



Mathematics-9

Unit 1 – 1.3

Download All Subjects Notes from website www.lasthopestudy.com

Exercise 1.3

Q.1 Which of the following matrices are comfortable for addition?

$$A = \begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix}, \quad B = \begin{bmatrix} 3 \\ 1 \end{bmatrix} \quad (\text{K.B})$$

$$C = \begin{bmatrix} 1 & 0 \\ 2 & -1 \\ 1 & -2 \end{bmatrix}, \quad D = \begin{bmatrix} 2+1 \\ 3 \end{bmatrix} \quad (\text{K.B})$$

$$E = \begin{bmatrix} -1 & 0 \\ 1 & 2 \end{bmatrix}, \quad F = \begin{bmatrix} 3 & 2 \\ 1+1 & -4 \\ 3+2 & 2+1 \end{bmatrix} \quad (\text{K.B})$$

Solution:

In the above matrices following matrices are suitable for addition.

- (i) A and E are conformable for addition because their order is same and both are square matrix.
- (ii) B and D are conformable for addition because the order is same i-e they have two rows and 1 column and both are rectangular matrices and column matrix.
- (iii) C and F are conformable for addition because their order is same i-e they have three rows and 2 columns and they are rectangular matrices.

Q.2 Find the additive inverse of the following matrices:

(1) $A = \begin{bmatrix} 2 & 4 \\ -2 & 1 \end{bmatrix}$ (FSD 2015, MTN 2016) (A.B)

Solution:

Additive inverse of a matrix is negative matrix.

$$A = \begin{bmatrix} 2 & 4 \\ -2 & 1 \end{bmatrix} \text{ is}$$

$$-A = - \begin{bmatrix} 2 & 4 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} (-1) \times 2 & (-1) \times 4 \\ (-1) \times (-2) & (-1) \times 1 \end{bmatrix}$$

$$-A = \begin{bmatrix} -2 & -4 \\ 2 & -1 \end{bmatrix}$$

(2) $B = \begin{bmatrix} 1 & 0 & -1 \\ 2 & -1 & 3 \\ 3 & -2 & 1 \end{bmatrix}$ (A.B)

Solution: $B = \begin{bmatrix} 1 & 0 & -1 \\ 2 & -1 & 3 \\ 3 & -2 & 1 \end{bmatrix}$

Its additive inverse is

$$-B = - \begin{bmatrix} 1 & 0 & -1 \\ 2 & -1 & 3 \\ 3 & -2 & 1 \end{bmatrix}$$

$$-B = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 1 & -3 \\ -3 & 2 & -1 \end{bmatrix}$$

(3) $C = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$ (A.B)

Solution: $C = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$

$$-C = - \begin{bmatrix} 4 \\ -2 \end{bmatrix} = \begin{bmatrix} -1 \times 4 \\ -1 \times (-2) \end{bmatrix}$$

The additive inverse is

$$-C = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$$

(4) $D = \begin{bmatrix} 1 & 0 \\ -3 & -2 \\ 2 & 1 \end{bmatrix}$ (A.B)

Solution: $D = \begin{bmatrix} 1 & 0 \\ -3 & -2 \\ 2 & 1 \end{bmatrix}$

The additive inverse is

$$-D = -\begin{bmatrix} 1 & 0 \\ -3 & -2 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} -1 \times 1 & -1 \times 0 \\ -1 \times -3 & -1 \times -2 \\ -1 \times 2 & -1 \times 1 \end{bmatrix}$$

$$-D = \begin{bmatrix} -1 & 0 \\ 3 & 2 \\ -2 & -1 \end{bmatrix}$$

(5) $E = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ **(A.B)**

Solution: $E = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

The additive inverse of the given matrix is:

$$-E = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -1 \times 1 & -1 \times 0 \\ -1 \times 0 & -1 \times 1 \end{bmatrix}$$

$$-E = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ 3 & -2 \end{bmatrix}$$

(6) $F = \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{2} \end{bmatrix}$ **(A.B)**

Solution: $F = \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{2} \end{bmatrix}$

Its additive inverse is

$$-F = -\begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{2} \end{bmatrix}$$

$$= \begin{bmatrix} -1 \times \sqrt{3} & -1 \times 1 \\ -1 \times -1 & -1 \times \sqrt{2} \end{bmatrix}$$

$$-F = \begin{bmatrix} -\sqrt{3} & -1 \\ 1 & -\sqrt{2} \end{bmatrix}$$

Q.3 If $A = \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$,

$$C = \begin{bmatrix} 1 & -1 & 2 \\ -1 & 0 & 2 \end{bmatrix}, D = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 2 \end{bmatrix},$$

then find. **(A.B)**

(i) $A + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

Solution:

As $A = \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix}$

So, $A + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

$$= \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$$

The order of matrix A and the given matrix order is same. So, they can be added easily.

$$= \begin{bmatrix} -1+1 & 2+1 \\ 2+1 & 1+1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 3 \\ 3 & -2 \end{bmatrix}$$

(ii) $B + \begin{bmatrix} -2 \\ 3 \end{bmatrix}$ **(SGD 2017)** **(A.B)**

Solution:

As $B = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

So, $B + \begin{bmatrix} -2 \\ 3 \end{bmatrix}$

$$= \begin{bmatrix} 1 \\ -1 \end{bmatrix} + \begin{bmatrix} -2 \\ 3 \end{bmatrix}$$

$$= \begin{bmatrix} 1+(-2) \\ -1+3 \end{bmatrix}$$

$$= \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

(iii) $C + \begin{bmatrix} -2 & 1 & 3 \end{bmatrix}$ **(A.B)**

Solution:

As $C = \begin{bmatrix} 1 & -1 & 2 \\ -1 & 0 & 2 \end{bmatrix}$

So, $C + \begin{bmatrix} -2 & 1 & 3 \end{bmatrix}$

$$\begin{aligned}
 &= [1 \ -1 \ 2] + [-2 \ 1 \ 3] \\
 &= [1+(-2) \ -1+(1) \ 2+3] \\
 &= [1-2 \ -1+1 \ 5] \\
 &= [-1 \ 0 \ 5]
 \end{aligned}$$

(iv) $D + \begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix}$ (A.B)

Solution:

As $D = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 2 \end{bmatrix}$

So, $D + \begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix}$

$$\begin{aligned}
 &= \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 2 \end{bmatrix} + \begin{bmatrix} 0 & 1 & 0 \\ 2 & 0 & 1 \end{bmatrix} \\
 &= \begin{bmatrix} 1+0 & 2+1 & 3+0 \\ -1+2 & 0+0 & 2+1 \end{bmatrix} \\
 &= \begin{bmatrix} 1 & 3 & 3 \\ 1 & 0 & 3 \end{bmatrix}
 \end{aligned}$$

(v) $2A$ (RWP 2018) (A.B)

Solution:

As $A = \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix}$

So,

$$\begin{aligned}
 2A &= 2 \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 2(-1) & 2 \times 2 \\ 2 \times 2 & 2 \times 1 \end{bmatrix} \\
 &= \begin{bmatrix} -2 & 4 \\ 4 & 2 \end{bmatrix}
 \end{aligned}$$

(vi) $(-1)B$ (A.B)

Solution:

As $B = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

So,

$$\begin{aligned}
 (-1)B &= (-1) \times \begin{bmatrix} 1 \\ -1 \end{bmatrix} \\
 &= \begin{bmatrix} (-1) \times 1 \\ (-1) \times (-1) \end{bmatrix} \\
 &= \begin{bmatrix} -1 \\ 1 \end{bmatrix}
 \end{aligned}$$

(vii) $(-2)C$ (SWL 2018) (A.B)

Solution:

As $C = \begin{bmatrix} 1 & -1 & 2 \end{bmatrix}$

So,

$$\begin{aligned}
 (-2)C &= (-2) \times \begin{bmatrix} 1 & -1 & 2 \end{bmatrix} \\
 &= \begin{bmatrix} (-2)(1) & (-2)(-1) & (-2)(2) \end{bmatrix} \\
 &= \begin{bmatrix} -2 & 2 & -4 \end{bmatrix}
 \end{aligned}$$

(viii) $3D$ (A.B)

Solution:

As $D = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 2 \end{bmatrix}$

So, $3D = (3) \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 2 \end{bmatrix}$

$$\begin{aligned}
 &= \begin{bmatrix} 3 \times 1 & 3 \times 2 & 3 \times 3 \\ 3 \times -1 & 3 \times 0 & 3 \times 2 \end{bmatrix} \\
 &= \begin{bmatrix} 3 & 6 & 9 \\ -3 & 0 & 6 \end{bmatrix}
 \end{aligned}$$

(ix) $3C$ (A.B)

Solution:

As $C = \begin{bmatrix} 1 & -1 & 2 \end{bmatrix}$

So, $3C = (3) \times \begin{bmatrix} 1 & -1 & 2 \end{bmatrix}$

$$\begin{aligned}
 &= \begin{bmatrix} 3 \times 1 & 3 \times -1 & 3 \times 2 \end{bmatrix} \\
 &= \begin{bmatrix} 3 & -3 & 6 \end{bmatrix}
 \end{aligned}$$

Q.4 Perform the indicated operations and simplify the following:

(i) $\left(\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 2 \\ 3 & 0 \end{bmatrix} \right) + \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$ (A.B)

Solution:

$$\begin{aligned}
 &\left(\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 2 \\ 3 & 0 \end{bmatrix} \right) + \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1+0 & 0+2 \\ 0+3 & 1+0 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1+1 & 2+1 \\ 3+1 & 1+0 \end{bmatrix} \\
 &= \begin{bmatrix} 2 & 3 \\ 4 & 1 \end{bmatrix}
 \end{aligned}$$

$$(ii) \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \left(\begin{bmatrix} 0 & 2 \\ 3 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \right) \quad (\text{A.B})$$

Solution:

$$\begin{aligned} & \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \left(\begin{bmatrix} 0 & 2 \\ 3 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \right) \\ &= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 0-1 & 2-1 \\ 3-1 & 0-0 \end{bmatrix} \\ &= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} -1 & 1 \\ 2 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 1-1 & 0+1 \\ 0+2 & 1+0 \end{bmatrix} \\ &= \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix} \end{aligned}$$

$$(iii) \begin{bmatrix} 2 & 3 & 1 \end{bmatrix} + \left(\begin{bmatrix} 1 & 0 & 2 \end{bmatrix} - \begin{bmatrix} 2 & 2 & 2 \end{bmatrix} \right) (\text{A.B})$$

Solution:

$$\begin{aligned} & \begin{bmatrix} 2 & 3 & 1 \end{bmatrix} + \left(\begin{bmatrix} 1 & 0 & 2 \end{bmatrix} - \begin{bmatrix} 2 & 2 & 2 \end{bmatrix} \right) \\ &= \begin{bmatrix} 2 & 3 & 1 \end{bmatrix} + \begin{bmatrix} 1-2 & 0-2 & 2-2 \end{bmatrix} \\ &= \begin{bmatrix} 2 & 3 & 1 \end{bmatrix} + \begin{bmatrix} -1 & -2 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 2-1 & 3-2 & 1-0 \end{bmatrix} \\ &= \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \end{aligned}$$

$$(iv) \begin{bmatrix} 1 & 2 & 3 \\ -1 & -1 & -1 \\ 0 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{bmatrix} \quad (\text{A.B})$$

Solution:

$$\begin{aligned} & \begin{bmatrix} 1 & 2 & 3 \\ -1 & -1 & -1 \\ 0 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{bmatrix} \\ &= \begin{bmatrix} 1+1 & 2+1 & 3+1 \\ -1+2 & -1+2 & -1+2 \\ 0+3 & 1+3 & 2+3 \end{bmatrix} \\ &= \begin{bmatrix} 2 & 3 & 4 \\ 1 & 1 & 1 \\ 3 & 4 & 5 \end{bmatrix} \end{aligned}$$

$$(v) \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 3 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 0 & -2 \\ -2 & -1 & 0 \\ 0 & 2 & -1 \end{bmatrix} \quad (\text{A.B})$$

Solution:

$$\begin{aligned} & \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 3 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 0 & -2 \\ -2 & -1 & 0 \\ 0 & 2 & -1 \end{bmatrix} \\ &= \begin{bmatrix} 1+1 & 2+0 & 3-2 \\ 2-2 & 3-1 & 1+0 \\ 3+0 & 1+2 & 2-1 \end{bmatrix} \\ &= \begin{bmatrix} 2 & 2 & 1 \\ 0 & 2 & 1 \\ 3 & 3 & 1 \end{bmatrix} \end{aligned}$$

$$(vi) \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \right) + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \quad (\text{A.B})$$

Solution:

$$\begin{aligned} & \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \right) + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \\ &= \begin{bmatrix} 1+2 & 2+1 \\ 0+1 & 1+0 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \\ &= \begin{bmatrix} 3 & 3 \\ 1 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \\ &= \begin{bmatrix} 3+1 & 3+1 \\ 1+1 & 1+1 \end{bmatrix} \\ &= \begin{bmatrix} 4 & 4 \\ 2 & 2 \end{bmatrix} \end{aligned}$$

Q.5 For the matrices $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$,

$$B = \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \text{ and } C = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix},$$

verify the following rules:

(i) $A + C = C + A$ (K.B)

Verification:

L.H.S. = $A + C$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 1-1 & 2+0 & 3+0 \\ 2+0 & 3-2 & 1+3 \\ 1+1 & -1+1 & 0+2 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 2 & 3 \\ 2 & 1 & 4 \\ 2 & 0 & 2 \end{bmatrix}$$

R.H.S. = $C + A$

$$= \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -1+1 & 0+2 & 0+3 \\ 0+2 & -2+3 & 3+1 \\ 1+1 & 1-1 & 2-0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 2 & 3 \\ 2 & 1 & 4 \\ 2 & 0 & 2 \end{bmatrix}$$

$A + C = C + A$

Hence proved

(ii) $A + B = B + A$ (K.B)

Verification:

L.H.S. = $A + B$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 1+1 & 2-1 & +3+1 \\ 2+2 & 3-2 & 1+2 \\ 1+3 & -1+1 & 0+3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 1 & 4 \\ 4 & 1 & 3 \\ 4 & 0 & 3 \end{bmatrix}$$

R.H.S. = $B + A$

$$= \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 1+1 & -1+2 & 1+3 \\ 2+2 & -2+3 & 2+1 \\ 3+1 & 1-1 & 3+0 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 1 & 4 \\ 4 & 1 & 3 \\ 4 & 0 & 3 \end{bmatrix}$$

$A + B = B + A$
Hence proved

(iii) $B + C = C + B$ (K.B)

Verification:

L.H.S. = $B + C$

$$= \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} + \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 1-1 & -1+0 & 1+0 \\ 2+0 & -2-2 & 2+3 \\ 3+1 & 1+1 & 3+2 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & -1 & 1 \\ 2 & -4 & 5 \\ 4 & 2 & 5 \end{bmatrix}$$

R.H.S. = $C + B$

$$= \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} -1+1 & 0-1 & 0+1 \\ 0+2 & -2-2 & 3+2 \\ 1+3 & 1+1 & 2+3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & -1 & 1 \\ 2 & -4 & 5 \\ 4 & 2 & 5 \end{bmatrix}$$

L.H.S. = R.H.S.

$B+C=C+B$

Hence proved

(iv) $A+(B+A)=2A+B$ (K.B)

Verification:

L.H.S. = $A+(B+A)$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \left(\begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} \right)$$

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

$$= \begin{bmatrix} 3 & 3 & 7 \\ 6 & 4 & 4 \\ 5 & -1 & 3 \end{bmatrix}$$

R.H.S. = $2A+B$

$$= 2 \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 4 & 6 \\ 4 & 6 & 2 \\ 2 & -2 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 3 & 7 \\ 6 & 4 & 4 \\ 5 & -1 & 3 \end{bmatrix}$$

L.H.S. = R.H.S.

$A+(B+A)=2A+B$

Hence proved

(v) $(C-B)+A=C+(A+B)$ (A.B+K. B)

Verification:

L.H.S. = $(C-B)+A$

$$= \left(\begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} - \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right) + \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -2 & 1 & -1 \\ -2 & 0 & 1 \\ -2 & 0 & -1 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -1 & 3 & 2 \\ 0 & 3 & 2 \\ -1 & -1 & -1 \end{bmatrix}$$

R.H.S. = $C+(A-B)$

$$= \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} + \left(\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} - \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right)$$

$$= \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} + \begin{bmatrix} 0 & 3 & 2 \\ 0 & 5 & -1 \\ -2 & -2 & -3 \end{bmatrix}$$

$$= \begin{bmatrix} -1 & 3 & 2 \\ 0 & 3 & 2 \\ -1 & -1 & -1 \end{bmatrix}$$

L.H.S. = R.H.S.

$(C-B)+A=C+(A+B)$

Hence proved

(vi) $2A+B=A+(A+B)$ (K.B)

Verification:

L.H.S. = $2A+B$

$$= 2 \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 4 & 6 \\ 4 & 6 & 2 \\ 2 & -2 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 3 & 7 \\ 6 & 4 & 4 \\ 5 & -1 & 3 \end{bmatrix}$$

$$\text{R.H.S.} = A + (A+B)$$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \left(\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right)$$

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

$$= \begin{bmatrix} 3 & 3 & 7 \\ 6 & 4 & 4 \\ 5 & -1 & 3 \end{bmatrix}$$

$$\text{L.H.S.} = \text{R.H.S.}$$

$$2A+B=A+(A+B)$$

Hence proved

$$\text{(vii)} \quad (C-B)-A=(C-A)-B$$

(A.B + K. B)

Verification:

$$\text{L.H.S.} = (C-B)-A$$

$$= \left(\begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} - \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right) - \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -2 & 1 & -1 \\ -2 & 0 & 1 \\ -2 & 0 & -1 \end{bmatrix} - \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -3 & -1 & -4 \\ -4 & -3 & 0 \\ -3 & 1 & -1 \end{bmatrix}$$

$$\text{R.H.S.} = (C-A)-B$$

$$= \left(\begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} - \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} \right) - \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} -2 & -2 & -3 \\ -2 & -5 & 2 \\ 0 & 2 & 2 \end{bmatrix} - \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} -3 & -1 & -4 \\ -4 & -3 & 0 \\ -3 & 1 & -1 \end{bmatrix}$$

$$\text{L.H.S.} = \text{R.H.S.}$$

$$(C-B)-A=(C-A)-B$$

Hence proved

$$(A+B)+C=A+(B+C)$$

(U.B)

Verification:

$$\text{L.H.S.} = (A+B)+C$$

$$= \left(\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right) + \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$$

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

$$= \begin{bmatrix} 1 & 1 & 4 \\ 4 & -1 & 6 \\ 5 & 1 & 5 \end{bmatrix}$$

$$\text{R.H.S.} = A+(B+C)$$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 3 & -1 & 0 \end{bmatrix} + \left(\begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} + \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} \right)$$

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

$$= \begin{bmatrix} 1 & 1 & 4 \\ 4 & -1 & 6 \\ 5 & 1 & 5 \end{bmatrix}$$

$$\text{L.H.S.} = \text{R.H.S.}$$

$$(A+B)+C=A+(B+C)$$

Hence proved

$$\text{(viii)} \quad A+(B-C)=(A-C)+B \quad (\text{A.B + K. B})$$

Verification:

$$\text{L.H.S.} = A+(B-C)$$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \left(\begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} - \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} \right)$$

$$= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 2 & -1 & 1 \\ 2 & 0 & -1 \\ 2 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 1 & 4 \\ 4 & 3 & 0 \\ 3 & -1 & 1 \end{bmatrix}$$

R.H.S. = (A-C) + B

$$= \left(\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} - \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 1 & 1 & 2 \end{bmatrix} \right) + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 1+1 & 2-0 & 3-0 \\ 2-0 & 3+2 & 1-3 \\ 1-1 & -1-1 & 0-2 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 2 & 3 \\ 2 & 5 & -2 \\ 0 & -2 & -2 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 1 & 4 \\ 4 & 3 & 0 \\ 3 & -1 & 1 \end{bmatrix}$$

L.H.S. = R.H.S.

A + (B-C) = (A-C) + B

Hence proved

(ix) $2A + 2B = 2(A+B)$ (U.B)

Verification:

L.H.S. = $2A + 2B$

$$= 2 \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + 2 \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 4 & 6 \\ 4 & 6 & 2 \\ 2 & -2 & 0 \end{bmatrix} + \begin{bmatrix} 2 & -2 & 2 \\ 4 & -4 & 4 \\ 6 & 2 & 6 \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 2 & 8 \\ 8 & 2 & 6 \\ 8 & 0 & 6 \end{bmatrix}$$

R.H.S. = $2(A+B)$

$$= 2 \left(\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 1 & -1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & -1 & 1 \\ 2 & -2 & 2 \\ 3 & 1 & 3 \end{bmatrix} \right)$$

$$= \begin{bmatrix} 1+1 & 2-1 & 3+1 \\ 2+2 & 3-2 & 1+2 \\ 1+3 & -1+1 & 0+3 \end{bmatrix}$$

$$= 2 \begin{bmatrix} 2 & 1 & 4 \\ 4 & 1 & 3 \\ 4 & 0 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 2 & 8 \\ 8 & 2 & 6 \\ 8 & 0 & 6 \end{bmatrix}$$

L.H.S. = R.H.S.

$2A + 2B = 2(A+B)$

Hence proved

Q.6 If $A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 7 \\ -3 & 8 \end{bmatrix}$ find: (A.B)

(i) $3A - 2B$

Solution:

$$3A - 2B = 3 \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix} - 2 \begin{bmatrix} 0 & 7 \\ -3 & 8 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & -6 \\ 9 & 12 \end{bmatrix} - \begin{bmatrix} 0 & 14 \\ -6 & 16 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & -20 \\ 15 & -4 \end{bmatrix}$$

(ii) $2A^t - 3B^t$

Solution:

$$A^t = \begin{bmatrix} 1 & 3 \\ -2 & 4 \end{bmatrix}$$

$$B^t = \begin{bmatrix} 0 & -3 \\ 7 & 8 \end{bmatrix}$$

Now

$$2A^t - 3B^t = 2 \begin{bmatrix} 1 & 3 \\ -2 & 4 \end{bmatrix} - 3 \begin{bmatrix} 0 & -3 \\ 7 & 8 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 6 \\ -4 & 8 \end{bmatrix} - \begin{bmatrix} 0 & -9 \\ 21 & 24 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 15 \\ -25 & -16 \end{bmatrix}$$

Q.7 If $2 \begin{bmatrix} 2 & 4 \\ -3 & a \end{bmatrix} + 3 \begin{bmatrix} 1 & b \\ 8 & -4 \end{bmatrix} = \begin{bmatrix} 7 & 10 \\ 18 & 1 \end{bmatrix}$ (A.B)
(LHR 2017)

Solution:

$$2 \begin{bmatrix} 2 & 4 \\ -3 & a \end{bmatrix} + 3 \begin{bmatrix} 1 & b \\ 8 & -4 \end{bmatrix} = \begin{bmatrix} 7 & 10 \\ 18 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 4 & 8 \\ -6 & 2a \end{bmatrix} + \begin{bmatrix} 3 & 3b \\ 24 & -12 \end{bmatrix} = \begin{bmatrix} 7 & 10 \\ 18 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 7 & 8+3b \\ 18 & 2a+(-12) \end{bmatrix} = \begin{bmatrix} 7 & 10 \\ 18 & 1 \end{bmatrix}$$

By comparing equal matrices, we get

$$8 + 3b = 10 \quad \text{--- (i)}$$

$$2a - 12 = 1 \quad \text{--- (ii)}$$

By solving equation (ii)

$$2a - 12 = 1$$

$$2a = 1 + 12$$

$$2a = 13$$

$$a = \frac{13}{2}$$

By solving equation (i)

$$8 + 3b = 10$$

$$3b = 10 - 8$$

$$3b = 2$$

$$b = \frac{2}{3}$$

Q.8 If $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}$

Then verify that

(i) $(A+B)^t = A^t + B^t$ (A.B)

Verification:

$$\text{L.H.S.} = (A+B)^t$$

$$= \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} \right)^t$$

$$= \begin{bmatrix} 2 & 3 \\ 2 & 1 \end{bmatrix}^t$$

$$= \begin{bmatrix} 2 & 2 \\ 3 & 1 \end{bmatrix} \rightarrow (i)$$

$$\text{R.H.S.} = A^t + B^t$$

$$A^t = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$$

$$B^t = \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 2 \\ 3 & 1 \end{bmatrix} \rightarrow (ii)$$

From (i) and (ii)

$$\text{L.H.S.} = \text{R.H.S.}$$

$$(A+B)^t = A^t + B^t$$

Hence Proved

(ii) $(A-B)^t = A^t - B^t$ (BWP 2017) (A.B)

Verification:

$$\text{L.H.S.} = (A-B)^t$$

$$(A-B)^t = \left(\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} \right)^t$$

$$= \begin{bmatrix} 0 & 1 \\ -2 & 1 \end{bmatrix}^t$$

$$(A-B)^t = \begin{bmatrix} 0 & -2 \\ 1 & 1 \end{bmatrix}$$

$$\text{R.H.S.} = A^t - B^t$$

$$= \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}^t - \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}^t$$

$$= \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} - \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 1-1 & 0-2 \\ 2-1 & 1-0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & -2 \\ 1 & 1 \end{bmatrix}$$

$$\text{L.H.S.} = \text{R.H.S.}$$

$$(A-B)^t = A^t - B^t$$

Hence proved

(iii) $A + A^t$ is a symmetric (K.B)
(BWP 2014)

Verification:

To show that $A + A^t$ is symmetric, we

$$\text{will show that } (A + A^t)^t = (A + A^t)$$

$$\begin{aligned}
 A + A^t &= \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}^t \\
 &= \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \\
 &= \begin{bmatrix} 1+1 & 2+0 \\ 0+2 & 1+1 \end{bmatrix} \\
 A + A^t &= \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} \rightarrow (i)
 \end{aligned}$$

Now

$$\begin{aligned}
 (A + A^t)^t &= \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}^t \\
 &= \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} \rightarrow (ii)
 \end{aligned}$$

From (i) and (ii)

$$(A + A^t)^t = (A + A^t)$$

Hence $A + A^t$ is symmetric Proved

(iv) $A - A^t$ is a skew symmetric (K.B)

Verification:

To show that $A - A^t$ is skew symmetric we

will show that $(A - A^t)^t = -(A - A^t)$

$$\begin{aligned}
 A - A^t &= \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}^t \\
 &= \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \\
 &= \begin{bmatrix} 1-1 & 2-0 \\ 0-2 & 1-1 \end{bmatrix} \\
 A - A^t &= \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}
 \end{aligned}$$

$$A - A^t = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}$$

$$\begin{aligned}
 (A - A^t)^t &= \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}^t \\
 &= \begin{bmatrix} 0 & -2 \\ 2 & 0 \end{bmatrix} \rightarrow (i)
 \end{aligned}$$

$$-(A - A^t) = -\begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix} \rightarrow (ii)$$

From (i) and (ii)

$$(A - A^t)^t = -(A - A^t)$$

Hence $A - A^t$ is a skew symmetric, Proved.

(v) $B + B^t$ is a symmetric (K.B)

Verification:

To show that $B + B^t$ is symmetric we will

show that $(B + B^t)^t = (B + B^t)$

$$\begin{aligned}
 B + B^t &= \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}^t \\
 &= \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1+1 & 1+2 \\ 2+1 & 0+0 \end{bmatrix}
 \end{aligned}$$

$$B + B^t = \begin{bmatrix} 2 & 3 \\ 3 & 0 \end{bmatrix} \rightarrow (i)$$

$$(B + B^t)^t = \begin{bmatrix} 2 & 3 \\ 3 & 0 \end{bmatrix}^t$$

$$= \begin{bmatrix} 2 & 3 \\ 3 & 0 \end{bmatrix} \rightarrow (ii)$$

From (i) and (ii)

$$(B + B^t)^t = (B + B^t)$$

Hence $B + B^t$ is a symmetric proved

(vi) $B - B^t$ is a skew symmetric (K.B)

Verification:

To show that $B - B^t$ is skew symmetric,

we will show that $(B - B^t)^t = -(B - B^t)$

$$\begin{aligned}
 B - B^t &= \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}^t \\
 &= \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1-1 & 1-2 \\ 2-1 & 0-0 \end{bmatrix} \\
 B - B^t &= \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}
 \end{aligned}$$

$$B - B^t = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$$B - B^t = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$$(B - B^t)^t = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}^t$$

$$= \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \rightarrow (i)$$

$$\begin{aligned} -(B - B^t) &= -\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \rightarrow (ii) \end{aligned}$$

From (i) and (ii)

$$(B - B^t)^t = -(B - B^t)$$

Hence $B - B^t$ is skew symmetric, proved

