4.1 Matrix Operations: Addition, Subtraction and Multiplication: 2-hour Pack

AQA 8365 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A = [[-4, -4], [2, -2]] and B = [[6, -2], [5, 6]]. Work out 3A - 4B.

(Total for Question 1 is 3 marks)

2 The matrix [[1, k], [1, -1]] has no inverse. Find the value of k.

(Total for Question 2 is 3 marks)

3 P = [[1, 5, 5], [-3, 3, 0]] and Q = [[3, 2], [-2, -3], [0, 5]]. Work out PQ and write down its order.

(Total for Question 3 is 4 marks)

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4 Matrix P gives the prices, in pounds, of tickets, programmes and badges at two shops: P = [[13, 13, 6], [14, 15, 7]]. Matrix Q = [[9], [15], [10]] gives the numbers of each item bought. Work out PQ and say what its entries represent.

(Total for Question 4 is 4 marks)

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5 A = [[4, -4], [2, -1]]. Find the inverse matrix A^{-1}.

(Total for Question 5 is 4 marks)

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6 A = [[0, -4], [3, 0]]. Work out $A^2 + A$.

(Total for Question 6 is 3 marks)

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7 A = [[4, 3], [5, 4]] and AX = [[-6, -19], [-8, -24]]. Find the matrix X.

(Total for Question 7 is 4 marks)

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

(Total for Question 8 is 3 marks)

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9 Matrix P = [[12, 11, 11]] gives the prices, in pounds, of pens, pencils and rulers. Matrix Q = [[3], [4], [13]] gives the number of each item bought. Work out PQ and say what the answer represents.

(Total for Question 9 is 4 marks)

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10 The matrix [[5, k], [1, 5]] has no inverse. Find the value of k.

(Total for Question 10 is 3 marks)

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11 P = [[0, -2, -1], [-4, 3, 2]] and Q = [[3, -2], [1, 5], [-1, 4]]. Work out QP and write down its order.

(Total for Question 11 is 4 marks)

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12 Matrix P = [[9, 10, 5]] gives the prices, in pounds, of apples, pears and plums. Matrix Q = [[5], [14], [11]] gives the number of each item bought. Work out PQ and say what the answer represents.

(Total for Question 12 is 4 marks)

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13 A = [[2, 1], [5, 3]] and AX = [[-3, -8], [-7, -20]]. Find the matrix X.

(Total for Question 13 is 4 marks)

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14 A = [[3, 5], [4, 5]] and v = [[-2], [1]]. Work out Av.

(Total for Question 14 is 3 marks)

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15 Matrix P = [[14, 2, 2]] gives the prices, in pounds, of apples, pears and plums. Matrix Q = [[9], [12], [17]] gives the number of each item bought. Work out PQ and say what the answer represents.

(Total for Question 15 is 4 marks)

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16 A = [[3, -1], [6, 2]] and B = [[4, -5], [4, 6]]. Work out AB.

(Total for Question 16 is 3 marks)

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17 A = [[-3, 1], [5, -2]] and AX = [[9, 11], [-15, -18]]. Find the matrix X.

(Total for Question 17 is 4 marks)

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18 The matrix [[-2, k], [6, 3]] has no inverse. Find the value of k.

(Total for Question 18 is 3 marks)

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19 A = [[-1, 2], [2, -3]] and AX = [[-1, 12], [0, -20]]. Find the matrix X.

(Total for Question 19 is 4 marks)

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20 A = [[3, -4], [0, 2]]. Work out A^2.

(Total for Question 20 is 3 marks)

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21 A = [[5, -3], [-3, 2]] and AX = [[37, 12], [-23, -8]]. Find the matrix X.

(Total for Question 21 is 4 marks)

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22 A = [[1, 0], [1, -5]] and B = [[5, -4], [-2, 2]]. Work out AB.

(Total for Question 22 is 3 marks)

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23 The matrix [[4, k], [1, -2]] has no inverse. Find the value of k.

(Total for Question 23 is 3 marks)

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24 A = [[5, 3], [-2, -1]] and AX = [[6, 9], [-2, -3]]. Find the matrix X.

(Total for Question 24 is 4 marks)

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25 A = [[1, 2], [3, 2]]. Find the inverse matrix A^{-1}.

(Total for Question 25 is 4 marks)

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26 A = [[5, -3], [-2, 1]] and AX = [[-2, -15], [1, 6]]. Find the matrix X.

(Total for Question 26 is 4 marks)

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27 A = [[-1, 2], [3, 5]]. Work out A^2.

(Total for Question 27 is 3 marks)

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28 G = [[1, 2], [3, -1]] and H = [[4, 0], [-2, 5]].

(a) Find GH. **(3)**

(b) Find HG. **(3)**

(c) Hence state, giving a reason, whether GH = HG. **(1)**

(Total for Question 28 is 7 marks)

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29 A = [[2, -1], [3, 0]], B = [[1, 4], [-2, 5]] and C = [[7, 1], [7, 5]]. Given that kA + B = C, find the value of k.

(Total for Question 29 is 3 marks)

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Mark scheme · 4.1 Matrix Operations: Addition, Subtraction and Multiplication: 2-hour Pack

Question 1

3A = [[-12, -12], [6, -6]]	**M1**
4B found	**M1**
[[-36, -4], [-14, -30]] cao	**A1**

Answer: [[-36, -4], [-14, -30]]

Question 2

uses determinant = 0	**M1**
1(-1) - k(1) = 0 or equivalent	**M1**
k = -1 cao	**A1**

Answer: k = -1

Question 3

order 2 x 2	**B1**
row-by-column method	**M1**
at least half the entries correct	**A1**
[[-7, 12], [-15, -15]] cao	**A1**

Answer: [[-7, 12], [-15, -15]], order 2 x 2

Question 4

row-by-column multiplication	**M1**
first entry 372	**A1**
[[372], [421]]	**A1**
each entry is the total cost, in pounds, at one shop	**B1**

Answer: [[372], [421]], the total cost in pounds at each shop

Question 5

attempt to find the determinant	**M1**
determinant = 4	**A1**
swaps leading diagonal and changes sign of the other two entries	**M1**
[[-1/4, 1], [-1/2, 1]] oe cao	**A1**

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

Question 6

attempt at A^2	**M1**
adds A to the result	**M1**
[[-12, -4], [3, -12]] cao	**A1**

Answer: [[-12, -4], [3, -12]]

Question 7

$X = A^{-1}B$ or equivalent method	**M1**
A^{-1} = [[4, -3], [-5, 4]]	**M1**
at least two entries of X correct	**A1**
[[0, -4], [-2, -1]] cao	**A1**

Answer: [[0, -4], [-2, -1]]

Question 8

row-by-column method with at least two correct entries	**M1**
at least three correct entries	**A1**
[[3, -15], [-16, 14]] cao	**A1**

Answer: [[3, -15], [-16, 14]]

Question 9

attempts the multiplication of a 1 x 3 by a 3 x 1 matrix	**M1**
36 + 44 + 143	**A1**
[[223]]	**A1**
the total cost in pounds	**B1**

Answer: [[223]], the total cost in pounds

Question 10

uses determinant = 0	**M1**
5(5) - k(1) = 0 or equivalent	**M1**
k = 25 cao	**A1**

Answer: k = 25

Question 11

order 3 x 3	**B1**
row-by-column method	**M1**
at least half the entries correct	**A1**
[[8, -12, -7], [-20, 13, 9], [-16, 14, 9]] cao	**A1**

Answer: [[8, -12, -7], [-20, 13, 9], [-16, 14, 9]], order 3 x 3

Question 12

attempts the multiplication of a 1 x 3 by a 3 x 1 matrix	**M1**
45 + 140 + 55	**A1**
[[240]]	**A1**
the total cost in pounds	**B1**

Answer: [[240]], the total cost in pounds

Question 13

$X = A^{-1}B$ or equivalent method	**M1**
A^{-1} = [[3, -1], [-5, 2]]	**M1**
at least two entries of X correct	**A1**
[[-2, -4], [1, 0]] cao	**A1**

Answer: [[-2, -4], [1, 0]]

Question 14

row-by-column method	**M1**
one entry correct	**A1**
[[-1], [-3]] cao	**A1**

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

Question 15

attempts the multiplication of a 1 x 3 by a 3 x 1 matrix	**M1**
126 + 24 + 34	**A1**
[[184]]	**A1**
the total cost in pounds	**B1**

Answer: [[184]], the total cost in pounds

Question 16

row-by-column method with at least two correct entries	**M1**
at least three correct entries	**A1**
[[8, -21], [32, -18]] cao	**A1**

Answer: [[8, -21], [32, -18]]

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Question 17

$X = A^{-1}B$ or equivalent method	**M1**
$A^{-1} = [[-2, -1], [-5, -3]]$	**M1**
at least two entries of X correct	**A1**
[[-3, -4], [0, -1]] cao	**A1**

Answer: [[-3, -4], [0, -1]]

Question 18

uses determinant = 0	**M1**
-2(3) - k(6) = 0 or equivalent	**M1**
k = -1 cao	**A1**

Answer: k = -1

Question 19

$X = A^{-1}B$ or equivalent method	**M1**
$A^{-1} = [[3, 2], [2, 1]]$	**M1**
at least two entries of X correct	**A1**
[[-3, -4], [-2, 4]] cao	**A1**

Answer: [[-3, -4], [-2, 4]]

Question 20

attempt at A x A	**M1**
at least two entries correct	**A1**
[[9, -20], [0, 4]] cao	**A1**

Answer: [[9, -20], [0, 4]]

Question 21

$X = A^{-1}B$ or equivalent method	**M1**
$A^{-1} = [[2, 3], [3, 5]]$	**M1**
at least two entries of X correct	**A1**
[[5, 0], [-4, -4]] cao	**A1**

Answer: [[5, 0], [-4, -4]]

Question 22

row-by-column method with at least two correct entries	**M1**
at least three correct entries	**A1**
[[5, -4], [15, -14]] cao	**A1**

Answer: [[5, -4], [15, -14]]

Question 23

uses determinant = 0	**M1**
4(-2) - k(1) = 0 or equivalent	**M1**
k = -8 cao	**A1**

Answer: k = -8

Question 24

$X = A^{-1}B$ or equivalent method	**M1**
$A^{-1} = [[-1, -3], [2, 5]]$	**M1**
at least two entries of X correct	**A1**
[[0, 0], [2, 3]] cao	**A1**

Answer: [[0, 0], [2, 3]]

Question 25

attempt to find the determinant	**M1**
determinant = -4	**A1**
swaps leading diagonal and changes sign of the other two entries	**M1**
[[-1/2, 1/2], [3/4, -1/4]] oe cao	**A1**

Answer: [[-1/2, 1/2], [3/4, -1/4]]

Question 26

$X = A^{-1}B$ or equivalent method	**M1**
$A^{-1} = [[-1, -3], [-2, -5]]$	**M1**
at least two entries of X correct	**A1**
[[-1, -3], [-1, 0]] cao	**A1**

Answer: [[-1, -3], [-1, 0]]

Question 27

attempt at A x A	**M1**
at least two entries correct	**A1**
[[7, 8], [12, 31]] cao	**A1**

Answer: [[7, 8], [12, 31]]

Question 28

(a) correct method for row 1 of GH: 1(4)+2(-2)=0 and 1(0)+2(5)=10	**M1**
(a) correct method for row 2 of GH: 3(4)+(-1)(-2)=14 and 3(0)+(-1)(5)=-5	**M1**
(a) [[0, 10], [14, -5]] cao	**A1**

(a) Answer: [[0, 10], [14, -5]]

(b) correct method for row 1 of HG: 4(1)+0(3)=4 and 4(2)+0(-1)=8	**M1**
(b) correct method for row 2 of HG: -2(1)+5(3)=13 and -2(2)+5(-1)=-9	**M1**
(b) [[4, 8], [13, -9]] cao	**A1**

(b) Answer: [[4, 8], [13, -9]]

(c) GH is not equal to HG, e.g. the (1,1) entries differ (0 compared with 4), so matrix multiplication is not commutative here	**B1**

(c) Answer: GH is not equal to HG

Question 29

forms an equation from one pair of entries, e.g. 2k + 1 = 7	**M1**
k = 3 cao	**A1**
checks k = 3 against a second entry, e.g. 3(3) - 2 = 7, confirming consistency	**B1**

Answer: k = 3

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