A = [[1, 0], [2, -1]], B = [[3, -2], [0, 1]] and C = [[1, 1], [2, 0]]. Show that (A + B)C = AC + BC for these matrices.

(a) Find (A + B)C. **(3)**

(b) Find AC + BC, and hence state whether (A + B)C = AC + BC for these matrices. **(4)**

(Total for Question 11 is 7 marks)

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12 A = [[2, 4], [1, 2]] and B = [[x, -8], [-1, y]]. Given that AB is the zero matrix [[0, 0], [0, 0]], find the values of x and y.

(a) Find the value of x. **(2)**

(b) Find the value of y. **(2)**

(c) State what this result shows about matrix multiplication, compared with multiplication of real numbers. **(1)**

(Total for Question 12 is 5 marks)

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Mark scheme · 4.1 Matrix Operations: Addition, Subtraction and Multiplication: Test Pack

Question 1

(a) 2 x 3 cao **B1**

(a) Answer: 2 x 3

(b) 3 x 1 cao **B1**

(b) Answer: 3 x 1

(c) valid reason: PQ can be calculated because the number of columns of P (3) equals the number of rows of Q (3) oe **B1**

(c) states the order of PQ is 2 x 1 (rows of P by columns of Q) **B1**

(c) Answer: Yes, PQ can be calculated; PQ has order 2 x 1

Question 2

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

(a) Answer: 2 x 2

(b) correct method for row 1: 2(1)+0(0)+(-1)(5)=-3 and 2(2)+0(-3)+(-1)(1)=3 **M1**

(b) correct method for row 2: 3(1)+4(0)+1(5)=8 and 3(2)+4(-3)+1(1)=-5 **M1**

(b) first row correct: [-3, 3] **A1**

(b) second row correct: [8, -5], giving JK = [[-3, 3], [8, -5]] cao **A1**

(b) Answer: [[-3, 3], [8, -5]]

Question 3

C cao **B1**

Answer: C) Y

Question 4

(a) for QP: the order of Q is 2 x 3 and the order of P is 3 x 1; the number of columns of Q (3) equals the number of rows of P (3), so QP is defined oe **B1**

(a) for PQ: the number of columns of P (1) does not equal the number of rows of Q (2), so PQ is not defined oe **B1**

(a) Answer: QP is defined because the inner dimensions match (3=3); PQ is not defined because they do not (1 is not equal to 2)

(b) correct method for Priya's row: 12(1.20)+5(1.50)+8(0.90) **M1**

(b) correct method for Tom's row: 7(1.20)+10(1.50)+3(0.90) **M1**

(b) first entry correct: 29.10 (£) **A1**

(b) second entry correct: 26.10 (£), giving QP = [[29.10], [26.10]] cao **A1**

(b) Answer: [[29.10], [26.10]] (in GBP)

(c) states that £29.10 is the total revenue Priya earned from her scarf sales **B1**

(c) states that £26.10 is the total revenue Tom earned from his scarf sales **B1**

(c) Answer: Priya's total revenue is £29.10 and Tom's total revenue is £26.10

Question 5

correct method for row 1: 2(2)+(-1)(3)=1 and 2(-1)+(-1)(0)=-2 **M1**

correct method for row 2: 3(2)+0(3)=6 and 3(-1)+0(0)=-3 **M1**

[[1, -2], [6, -3]] cao **A1**

Answer: [[1, -2], [6, -3]]

Question 6

attempts the multiplication of a 1 x 3 by a 3 x 1 matrix **M1**

77 + 135 + 85 **A1**

[[297]] **A1**

the total cost in pounds **B1**

Answer: [[297]], the total cost in pounds

Question 7

attempt at A x A **M1**

at least two entries correct **A1**

[[10, -2], [-3, 15]] cao **A1**

Answer: [[10, -2], [-3, 15]]

Question 8

row-by-column multiplication **M1**

first entry 263 **A1**

[[263], [315]] **A1**

each entry is the total cost, in pounds, at one shop **B1**

Answer: [[263], [315]], the total cost in pounds at each shop

Question 9

attempt to find the determinant **M1**

determinant = -11 **A1**

swaps leading diagonal and changes sign of the other two entries **M1**

[[-5/11, 1/11], [1/11, 2/11]] oe cao **A1**

Answer: [[-5/11, 1/11], [1/11, 2/11]]

Question 10

attempt to find the determinant **M1**

determinant = -1 **A1**

swaps leading diagonal and changes sign of the other two entries **M1**

[[1, 1], [1, 0]] oe cao **A1**

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

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Question 11

(a) finds A + B = [[4, -2], [2, 0]] **M1**

(a) correct method for multiplying (A+B) by C **M1**

(a) [[0, 4], [2, 2]] cao **A1**

(a) Answer: [[0, 4], [2, 2]]

(b) finds AC = [[1, 1], [0, 2]] correctly **M1**

(b) finds BC = [[-1, 3], [2, 0]] correctly **M1**

(b) AC + BC = [[0, 4], [2, 2]] cao **A1**

(b) correct conclusion that AC + BC = [[0,4],[2,2]] is identical to (A+B)C found in (a), so (A+B)C = AC + BC is confirmed for these matrices **B1**

(b) Answer: AC + BC = [[0, 4], [2, 2]], which equals (A+B)C, confirming the result

Question 12

(a) forms an equation from an entry of AB containing x, e.g. 2x + 4(-1) = 0 **M1**

(a) x = 2 cao **A1**

(a) Answer: x = 2

(b) forms an equation from an entry of AB containing y, e.g. 2(-8) + 4y = 0 **M1**

(b) y = 4 cao **A1**

(b) Answer: y = 4

(c) states that, unlike real numbers, two non-zero matrices can multiply together to give the zero matrix oe **B1**

(c) Answer: Two non-zero matrices can have a product equal to the zero matrix, which is impossible for two non-zero real numbers

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