

Name:

Section:

## Matrices Worksheet

- 1 (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.

*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]

- 2 (a) The matrix  $\mathbf{A}$  satisfies the following equation.

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

Find  $\mathbf{A}$ .

$$\mathbf{A} = \begin{pmatrix} & \\ & \end{pmatrix} \quad [2]$$

(b)  $\mathbf{B} = \begin{pmatrix} 2 & -2 \\ 4 & p \end{pmatrix}$

The determinant of  $\mathbf{B}$  is 2.

Find the value of  $p$  and hence write down  $\mathbf{B}^{-1}$ .

$$\mathbf{B}^{-1} = \begin{pmatrix} & \\ & \end{pmatrix} \quad [3]$$

**3**  $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ -3 & -2 \end{pmatrix}$   
(a) Find  $\mathbf{A}^2$ .

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

(b) The matrix  $\mathbf{X}$  satisfies the equation  $\mathbf{X} \begin{pmatrix} 2 & 1 \\ -3 & -2 \end{pmatrix} = \begin{pmatrix} 0 & 2 \end{pmatrix}$ .  
Find  $\mathbf{X}$ .

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**4** Find.

$$\begin{pmatrix} 3 & -2 \\ 1 & 2 \end{pmatrix}^{-1}$$

$$\mathbf{X} = \qquad [2]$$

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

5 Adam and Ben buy tickets for the cinema and the theatre.

- (a) Adam buys 5 cinema tickets and 4 theatre tickets.  
Ben buys 7 cinema tickets and 9 theatre tickets.

Complete the matrix,  $\mathbf{X}$ , to represent this information.

$$\mathbf{X} = \begin{pmatrix} & \text{Cinema} & \text{Theatre} \\ & & \end{pmatrix} \begin{matrix} \text{Adam} \\ \text{Ben} \end{matrix}$$

[1]

- (b) Cinema tickets cost \$11 each and theatre tickets cost \$30 each.  
The matrix  $\mathbf{Y}$  represents this information.

$$\mathbf{Y} = \begin{pmatrix} 11 \\ 30 \end{pmatrix}$$

- (i)  $\mathbf{P} = \mathbf{XY}$

Find the matrix  $\mathbf{P}$ .

$$\mathbf{P} =$$

[2]

- (ii) Explain what the elements in matrix  $\mathbf{P}$  represent.

.....  
.....

[1]

- 6 On Monday, 40 adults and 20 children visit a museum.  
 On Tuesday, 30 adults and 35 children visit the museum.  
 The cost of an adult ticket is \$2.50 and the cost of a child ticket is \$2.

This information can be represented by the matrices **M** and **N**.

$$\mathbf{M} = \begin{pmatrix} 40 & 20 \\ 30 & 35 \end{pmatrix} \quad \mathbf{N} = \begin{pmatrix} 2.50 \\ 2 \end{pmatrix}$$

- (a) (i) Work out **MN**.

$$\mathbf{MN} = \quad [2]$$

- (ii) Explain what the numbers in your answer to **part (a)(i)** represent.

.....  
 ..... [1]

- (b) The museum increases the cost of tickets by 10%.

Complete matrix **P** to show the new ticket costs.

$$\mathbf{P} = \begin{pmatrix} & \\ & \end{pmatrix} [2]$$

7  $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ -3 & -1 \end{pmatrix}$

(a) Evaluate  $2\mathbf{A} - \begin{pmatrix} -5 & 4 \\ 0 & 3 \end{pmatrix}$ .

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

(b) Find  $|\mathbf{A}|$ .

(c) Find  $\mathbf{A}^{-1}$ .

..... [1]

$\begin{pmatrix} & \\ & \end{pmatrix}$  [1]

(d) Find the matrix  $\mathbf{X}$ , where  $\mathbf{XA} = \begin{pmatrix} 4 & -2 \end{pmatrix}$ .

$\mathbf{X} =$  [2]

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

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

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

(c) Find the matrix  $\mathbf{X}$  such that  $\mathbf{X}\begin{pmatrix} 3 & 2 \end{pmatrix} = \begin{pmatrix} 6 & 4 \\ -3 & -2 \end{pmatrix}$ .

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

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[2]

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

Evaluate  $\mathbf{PQ}$ .

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

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

The determinant of matrix  $\mathbf{M}$  is  $-4$ .

(i) Find the value of  $k$ .

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

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

$$\begin{pmatrix} & \\ & \end{pmatrix} \quad [1]$$

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

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

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

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

*Answer*

[3]

- 11 During two weeks, a shopkeeper records the number of packets of two different types of tea he sells and the profit he makes from them.

Week 1

- Type A tea, 30 packets sold, profit of \$1.20 on each packet
- Type B tea, 20 packets sold, profit of \$2 on each packet

Week 2

- Type A tea, 40 packets sold, loss of \$0.50 on each packet
- Type B tea, 30 packets sold, profit of \$3 on each packet

This information can be represented by these matrices.

$$\begin{pmatrix} 30 & 20 \end{pmatrix} \quad \begin{pmatrix} 40 & 30 \end{pmatrix} \quad \begin{pmatrix} 1.2 \\ 2 \end{pmatrix} \quad \begin{pmatrix} -0.5 \\ 3 \end{pmatrix}$$

(a) Work out  $\begin{pmatrix} 30 & 20 \end{pmatrix} \begin{pmatrix} 1.2 \\ 2 \end{pmatrix} - \begin{pmatrix} 40 & 30 \end{pmatrix} \begin{pmatrix} -0.5 \\ 3 \end{pmatrix}$ .

*Answer*

[2]

(b) Explain the meaning of your answer to part (a).

.....  
..... [1]

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

(a) Calculate  $2\mathbf{B} - 3\mathbf{A}$ .

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

(b) Calculate  $\mathbf{BC}$ .

*Answer* [2]

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

*Answer*       $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$  [3]

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$$\mathbf{A} = \begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix} \quad \mathbf{A}^{-1} = k \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}$$

(a) Find the value of  $k$ .

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

(b) Find the matrix  $\mathbf{X}$ , where  $2\mathbf{A} + \mathbf{X} = \begin{pmatrix} 5 & -2 \\ 0 & 4 \end{pmatrix}$ .

*Answer* [2]

(c) Find the matrix  $\mathbf{Y}$ , where  $\mathbf{YA} = \begin{pmatrix} 6 & 2 \end{pmatrix}$ .

*Answer* [2]

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14 (a) Express as a single matrix  $5\begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix} - 4\begin{pmatrix} 1 \\ -3 \\ 0 \end{pmatrix}$ .

*Answer* [2]

(b) Express as a single matrix  $\begin{pmatrix} 7 & -1 & 3 \\ 2 & 0 & 4 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix}$ .

*Answer* [2]

(c)  $\mathbf{A} = \begin{pmatrix} 1 & 0 \\ -2 & 4 \end{pmatrix}$

(i) Find  $\mathbf{A}^{-1}$ .

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

(ii)  $\mathbf{B} + 3\mathbf{I} = \mathbf{A}$  where  $\mathbf{I}$  is the  $2 \times 2$  identity matrix.

Find  $\mathbf{B}$ .

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

15       $\mathbf{m} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$     $\mathbf{n} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

(a) Calculate  $\mathbf{m} - 2\mathbf{n}$ .

*Answer*       $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$       [1]

(b) Given that  $s\mathbf{m} + 3\mathbf{n} = \begin{pmatrix} 12 \\ t \end{pmatrix}$ , calculate  $s$  and  $t$ .

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*Answer*    $s = \dots\dots\dots$   
 $t = \dots\dots\dots$  [2]