

Exercise 1.4

Q1. Which of the following product of matrices is conformable for multiplication?

(i) $\begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} -2 \\ 3 \end{bmatrix}$

(ii) $\begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$

(iii) $\begin{bmatrix} 1 \\ -1 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$

(iv) $\begin{bmatrix} 1 & 2 \\ 0 & -1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 2 \end{bmatrix}$

(v) $\begin{bmatrix} 3 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 2 \\ -2 & 3 \end{bmatrix}$

Solution:

Two matrices are conformable for multiplication if the numbers of columns of first matrix are equal to number of rows of second matrix.

So, according to the definition:

- (i) is conformable for multiplication (because the first matrix has two columns and second matrix has same number of rows).
- (ii) is conformable for multiplication (because the first matrix has two columns and second matrix has same number of rows).
- (iii) is not conformable for multiplication (because the first matrix has just one column and second matrix has two rows).
- (iv) is conformable for multiplication (because the first matrix has just two columns and second matrix has the same number of rows).
- (v) is conformable for multiplication (because the first matrix has three columns and second matrix has same number of rows).

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Q2. If $A = \begin{bmatrix} 3 & 0 \\ -1 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 6 \\ 5 \end{bmatrix}$,

find (i) AB (ii) BA

(if possible)

Solution:

(i) AB

$$= \begin{bmatrix} 3 & 0 \\ -1 & 2 \end{bmatrix} \times \begin{bmatrix} 6 \\ 5 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \times 6 + 0 \times 5 \\ (-1) \times 6 + 2 \times 5 \end{bmatrix}$$

$$= \begin{bmatrix} 18 + 0 \\ -6 + 10 \end{bmatrix}$$

$$= \begin{bmatrix} 18 \\ 4 \end{bmatrix}$$

So, $AB = \begin{bmatrix} 18 \\ 4 \end{bmatrix}$

(ii) BA

BA is not possible (because number of columns of B is

Not equal to number of rows of A)

Q3. Find the following products

(i) $\begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix}$

(ii) $\begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} 5 \\ -4 \end{bmatrix}$

(iii) $\begin{bmatrix} -3 & 0 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix}$

(iv) $\begin{bmatrix} 6 & -0 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix}$

(v) $\begin{bmatrix} 1 & 2 \\ -3 & 0 \\ 6 & -1 \end{bmatrix} \begin{bmatrix} 4 & 5 \\ 0 & -4 \end{bmatrix}$

(vi) $\begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix}$

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Solution:

$$\begin{aligned}\text{(i)} \quad [1 \quad 2] \begin{bmatrix} 4 \\ 0 \end{bmatrix} \\&= [1 \times 4 + 2 \times 0] \\&= [4 + 0] \\&= [4]\end{aligned}$$

$$\text{So, } [1 \quad 2] \begin{bmatrix} 4 \\ 0 \end{bmatrix} = [4]$$

$$\begin{aligned}\text{(ii)} \quad [1 \quad 2] \begin{bmatrix} 5 \\ -4 \end{bmatrix} \\&= [1 \times 5 + 2 \times (-4)] \\&= [5 - 8] \\&= [-3]\end{aligned}$$

$$\text{So, } [1 \quad 2] \begin{bmatrix} 5 \\ -4 \end{bmatrix} = [-3]$$

$$\begin{aligned}\text{(iii)} \quad [-3 \quad 0] \begin{bmatrix} 4 \\ 0 \end{bmatrix} \\&= [(-3) \times 4 + 0 \times 0] \\&= [-12]\end{aligned}$$

$$\text{So, } [-3 \quad 0] \begin{bmatrix} 4 \\ 0 \end{bmatrix} = [-12]$$

$$\begin{aligned}\text{(iv)} \quad [6 \quad -0] \begin{bmatrix} 4 \\ 0 \end{bmatrix} \\&= [6 \times 4 + 0 \times 0] \\&= [24 + 0] \\&= [24]\end{aligned}$$

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$$\text{So, } \begin{bmatrix} 6 & -0 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \end{bmatrix} = [24]$$

$$\begin{aligned} \text{(v)} \quad & \begin{bmatrix} 1 & 2 \\ -3 & 0 \\ 6 & -1 \end{bmatrix} \begin{bmatrix} 4 & 5 \\ 0 & -4 \end{bmatrix} \\ &= \begin{bmatrix} 1 \times 4 + 2 \times 0 & 1 \times 5 + 2 \times (-4) \\ -3 \times 4 + 0 \times 0 & -3 \times 5 + 0 \times (-4) \\ 6 \times 4 + (-1) \times 0 & 6 \times 5 + (-1) \times (-4) \end{bmatrix} \\ &= \begin{bmatrix} 4 + 0 & 5 + (-8) \\ -12 + 0 & -15 + 0 \\ 24 + 0 & 30 + 4 \end{bmatrix} \\ &= \begin{bmatrix} 4 & -3 \\ -12 & -15 \\ 24 & 34 \end{bmatrix} \end{aligned}$$

$$\text{So, } \begin{bmatrix} 1 & 2 \\ -3 & 0 \\ 6 & -1 \end{bmatrix} \begin{bmatrix} 4 & 5 \\ 0 & -4 \end{bmatrix} = \begin{bmatrix} 4 & -3 \\ -12 & -15 \\ 24 & 34 \end{bmatrix}$$

Q4. Multiply the following matrices.

$$\text{(a)} \begin{bmatrix} 2 & 3 \\ 1 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 3 & 0 \end{bmatrix} \qquad \text{(b)} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ -1 & 1 \end{bmatrix}$$

$$\text{(c)} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \qquad \text{(d)} \begin{bmatrix} 8 & 5 \\ 6 & 4 \end{bmatrix} \begin{bmatrix} 2 & -5/2 \\ -4 & 4 \end{bmatrix}$$

$$\text{(e)} \begin{bmatrix} -1 & 2 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Solution:

$$\begin{aligned} \text{(a)} \quad & \begin{bmatrix} 2 & 3 \\ 1 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 3 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 2 \times 2 + 3 \times 3 & 2 \times (-1) + 3 \times 0 \\ 1 \times 2 + 1 \times 3 & 1 \times (-1) + 1 \times 0 \\ 0 \times 2 + (-2) \times 3 & 0 \times (-1) + (-2) \times 0 \end{bmatrix} \end{aligned}$$

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$$= \begin{bmatrix} 4+9 & -2+0 \\ 2+3 & -1+0 \\ 0-6 & 0+0 \end{bmatrix}$$

$$= \begin{bmatrix} 13 & -2 \\ 5 & -1 \\ -6 & 0 \end{bmatrix}$$

$$\text{So, } \begin{bmatrix} 2 & 3 \\ 1 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 3 & 0 \end{bmatrix} = \begin{bmatrix} 13 & -2 \\ 5 & -1 \\ -6 & 0 \end{bmatrix}$$

$$(b) \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ -1 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \times 1 + 2 \times 3 + 3 \times (-1) & 1 \times 2 + 2 \times 4 + 3 \times 1 \\ 4 \times 1 + 5 \times 3 + 6 \times (-1) & 4 \times 2 + 5 \times 4 + 6 \times 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1+6-3 & 2+8+3 \\ 4+15-6 & 8+20+6 \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 13 \\ 13 & 34 \end{bmatrix}$$

$$\text{So, } \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ -1 & 1 \end{bmatrix} = \begin{bmatrix} 4 & 13 \\ 13 & 34 \end{bmatrix}$$

$$(c) \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \times 1 + 2 \times 4 & 1 \times 2 + 2 \times 5 & 1 \times 3 + 2 \times 6 \\ 3 \times 1 + 4 \times 4 & 3 \times 2 + 4 \times 5 & 3 \times 3 + 4 \times 6 \\ -1 \times 1 + 1 \times 4 & -1 \times 2 + 1 \times 5 & -1 \times 3 + 1 \times 6 \end{bmatrix}$$

$$= \begin{bmatrix} 1+8 & 2+10 & 3+12 \\ 3+16 & 6+20 & 9+24 \\ -1+4 & -2+5 & -3+6 \end{bmatrix}$$

$$= \begin{bmatrix} 9 & 12 & 15 \\ 19 & 26 & 33 \\ 3 & 3 & 3 \end{bmatrix}$$

$$\text{So, } \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} 9 & 12 & 15 \\ 19 & 26 & 33 \\ 3 & 3 & 3 \end{bmatrix}$$

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$$\begin{aligned} \text{(d)} \quad & \begin{bmatrix} 8 & 5 \\ 6 & 4 \end{bmatrix} \begin{bmatrix} 2 & -5/2 \\ -4 & 4 \end{bmatrix} \\ &= \begin{bmatrix} 8 \times 2 + 5 \times (-4) & 8 \times (-\frac{5}{2}) + 5 \times 4 \\ 6 \times 2 + 4 \times (-4) & 6 \times (-\frac{5}{2}) + 4 \times 4 \end{bmatrix} \\ &= \begin{bmatrix} 16 - 20 & -20 + 20 \\ 12 - 16 & -15 + 16 \end{bmatrix} \\ &= \begin{bmatrix} -4 & 0 \\ -4 & 1 \end{bmatrix} \end{aligned}$$

$$\text{So, } \begin{bmatrix} 8 & 5 \\ 6 & 4 \end{bmatrix} \begin{bmatrix} 2 & -5/2 \\ -4 & 4 \end{bmatrix} = \begin{bmatrix} -4 & 0 \\ -4 & 1 \end{bmatrix}$$

$$\begin{aligned} \text{(e)} \quad & \begin{bmatrix} -1 & 2 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \\ &= \begin{bmatrix} -1 \times 0 + 2 \times 0 & -1 \times 0 + 2 \times 0 \\ 1 \times 0 + 3 \times 0 & 1 \times 0 + 3 \times 0 \end{bmatrix} \\ &= \begin{bmatrix} 0 + 0 & 0 + 0 \\ 0 + 0 & 0 + 0 \end{bmatrix} \\ &= \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \end{aligned}$$

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

$$\text{Q5. Let } A = \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} \text{ and } C = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$$

Verify whether

- | | |
|--------------------------|-------------------------|
| (i) $AB = BA$ | (ii) $A(BC) = (AB)C$ |
| (iii) $A(B+C) = AB + AC$ | (iv) $A(B-C) = AB - AC$ |

Solution:

$$\text{(i) } AB = BA$$

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

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$$\begin{aligned}
 &= \begin{bmatrix} -4 - 33 & -7 - 54 \\ 8 + 0 & 14 + 90 \end{bmatrix} \\
 &= \begin{bmatrix} -37 & -61 \\ 8 & 14 \end{bmatrix} \quad \text{----- (i)}
 \end{aligned}$$

$$\begin{aligned}
 \text{R.H.S} &= (\text{AB}) \text{C} \\
 &= \left(\begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} \right) \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \\
 &= \left(\begin{bmatrix} -1 \times 1 + 3 \times (-3) & -1 \times 2 + 3 \times (-5) \\ 2 \times 1 + 0 \times (-3) & 2 \times 2 + 0 \times (-5) \end{bmatrix} \right) \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 - 9 & -2 - 15 \\ 2 + 0 & 4 + 0 \end{bmatrix} \times \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} -10 & -17 \\ 2 & 4 \end{bmatrix} \times \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} -10 \times 2 + (-17) \times 1 & -10 \times 1 + (-17) \times 3 \\ 2 \times 2 + 4 \times 1 & 2 \times 1 + 4 \times 3 \end{bmatrix} \\
 &= \begin{bmatrix} -20 - 17 & -10 - 51 \\ 4 + 4 & 2 + 12 \end{bmatrix} \\
 &= \begin{bmatrix} -37 & -61 \\ 8 & 14 \end{bmatrix} \quad \text{----- (ii)}
 \end{aligned}$$

From (i) and (ii), it is obvious that: L.H.S = R.H.S

$$\mathbf{A (BC) = (AB) C}$$

$$\text{(iii) } \mathbf{A (B+C) = AB + AC}$$

$$\begin{aligned}
 \text{L.H.S} &= \text{A (B+C)} \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \left(\begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \right) \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 + 2 & 2 + 1 \\ -3 + 1 & -5 + 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 3 & 3 \\ -2 & -2 \end{bmatrix}
 \end{aligned}$$

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$$\begin{aligned}
 &= \begin{bmatrix} -1 \times 3 + 3 \times (-2) & -1 \times 3 + 3 \times (-2) \\ 2 \times 3 + 0 \times (-2) & 2 \times 3 + 0 \times (-2) \end{bmatrix} \\
 &= \begin{bmatrix} -3 - 6 & -3 - 6 \\ 6 + 0 & 6 + 0 \end{bmatrix} \\
 &= \begin{bmatrix} -9 & -9 \\ 6 & 6 \end{bmatrix} \quad \text{----- (i)}
 \end{aligned}$$

$$\text{R.H.S} = AB + AC$$

$$\begin{aligned}
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} + \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 \times 1 + 3 \times (-3) & -1 \times 2 + 3 \times 2 \\ 2 \times (-3) + 0 \times (-3) & 2 \times 2 + 0 \times (-5) \end{bmatrix} + \begin{bmatrix} -1 \times 2 + 3 \times 1 & -1 \times 1 + 3 \times 3 \\ 2 \times 2 + 0 \times 1 & 2 \times 1 + 0 \times 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 - 9 & -2 - 15 \\ 2 + 0 & 4 + 0 \end{bmatrix} + \begin{bmatrix} -2 + 3 & -1 + 9 \\ 4 + 0 & 2 + 0 \end{bmatrix} \\
 &= \begin{bmatrix} -10 & -17 \\ 2 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 8 \\ 4 & 2 \end{bmatrix} \\
 &= \begin{bmatrix} -10 + 1 & -17 + 8 \\ 2 + 4 & 4 + 2 \end{bmatrix} \\
 &= \begin{bmatrix} -9 & -9 \\ -6 & 6 \end{bmatrix} \quad \text{----- (ii)}
 \end{aligned}$$

From (i) and (ii), it is proved that L.H.S = R.H.S

$$\mathbf{A (B+C) = AB + AC}$$

$$\text{(iv) } \mathbf{A (B-C) = AB - AC}$$

$$\begin{aligned}
 \text{L.H.S} &= A (B-C) \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \left(\begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} - \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \right) \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 - 2 & 2 - 1 \\ -3 - 1 & -5 - 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} -1 & 1 \\ -4 & -8 \end{bmatrix}
 \end{aligned}$$

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$$\begin{aligned}
 &= \begin{bmatrix} -1 \times (-1) + 3 \times (-4) & -1 \times 1 + 3 \times (-8) \\ 2 \times (-1) + 0 \times (-4) & 2 \times 1 + 0 \times (-8) \end{bmatrix} \\
 &= \begin{bmatrix} 1 - 12 & -1 - 24 \\ -2 + 0 & 2 + 0 \end{bmatrix} \\
 &= \begin{bmatrix} 11 & -25 \\ -2 & 2 \end{bmatrix} \quad \text{----- (i)}
 \end{aligned}$$

$$\text{R.H.S} = AB - AC$$

$$\begin{aligned}
 &= \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} - \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 \times 1 + 3 \times (-3) & -1 \times 2 + 3 \times 2 \\ 2 \times (-3) + 0 \times (-3) & 2 \times 2 + 0 \times (-5) \end{bmatrix} - \begin{bmatrix} -1 \times 2 + 3 \times 1 & -1 \times 1 + 3 \times 3 \\ 2 \times 2 + 0 \times 1 & 2 \times 1 + 0 \times 3 \end{bmatrix} \\
 &= \begin{bmatrix} -1 - 9 & -2 - 15 \\ 2 + 0 & 4 + 0 \end{bmatrix} - \begin{bmatrix} -2 + 3 & -1 + 9 \\ 4 + 0 & 2 + 0 \end{bmatrix} \\
 &= \begin{bmatrix} -10 & -17 \\ 2 & 4 \end{bmatrix} - \begin{bmatrix} 1 & 8 \\ 4 & 2 \end{bmatrix} \\
 &= \begin{bmatrix} -10 - 1 & -17 - 8 \\ 2 - 4 & 4 - 2 \end{bmatrix} \\
 &= \begin{bmatrix} 11 & -25 \\ -2 & 2 \end{bmatrix} \quad \text{----- (ii)}
 \end{aligned}$$

From (i) and (ii), it is proved that L.H.S = R.H.S

$$\mathbf{A(B-C) = AB - AC}$$

Q6. For the matrices

$$\mathbf{A = \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix}, C = \begin{bmatrix} -2 & 6 \\ 3 & -9 \end{bmatrix}}$$

Verify that

$$(i) \mathbf{(AB)^t = B^t A^t} \quad (ii) \mathbf{(BC)^t = C^t B^t}$$

9th Mathematics Exercise 1.4 Notes

(i) $(AB)^t = B^t A^t$

Solution:

$$\begin{aligned}
 \text{L.H.S} &= (AB)^t \\
 &= \left(\begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} \right)^t \\
 &= \left(\begin{bmatrix} -1 \times 1 + 3 \times (-3) & -1 \times 2 + 3 \times 2 \\ 2 \times (-3) + 0 \times (-3) & 2 \times 2 + 0 \times (-5) \end{bmatrix} \right)^t \\
 &= \left(\begin{bmatrix} -1 - 9 & -2 - 15 \\ 2 + 0 & 4 + 0 \end{bmatrix} \right)^t \\
 &= \left(\begin{bmatrix} -10 & -17 \\ 2 & 4 \end{bmatrix} \right)^t \\
 &= \begin{bmatrix} -10 & 2 \\ -17 & 4 \end{bmatrix} \quad \text{----- (i)}
 \end{aligned}$$

$$\begin{aligned}
 \text{R.H.S} &= B^t A^t \\
 &= \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix}^t \times \begin{bmatrix} -1 & 3 \\ 2 & 0 \end{bmatrix}^t \\
 &= \begin{bmatrix} 1 & -3 \\ 2 & -5 \end{bmatrix} \times \begin{bmatrix} -1 & 2 \\ 3 & 0 \end{bmatrix} \\
 &= \begin{bmatrix} 1 \times (-1) + (-3) \times 3 & 1 \times 2 + (-3) \times 0 \\ 2 \times (-1) + (-5) \times 3 & 2 \times 2 + (-5) \times 0 \end{bmatrix} \\
 &= \begin{bmatrix} -1 - 9 & 2 + 0 \\ -2 - 15 & 4 + 0 \end{bmatrix} \\
 &= \begin{bmatrix} -10 & 2 \\ -17 & 4 \end{bmatrix} \quad \text{----- (ii)}
 \end{aligned}$$

From (i) and (ii), it is proved that L.H.S = R.H.S

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

(ii) $(BC)^t = C^t B^t$

$$\text{L.H.S} = (BC)^t$$

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$$\begin{aligned}
 &= \left(\begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix} \times \begin{bmatrix} -2 & 6 \\ 3 & -9 \end{bmatrix} \right)^{\dagger} \\
 &= \left(\begin{bmatrix} 1 \times (-2) + 2 \times 3 & 1 \times 6 + 2 \times (-9) \\ -3 \times (-2) + (-5) \times 3 & -3 \times 6 + (-5) \times (-9) \end{bmatrix} \right)^{\dagger} \\
 &= \left(\begin{bmatrix} -2 + 6 & 6 - 18 \\ 6 - 15 & -18 + 45 \end{bmatrix} \right)^{\dagger} \\
 &= \left(\begin{bmatrix} 4 & -12 \\ -9 & 27 \end{bmatrix} \right)^{\dagger} \\
 &= \begin{bmatrix} 4 & -9 \\ -12 & 27 \end{bmatrix} \quad \text{----- (i)}
 \end{aligned}$$

$$\begin{aligned}
 \text{R.H.S} &= C^{\dagger} B^{\dagger} \\
 &= \begin{bmatrix} -2 & 6 \\ 3 & -9 \end{bmatrix}^{\dagger} \times \begin{bmatrix} 1 & 2 \\ -3 & -5 \end{bmatrix}^{\dagger} \\
 &= \begin{bmatrix} -2 & 3 \\ 6 & -9 \end{bmatrix} \times \begin{bmatrix} 1 & -3 \\ 2 & -5 \end{bmatrix} \\
 &= \begin{bmatrix} -2 \times 1 + 3 \times 2 & 2 \times (-3) + 3 \times (-5) \\ 6 \times 1 + (-9) \times 2 & 6 \times (-3) + (-9) \times (-5) \end{bmatrix} \\
 &= \begin{bmatrix} -2 + 6 & 6 + 15 \\ 6 - 18 & -18 + 45 \end{bmatrix} \\
 &= \begin{bmatrix} 4 & -9 \\ -12 & 27 \end{bmatrix} \quad \text{----- (ii)}
 \end{aligned}$$

From (i) and (ii), hence proved L.H.S = R.H.S

$$(BC)^{\dagger} = C^{\dagger} B^{\dagger}$$

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