

## Matrices 4024

**Compiled by: Mustafa Asif**

### **Matrices**

- display information in the form of a matrix of any order
- solve problems involving the calculation of the sum and product (where appropriate) of two matrices, and interpret the results
- calculate the product of a matrix and a scalar quantity
- use the algebra of  $2 \times 2$  matrices including the zero and identity  $2 \times 2$  matrices
- calculate the determinant  $|A|$  and inverse  $A^{-1}$  of a non-singular matrix  $A$

For understanding concepts

<https://www.youtube.com/watch?v=xyAuNHPsq-g>

<https://www.youtube.com/watch?v=aIJEZwwtQ3U>

<https://www.youtube.com/watch?v=8RLn0fCJ7BI>

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**M/J19/11/Q15**

1       $T = \begin{pmatrix} 2 & 7 \\ 1 & 5 \end{pmatrix}$

Find  $T^{-1}$ .

$\left( \quad \right)$  [2]

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**M/J19/12/Q25**

2 (a)  $P = \begin{pmatrix} 4 & 0 \\ -2 & 3 \end{pmatrix}$      $Q = \begin{pmatrix} 1 & 2 \\ 0 & -1 \end{pmatrix}$

Evaluate  $PQ$ .

$\left( \begin{array}{cc} & \\ & \end{array} \right)$  [2]

(b)  $M = \begin{pmatrix} 3 & -1 \\ 2 & k \end{pmatrix}$

The determinant of matrix  $M$  is  $-4$ .

(i) Find the value of  $k$ .

$k = \dots\dots\dots$  [1]

(ii) Find  $M^{-1}$ .

$\left( \begin{array}{cc} & \\ & \end{array} \right)$  [1]

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SP18/P1/Q10

3  $A = \begin{pmatrix} 4 & -2 \\ -1 & 1 \end{pmatrix}$      $B = \begin{pmatrix} -3 & 2 \\ -1 & 4 \end{pmatrix}$

(a) Find  $2A - B$ .

*Answer*  $\left( \quad \quad \right)$  [2]

(b) Find  $A^{-1}$ .

*Answer*  $\left( \quad \quad \right)$  [2]

O/N18/11/Q20

4  $A = \begin{pmatrix} 2 & -1 \\ 0 & 1 \end{pmatrix}$      $B = \begin{pmatrix} 4 & 3 \\ 6 & -2 \end{pmatrix}$

(a) Express  $2A - B$  as a single matrix.

*Answer*  $\left( \quad \quad \right)$  [2]

(b) Find  $A^{-1}$ .

*Answer*  $\left( \quad \quad \right)$  [2]

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5 (a) Express  $\begin{pmatrix} 2 \\ 1 \end{pmatrix} - 3\begin{pmatrix} -1 \\ 2 \end{pmatrix} + 2\begin{pmatrix} 0 \\ -2 \end{pmatrix}$  as a single vector. O/N18/12/23

*Answer*  $\begin{pmatrix} \phantom{0} \\ \phantom{0} \end{pmatrix}$  [2]

(b) Find  $\begin{pmatrix} 2 & -1 \end{pmatrix} \begin{pmatrix} 0 & -1 & 2 \\ 3 & 1 & -3 \end{pmatrix}$ .

*Answer* [2]

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6

$$A = \begin{pmatrix} 4 & -1 \\ 2 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 6 & -3 \\ 0 & -2 \end{pmatrix}$$

M/J18/12/Q23

(a) Find the matrix  $X$ , such that  $2A + X = B$ .

Answer  $\left( \begin{array}{cc} & \end{array} \right)$  [2]

(b) Find the matrix  $Y$ , such that  $AY = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ .

Answer [3]

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7

$$A = \begin{pmatrix} 0 & -2 \\ 1 & 3 \end{pmatrix} \quad B = \begin{pmatrix} 3 & 2 \\ -1 & 0 \end{pmatrix}$$

(a) Express  $A - 2B$  as a single matrix.

O/N17/11/Q26

*Answer*

[2]

(b) Find  $A^2$ .

*Answer*

[2]

(c)  $B^{-1} = kA$  where  $k$  is a rational number.

Find  $k$ .

*Answer*  $k = \dots\dots\dots$  [1]

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- 8 (a) Express  $3 \begin{pmatrix} 3 & 1 \\ -5 & -4 \end{pmatrix} - 2 \begin{pmatrix} 1 & -3 \\ 0 & 2 \end{pmatrix}$  as a single matrix. O/N17/12/Q21

- (b) Find the inverse of  $\begin{pmatrix} 3 & 1 \\ -5 & -4 \end{pmatrix}$ .

*Answer*  $\begin{pmatrix} & \\ & \end{pmatrix}$  [2]

*Answer*  $\begin{pmatrix} & \\ & \end{pmatrix}$  [2]



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- 9 Anya makes T-shirts.  
The matrix,  $M$ , shows the number of T-shirts of different types she makes in one week.

$$M = \begin{matrix} & \begin{matrix} \text{Small} & \text{Medium} & \text{Large} \end{matrix} \\ \begin{pmatrix} 10 & 25 & 30 \\ 20 & 40 & 25 \end{pmatrix} & \begin{matrix} \text{Men} \\ \text{Women} \end{matrix} \end{matrix} \quad \text{O/N17/22/Q3}$$

- (a) Anya sells all of these T-shirts to a shop.  
She charges \$5 for each small T-shirt, \$6 for each medium T-shirt and \$8 for each large T-shirt.

Represent these amounts in a  $3 \times 1$  column matrix  $N$ .

*Answer*  $N =$  [1]

- (b) (i) Work out  $P = MN$ .

*Answer*  $P =$  [2]

- (ii) Explain what the elements in matrix  $P$  represent.

*Answer* .....

..... [1]

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- (c) The shopkeeper sells all sizes of men's T-shirts at \$10 each.  
He sells all sizes of women's T-shirts at \$9.50 each.  
He sells all of these T-shirts.

(i) Work out  $(10 \quad 9.50) \begin{pmatrix} 10 & 25 & 30 \\ 20 & 40 & 25 \end{pmatrix}$ .

*Answer* ..... [2]

- (ii) Work out the percentage profit the shopkeeper makes when he sells all of the T-shirts.

*Answer* .....% [3]

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10       $A = \begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix}$        $B = \begin{pmatrix} 2 & -1 \\ 6 & -1 \end{pmatrix}$       MJ17/21/Q4

(a) Calculate

(i)  $BA$ ,

*Answer*

[2]

(ii)  $B^{-1}$ .

*Answer*

$$\begin{pmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{pmatrix}$$

[2]

(b) Given that  $A + 2C = 3B$ , find  $C$ .

*Answer*

$$\begin{pmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{pmatrix}$$

[2]

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11       $A = \begin{pmatrix} 3 & 2 \\ -4 & -2 \end{pmatrix}$        $B = \begin{pmatrix} 5 & 3 \\ -2 & 1 \end{pmatrix}$        $C = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$

(a) Calculate  $2B - 3A$ .

M/J17/22/Q4

Answer  $\left( \begin{array}{c} \phantom{0} \\ \phantom{0} \end{array} \right)$  [2]

(b) Calculate  $BC$ .

Answer [2]

(c) Calculate  $A^{-1} + A$ .

Answer  $\left( \begin{array}{c} \phantom{0} \\ \phantom{0} \end{array} \right)$  [3]

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12

$$A = \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \quad \text{O/N16/11/21}$$

(a) Evaluate  $3A - 2 \begin{pmatrix} 3 & 1 \\ -2 & 0 \end{pmatrix}$ .

*Answer*  $\begin{pmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{pmatrix}$  [2]

(b) Find  $A^{-1}$ .

*Answer*  $\begin{pmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{pmatrix}$  [2]

(c) Write down the single matrix that is equivalent to  $A^{-1}A$ .

*Answer*  $\begin{pmatrix} \phantom{0} & \phantom{0} \\ \phantom{0} & \phantom{0} \end{pmatrix}$  [1]

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O/N16/22/Q6

13      $A = \begin{pmatrix} 2 & 0 \\ 3 & 1 \end{pmatrix}$       $B = \begin{pmatrix} 1 & 2 \\ -1 & 3 \end{pmatrix}$

(a) Find  $A + 2B$ .

*Answer*      $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$      [2]

(b) Find  $AB$ .

*Answer*      $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$      [2]

(c)  $A \begin{pmatrix} x \\ 2 \end{pmatrix} = \begin{pmatrix} 8 \\ 2y \end{pmatrix}$

Find  $x$  and  $y$ .

*Answer*  $x = \dots\dots\dots y = \dots\dots\dots$  [2]

(d) Find  $B^{-1}$ .

*Answer*      $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$      [2]

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14       $A = \begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix}$        $B = \begin{pmatrix} 2 & 0 \\ 7 & -5 \end{pmatrix}$       M/J16/21/Q6

(a) Evaluate  $2A - B$ .

*Answer*       $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$       [2]

(b) Find  $A^2$ .

*Answer*       $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$       [2]

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(c) Find  $B^{-1}$ .

*Answer*  $\left( \begin{array}{c} \\ \end{array} \right)$  [2]

(d)  $A + Z = A$   
Find  $Z$ .

*Answer*  $\left( \begin{array}{c} \\ \end{array} \right)$  [1]

(e)  $M + 2I = B$ , where  $I$  is the  $2 \times 2$  identity matrix.  
Find  $M$ .

*Answer*  $\left( \begin{array}{c} \\ \end{array} \right)$  [2]



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15       $X = \begin{pmatrix} 3 & -1 \\ 2 & 0 \end{pmatrix}$        $Y = \begin{pmatrix} 2 & 2 \\ -1 & 1 \end{pmatrix}$       M/J16/22/Q6(b)

Find

(i)  $2X + Y$ ,

*Answer*       $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$       [2]

(ii)  $Y^{-1}$ .

*Answer*       $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$       [2]

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- 16  $A$ ,  $B$  and  $C$  are three triangles.  
 $T_1$ ,  $T_2$  and  $T_3$  are three transformations such that  $T_1(A) = B$ ,  $T_2(A) = C$  and  $T_3(C) = B$ .  
The vertices of triangle  $A$  are  $(1, 0)$ ,  $(0, 1)$  and  $(1, 3)$ .

The matrix that represents  $T_1$  is  $\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$ . O/N15/12/Q26

(a) Find  $\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 3 \end{pmatrix}$ .

*Answer*

[2]

(b) The matrix that represents  $T_2$  is  $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ .

(i) Find the inverse of  $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ .

*Answer*

[1]

(ii) The matrix that represents  $T_3$  is  $M$ .

Find  $M$ .

*Answer*

[2]

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17 (a)  $A = \begin{pmatrix} 1 & 3 \\ -2 & 2 \end{pmatrix}$      $B = \begin{pmatrix} -1 & 2 \\ -3 & 2 \end{pmatrix}$

Find

(i)  $2A - B$ ,

*Answer*     $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$  [2]

(ii)  $B^{-1}$ .

*Answer*     $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$  [2]

(b) The matrix  $C$  satisfies the following equation.

$$3C + 4 \begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix} = C$$

Find  $C$ .

*Answer*     $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$  [2]

O/N15/21/Q3

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- (c) Theresa sells raspberries and blackcurrants.  
The first matrix shows the number of kilograms of each fruit she sells during three different weeks.  
The second matrix shows the price per kilogram, in cents, of the fruit Theresa sells.

	raspberries	blackcurrants	price/kg	
Week 1	$\left( \begin{array}{cc} 3 & 2 \end{array} \right)$		$\left( \begin{array}{c} 650 \\ 580 \end{array} \right)$	raspberries
Week 2	$\left( \begin{array}{cc} 1.5 & 3 \end{array} \right)$			blackcurrants
Week 3	$\left( \begin{array}{cc} 2 & 2.5 \end{array} \right)$			

(i)  $D = \begin{pmatrix} 3 & 2 \\ 1.5 & 3 \\ 2 & 2.5 \end{pmatrix} \begin{pmatrix} 650 \\ 580 \end{pmatrix}$

Find D.

*Answer* [2]

- (ii) Explain the meaning of the information given by matrix D.

*Answer* ..... [1]

- (iii) Find the total amount, in dollars, that Theresa gets for the fruit she sells.

*Answer* \$ ..... [1]

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M/J15/11/16

18 (a) Express as a single matrix  $\begin{pmatrix} -1 & -3 \\ 1 & 0 \end{pmatrix} - \begin{pmatrix} 1 & -2 \\ 2 & -5 \end{pmatrix}$ .

Answer ..... [1]

(b) Find the inverse of  $\begin{pmatrix} 1 & -1 \\ 5 & 3 \end{pmatrix}$ .

Answer ..... [2]

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- 19 (a) Express as a single matrix  $3\begin{pmatrix} 1 & 3 \\ -2 & 5 \end{pmatrix} - \begin{pmatrix} 4 & 0 \\ -1 & 2 \end{pmatrix}$ . M/J15/12/21

*Answer*

[2]

(b)  $A = \begin{pmatrix} 3 & -2 \\ p & -1 \end{pmatrix}$

The determinant of A is 2 .

- (i) Find  $p$ .

*Answer*  $p = \dots\dots\dots$  [1]

- (ii) Find  $A^{-1}$ .

*Answer*

[1]

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Marking scheme matrices

1	$\frac{1}{3} \begin{pmatrix} 5 & -7 \\ -1 & 2 \end{pmatrix}$ oe isw	2	B1 for $\begin{pmatrix} 5 & -7 \\ -1 & 2 \end{pmatrix}$ soi or $[ Z =] 3$
2(a)	$\begin{pmatrix} 4 & 8 \\ -2 & -7 \end{pmatrix}$	2	B1 for two or three correct elements
2(b)(i)	-2	1	
2(b)(ii)	$-\frac{1}{4} \begin{pmatrix} -2 & 1 \\ -2 & 3 \end{pmatrix}$ oe isw  or $\begin{pmatrix} \frac{1}{2} & -\frac{1}{4} \\ \frac{1}{2} & -\frac{3}{4} \end{pmatrix}$ oe isw	1	FT $-\frac{1}{4} \begin{pmatrix} \text{their } k & 1 \\ -2 & 3 \end{pmatrix}$
3(a)	$\begin{pmatrix} 11 & -6 \\ -1 & -2 \end{pmatrix}$	2	B1 for 3 or 2 correct elements
3(b)	$\begin{pmatrix} \frac{1}{2} & 1 \\ \frac{1}{2} & 2 \end{pmatrix}$ or $\frac{1}{2} \begin{pmatrix} 1 & 2 \\ 1 & 4 \end{pmatrix}$	2	B1 for determinant A = 2, or for $k \begin{pmatrix} 1 & 2 \\ 1 & 4 \end{pmatrix}$ oe
4(a)	$\begin{pmatrix} 0 & -5 \\ -6 & 4 \end{pmatrix}$	2	B1 for two or three correct elements.
4(b)	$\frac{1}{2} \begin{pmatrix} 1 & 1 \\ 0 & 2 \end{pmatrix}$ oe; or $\begin{pmatrix} \frac{1}{2} & \frac{1}{2} \\ 0 & 1 \end{pmatrix}$ oe	2	B1 for $k \begin{pmatrix} 1 & 1 \\ 0 & 2 \end{pmatrix}$ oe with $k \neq \frac{1}{2}$ ; or for $\frac{1}{2} \begin{pmatrix} \cdot & \cdot \\ \cdot & \cdot \end{pmatrix}$ oe
5(a)	$\begin{pmatrix} 5 \\ -9 \end{pmatrix}$	2	B1 for one correct element
5(b)	$(-3 \ -3 \ 7)$	2	M1 for any $1 \times 3$ matrix If 0 scored, SC1 for $\begin{pmatrix} -3 \\ -3 \\ 7 \end{pmatrix}$

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6(a)	$\begin{pmatrix} -2 & -1 \\ -4 & -2 \end{pmatrix}$	2	<p><b>B1</b> for two or three correct elements  or <b>M1</b> for <math>\begin{pmatrix} 6 &amp; -3 \\ 0 &amp; -2 \end{pmatrix} - 2\begin{pmatrix} 4 &amp; -1 \\ 2 &amp; 0 \end{pmatrix}</math> oe  or <b>SC1</b> for answer <math>\begin{pmatrix} 2 &amp; 1 \\ 4 &amp; 2 \end{pmatrix}</math></p>
6(b)	$\frac{1}{2}\begin{pmatrix} 0 & 1 \\ -2 & 4 \end{pmatrix}$ or $\begin{pmatrix} 0 & \frac{1}{2} \\ -1 & 2 \end{pmatrix}$ oe	3	<p><b>B2</b> for <math>k\begin{pmatrix} 0 &amp; 1 \\ -2 &amp; 4 \end{pmatrix}</math> oe with <math>k \neq \frac{1}{2}</math>  or for <math>\frac{1}{2}\begin{pmatrix} \cdot &amp; \cdot \\ \cdot &amp; \cdot \end{pmatrix}</math> oe  or for 3 or 4 correct elements in <math>\begin{pmatrix} 0 &amp; \frac{1}{2} \\ -1 &amp; 2 \end{pmatrix}</math> seen  or <b>M1</b> for <math>Y = A^{-1}</math>; or for <math>Y = A^{-1}\begin{pmatrix} 1 &amp; 0 \\ 0 &amp; 1 \end{pmatrix}</math>  or for determinant of <math>A = 2</math>  or <b>B1</b> for <math>\begin{pmatrix} 4 &amp; -1 \\ 2 &amp; 0 \end{pmatrix}\begin{pmatrix} a &amp; b \\ c &amp; d \end{pmatrix} = \begin{pmatrix} 4a-c &amp; 4b-d \\ 2a &amp; 2b \end{pmatrix}</math></p>

7(a)	$\begin{pmatrix} -6 & -6 \\ 3 & 3 \end{pmatrix}$ oe	2	<p><b>C1</b> for 2 or 3 correct elements;  or for 3 or 4 correct elements of <math>\begin{pmatrix} 6 &amp; 2 \\ -1 &amp; 3 \end{pmatrix}</math>  or <b>B1</b> for the correct matrix in the Wkg. and simplified, incorrectly, to give the response in the Ans.Space.</p>
7(b)	$\begin{pmatrix} -2 & -6 \\ 3 & 7 \end{pmatrix}$	2	<b>C1</b> for 2 or 3 correct elements
7(c)	$\frac{1}{2}$ ; or 0.5 ; only	1	

8(a)	$\begin{pmatrix} 7 & 9 \\ -15 & -16 \end{pmatrix}$	2	<p><b>C1</b> for two or three correct elements,  or for 3 or 4 elements of <math>\begin{pmatrix} 11 &amp; -3 \\ -15 &amp; -8 \end{pmatrix}</math>.</p>
8(b)	$-\frac{1}{7}\begin{pmatrix} -4 & -1 \\ 5 & 3 \end{pmatrix}$ oe, e.g. $\begin{pmatrix} \frac{4}{7} & \frac{1}{7} \\ -\frac{5}{7} & -\frac{3}{7} \end{pmatrix}$	2	<b>B1</b> for $(\det A) = -7$ or <b>B1</b> for $\begin{pmatrix} -4 & -1 \\ 5 & 3 \end{pmatrix}$ seen



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9(a)	$\begin{pmatrix} 5 \\ 6 \\ 8 \end{pmatrix}$ cao	1	
9(b)(i)	$\begin{pmatrix} 440 \\ 540 \end{pmatrix}$ cao	2	B1 for one element correct
9(b)(ii)	The amount Anya makes for men's T-shirts and women's T-shirts	1	
9(c)(i)	(290 630 537.5[0])	2	B1 for two correct values seen in a row of 3 elements or column of 3 elements isw
9(c)(ii)	48.7%	3	M1FT for <i>their</i> (440 + 540) and <i>their</i> (290 + 630 + 537.5) <b>and</b> M1 for ( <del>their</del> 1457.5 – <i>their</i> 980) ÷ <i>their</i> 980 oe

10(a)(i)	$\begin{pmatrix} 0 & 1 \\ 8 & 1 \end{pmatrix}$	2	B1 for $\begin{pmatrix} 0 & 1 \\ 8 & 1 \end{pmatrix}$ or 2 elements correct in a $2 \times 2$ matrix with brackets
10(a)(ii)	$\frac{1}{4} \begin{pmatrix} -1 & 1 \\ -6 & 2 \end{pmatrix}$ oe isw	2	B1 for for determinant = 4 soi or $k \begin{pmatrix} -1 & 1 \\ -6 & 2 \end{pmatrix}$
10(b)	$\frac{1}{2} \begin{pmatrix} 4 & -3 \\ 14 & -2 \end{pmatrix}$ or $\begin{pmatrix} 2 & -1.5 \\ 7 & -1 \end{pmatrix}$ oe	2	B1 for $2C = 3B - A$ or $-2C = A - 3B$ soi or $\begin{pmatrix} 4 & -3 \\ 14 & -2 \end{pmatrix}$ or M1 for $\begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix} + 2C = 3 \begin{pmatrix} 2 & -1 \\ 6 & -1 \end{pmatrix}$

11(a)	$\begin{pmatrix} 1 & 0 \\ 8 & 8 \end{pmatrix}$	2	B1 for 2 or 3 elements correct
11(b)	$\begin{pmatrix} -7 \\ 5 \end{pmatrix}$	2	B1 for $\begin{pmatrix} -7 \\ 5 \end{pmatrix}$ or $\frac{-7}{5}$ or $\begin{pmatrix} -7 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 5 \end{pmatrix}$ or $(-7 \text{ [1] } 5)$
11(c)	$\begin{pmatrix} 2 & 1 \\ -2 & -\frac{1}{2} \end{pmatrix}$ or $\frac{1}{2} \begin{pmatrix} 4 & 2 \\ -4 & -1 \end{pmatrix}$ oe isw	3	B2 for $\frac{1}{2} \begin{pmatrix} -2 & -2 \\ 4 & 3 \end{pmatrix}$ oe or B1 for determinant = 2 soi or $k \begin{pmatrix} -2 & -2 \\ 4 & 3 \end{pmatrix}$

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<b>12</b>	<b>(a)</b>	$\begin{pmatrix} 0 & -5 \\ 7 & 9 \end{pmatrix}$	<b>2</b>	C1 for 2 or 3 correct elements; or for 3 or 4 elements of $\begin{pmatrix} 12 & -1 \\ -1 & 9 \end{pmatrix}$ .
	<b>(b)</b>	$\frac{1}{7}\begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}$ ; or $\begin{pmatrix} \frac{3}{7} & \frac{1}{7} \\ -\frac{1}{7} & \frac{2}{7} \end{pmatrix}$ ; or any equivalent seen	<b>2 *</b>	C1 for $\frac{1}{7}\begin{pmatrix} \cdot & \cdot \\ \cdot & \cdot \end{pmatrix}$ ; or for $k\begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}, k \neq \frac{1}{7}$
	<b>(c)</b>	$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	<b>1</b>	

<b>13</b>	<b>(a)</b>	$\begin{pmatrix} 4 & 4 \\ 1 & 7 \end{pmatrix}$	<b>2</b>	B1 for 3 entries correct.
	<b>(b)</b>	$\begin{pmatrix} 2 & 4 \\ 2 & 9 \end{pmatrix}$	<b>2</b>	B1 for 3 entries correct.
	<b>(c)</b>	4    7	<b>2</b>	B1 for one correct or $\begin{pmatrix} 2x \\ 3x+2 \end{pmatrix}$ seen
	<b>(d)</b>	$\frac{1}{5}\begin{pmatrix} 3 & -2 \\ 1 & 1 \end{pmatrix}$ oe isw	<b>2</b>	B1 for $\det \mathbf{B} = 5$ soi or $\begin{pmatrix} 3 & -2 \\ 1 & 1 \end{pmatrix}$ soi

<b>14</b>	<b>(a)</b>	$\begin{pmatrix} 6 & -2 \\ -5 & 11 \end{pmatrix}$	<b>2</b>	B1 for at least 2 elements correct in a 2 x 2 matrix
	<b>(b)</b>	$\begin{pmatrix} 15 & -7 \\ 7 & 8 \end{pmatrix}$	<b>2</b>	B1 for at least 2 elements correct or  M1 for $\begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix}\begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix}$ soi
	<b>(c)</b>	$-\frac{1}{10}\begin{pmatrix} -5 & 0 \\ -7 & 2 \end{pmatrix}$ oe  isw	<b>2</b>	B1 for $\det \mathbf{B} = -10$ soi or $\begin{pmatrix} -5 & 0 \\ -7 & 2 \end{pmatrix}$
	<b>(d)</b>	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$	<b>1</b>	
	<b>(e)</b>	$\begin{pmatrix} 0 & 0 \\ 7 & -7 \end{pmatrix}$	<b>2</b>	B1 for $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ soi

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15 (i)	$\begin{pmatrix} 8 & 0 \\ 3 & 1 \end{pmatrix}$ final answer	2	B1 for 3 correct elements
(ii)	$\frac{1}{4}\begin{pmatrix} 1 & -2 \\ 1 & 2 \end{pmatrix}$ oe isw	2	B1 for $k\begin{pmatrix} 1 & -2 \\ 1 & 2 \end{pmatrix}$ or $\frac{1}{4}\begin{pmatrix} a & b \\ c & d \end{pmatrix}$
16 (a)	$\begin{pmatrix} 2 & 2 & 8 \\ 0 & 1 & 3 \end{pmatrix}$	2	C1 for 4 or 5 correct elements in a $2 \times 3$ matrix
(b) (i)	$\frac{1}{2}\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ or any equiv seen	1 *	
(ii)	$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ , or $\frac{1}{2}\begin{pmatrix} 2 & 4 \\ 0 & 2 \end{pmatrix}$	2 *	M1 for $\mathbf{M} \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$ oe or $\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 3 \end{pmatrix} = \text{their } (a) \text{ oe}$
17 (a) (i)	$\begin{pmatrix} 3 & 4 \\ -1 & 2 \end{pmatrix}$	2	B1 for one row or one column correct
(ii)	$\frac{1}{4}\begin{pmatrix} 2 & -2 \\ 3 & -1 \end{pmatrix}$ or $\begin{pmatrix} \frac{1}{2} & -\frac{1}{2} \\ \frac{3}{4} & -\frac{1}{4} \end{pmatrix}$ oe isw	2	B1 for det = 4 soi or for $\begin{pmatrix} 2 & -2 \\ 3 & -1 \end{pmatrix}$
(b)	$\begin{pmatrix} 4 & -2 \\ 0 & -6 \end{pmatrix}$ oe	2	B1 for one row or one column correct Or M1 for $2\mathbf{C} = -4\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$ oe or for $-\frac{1}{2}\mathbf{C} = \begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$
(c) (i)	$\begin{pmatrix} 3110 \\ 2715 \\ 2750 \end{pmatrix}$	2	B1 for 2 elements correct in a 3 by 1 matrix or all 3 values correct in dollars or M1 for $\begin{pmatrix} 1950+1160 \\ 975+1740 \\ 1300+1450 \end{pmatrix}$
(ii)	Amount [in cents] for each week	1	
(iii)	85.75 cao	1	

## Matrices 4024

**Compiled by: Mustafa Asif**

<b>18 (a)</b>	$\begin{pmatrix} -2 & -1 \\ -1 & 5 \end{pmatrix}$	1	
<b>(b)</b>	$\begin{pmatrix} \frac{3}{8} & \frac{1}{8} \\ -\frac{5}{8} & \frac{1}{8} \end{pmatrix}$ or $\frac{1}{8}\begin{pmatrix} 3 & 1 \\ -5 & 1 \end{pmatrix}$	2	<b>B1</b> for $\begin{pmatrix} 3 & 1 \\ -5 & 1 \end{pmatrix}$ seen or B1 for (determinant =) 8 seen

<b>19 (a)</b>	$\begin{pmatrix} -1 & 9 \\ -5 & 13 \end{pmatrix}$	2	<b>B1</b> for 2 or 3 correct elements
<b>(b) (i)</b>	2.5 oe	1	
<b>(ii)</b>	$0.5\begin{pmatrix} -1 & 2 \\ -2.5 & 3 \end{pmatrix}$ isw oe	1	FT their <b>(b)(i)</b> If 0 scored in <b>(b)(i)</b> and <b>(b)(ii)</b> SC1 for correct FT adjoint matrix  $\begin{pmatrix} -1 & 2 \\ -their(bi) & 3 \end{pmatrix}$ isw