

## Review Exercise

Q1. Select the correct answer in each of the following.

(i) The order of matrix  $\begin{bmatrix} 2 & 1 \end{bmatrix}$  is .....

(a) 2-by-1

(b) 1-by-2

(c) 1-by-1

(d) 2-by-2

(ii)  $\begin{bmatrix} \sqrt{2} & 0 \\ 0 & \sqrt{2} \end{bmatrix}$  is called ..... matrix.

(a) zero

(b) unit

(c) scalar

(d) singular

(iii) Which is order of square matrix.....

(a) 2-by-1

(b) 1-by-2

(c) 2-by-1

(d) 3-by-2

(iv) Order of transpose of  $\begin{bmatrix} 2 & 1 \\ 0 & 1 \\ 3 & 2 \end{bmatrix}$  .....

(a) 3-by-2

(b) 2-by-3

(c) 1-by-3

(d) 3-by-1

(v) Ad joint of  $\begin{bmatrix} 1 & 2 \\ 0 & -1 \end{bmatrix}$  is .....

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

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



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

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

(vi) Product of  $\begin{bmatrix} x & y \end{bmatrix} \begin{bmatrix} 2 \\ -1 \end{bmatrix}$  is.....

(a)  $[2x + y]$

(b)  $[x - 2y]$

(c)  $[2x - y]$

(d)  $[x + 2y]$

(vii) If  $\begin{bmatrix} 2 & 6 \\ 3 & x \end{bmatrix} = 0$ , then x is equal to...a = .....

(a) 9

(b) - 6

(c) 6

(d) - 9

(viii) If  $X + \begin{bmatrix} -1 & -2 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ , then X is equal to.....

(a)  $\begin{bmatrix} 2 & 2 \\ 2 & 0 \end{bmatrix}$

(b)  $\begin{bmatrix} 0 & 2 \\ 2 & 2 \end{bmatrix}$

(c)  $\begin{bmatrix} 2 & 0 \\ 0 & 0 \end{bmatrix}$

(d)  $\begin{bmatrix} 2 & 2 \\ 0 & 2 \end{bmatrix}$

## Answers

(i) b

(ii) c

(iii) a

(iv) b

(v) a

(vi) c

(vii) a

(viii) d

**Q2. Complete the following:**

(i)  $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$  is called ..... matrix.

(ii)  $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$  is called ..... matrix.



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- (iii) Additive inverse of  $\begin{bmatrix} 1 & -2 \\ 0 & -1 \end{bmatrix}$  is .....
- (iv) In matrix multiplication, in general,  $AB$  .....  $BA$ .
- (v) Matrix  $A + B$  may be found if order of  $A$  and  $B$  is .....
- (vi) A matrix is called ..... matrix if number of rows and columns are equal.

**Answers:**

- |             |           |   |
|-------------|-----------|---|
| (i) Null    | (ii) Unit | (iii) $\begin{bmatrix} -1 & 2 \\ 0 & 1 \end{bmatrix}$ |
| (iv) $\neq$ | (v) Same  | (vi) Square   |

**Q3.** If  $\begin{bmatrix} a+3 & 4 \\ 6 & b-1 \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ 6 & 2 \end{bmatrix}$ , then find  $a$  and  $b$ .

**Solution:**

By comparing the corresponding elements, we get

$$a + 3 = -3$$

$$a = -3 - 3 = -6$$

$$a = -6 \quad \text{Answer}$$

and  $b - 1 = 2$

$$b = 2 + 1$$

$$b = 3 \quad \text{Answer}$$

**Q4.** If  $A = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix}$ ,  $B = \begin{bmatrix} 5 & -4 \\ -2 & -1 \end{bmatrix}$ , then find the following.

(i)  $2A + 3B$                       (ii)  $-3A + 2B$

(iii)  $-3(A + 2B)$                   (iv)  $\frac{2}{3}(2A - 3B)$



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**Solution:**

**(i)  $2A + 3B$**

$$\begin{aligned} &= 2 \times \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} + 3 \times \begin{bmatrix} 5 & -4 \\ -2 & -1 \end{bmatrix} \\ &= \begin{bmatrix} 2 \times 2 & 2 \times 3 \\ 2 \times 1 & 2 \times 0 \end{bmatrix} + \begin{bmatrix} 3 \times 5 & 3 \times (-4) \\ 3 \times (-2) & 3 \times (-1) \end{bmatrix} \\ &= \begin{bmatrix} 4 & 6 \\ 2 & 0 \end{bmatrix} + \begin{bmatrix} 15 & -12 \\ -6 & -3 \end{bmatrix} \\ &= \begin{bmatrix} 4 + 15 & 6 - 12 \\ 2 - 6 & 0 - 3 \end{bmatrix} \end{aligned}$$

$$2A + 3B = \begin{bmatrix} 19 & -6 \\ -4 & -3 \end{bmatrix}$$

**(ii)  $-3A + 2B$**

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

$$-3A + 2B = \begin{bmatrix} 4 & -17 \\ -7 & -2 \end{bmatrix}$$

**(iii)  $-3(A + 2B)$**

$$\begin{aligned} &= -3 \left( \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} + 2 \times \begin{bmatrix} 5 & -4 \\ -2 & -1 \end{bmatrix} \right) \\ &= -3 \left( \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} + \begin{bmatrix} 2 \times 5 & 2 \times (-4) \\ 2 \times (-2) & 2 \times (-1) \end{bmatrix} \right) \\ &= -3 \left( \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} + \begin{bmatrix} 10 & -8 \\ -4 & -2 \end{bmatrix} \right) \\ &= -3 \begin{bmatrix} 2 + 10 & 3 - 8 \\ 1 - 4 & 0 + -2 \end{bmatrix} \end{aligned}$$



$$\begin{aligned}
 &= -3 \begin{bmatrix} 12 & -5 \\ -3 & -2 \end{bmatrix} \\
 &= - \begin{bmatrix} 3 \times 12 & 3 \times (-5) \\ 3 \times (-3) & 3 \times (-2) \end{bmatrix} \\
 &= - \begin{bmatrix} 36 & -15 \\ -9 & -6 \end{bmatrix} \\
 -3(A + 2B) &= \begin{bmatrix} -36 & 15 \\ 9 & 6 \end{bmatrix}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad \frac{2}{3}(2A - 3B) &= \frac{2}{3} \left( 2 \times \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} - 3 \times \begin{bmatrix} 5 & -4 \\ -2 & -1 \end{bmatrix} \right) \\
 &= \frac{2}{3} \left( \begin{bmatrix} 2 \times 2 & 2 \times 3 \\ 2 \times 1 & 2 \times 0 \end{bmatrix} - \begin{bmatrix} 3 \times 5 & 3 \times (-4) \\ 3 \times (-2) & 3 \times (-1) \end{bmatrix} \right) \\
 &= \frac{2}{3} \left( \begin{bmatrix} 4 & 6 \\ 2 & 0 \end{bmatrix} - \begin{bmatrix} 15 & -12 \\ -6 & -3 \end{bmatrix} \right) \\
 &= \begin{bmatrix} 4 - 15 & 6 + 12 \\ 2 + 6 & 0 + 3 \end{bmatrix} \\
 &= \begin{bmatrix} -11 & 18 \\ 8 & 3 \end{bmatrix} \\
 \frac{2}{3}(2A - 3B) &= \begin{bmatrix} -\frac{22}{3} & 12 \\ \frac{16}{3} & 2 \end{bmatrix}
 \end{aligned}$$

**Q5.** Find the value of X, if  $\begin{bmatrix} 2 & 1 \\ 3 & -3 \end{bmatrix} + X = \begin{bmatrix} 4 & -2 \\ -1 & -2 \end{bmatrix}$ .

**Solution:**

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



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

Q6. If  $A = \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix}$ ,  $B = \begin{bmatrix} -3 & 4 \\ 5 & -2 \end{bmatrix}$ , then prove that

(i)  $AB \neq BA$

(ii)  $A(BC) = (AB)C$

**Solution:**

$$\begin{aligned} \text{(i)} \quad AB &= \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} -3 & 4 \\ 5 & -2 \end{bmatrix} \\ &= \begin{bmatrix} 0 \times (-3) + 1 \times 5 & 0 \times 4 + 1 \times (-2) \\ 2 \times (-3) + (-3) \times 5 & 2 \times 4 + (-3) \times (-2) \end{bmatrix} \\ &= \begin{bmatrix} 0 + 5 & 0 - 2 \\ -6 - 15 & 8 + 6 \end{bmatrix} \\ &= \begin{bmatrix} 5 & 2 \\ -21 & 14 \end{bmatrix} \quad \text{----- (i)} \end{aligned}$$

$$\begin{aligned} BA &= \begin{bmatrix} -3 & 4 \\ 5 & -2 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix} \\ &= \begin{bmatrix} (-3) \times 0 + 4 \times 2 & (-3) \times 1 + 4 \times (-3) \\ 5 \times 0 + (-2) \times 2 & 5 \times 1 + (-2) \times (-3) \end{bmatrix} \\ &= \begin{bmatrix} 0 + 8 & -3 - 12 \\ 0 - 4 & 5 + 6 \end{bmatrix} \\ &= \begin{bmatrix} 8 & -15 \\ -4 & 11 \end{bmatrix} \quad \text{----- (ii)} \end{aligned}$$

From (i) and (ii), it is clear that  $AB \neq BA$

(ii)  $A(BC) = (AB)C$

Solution is not possible because matrix C is not given.



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Q7. If  $A = \begin{bmatrix} 3 & 2 \\ 1 & -1 \end{bmatrix}$ ,  $B = \begin{bmatrix} 2 & 4 \\ -3 & -5 \end{bmatrix}$ , then verify that

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

(ii)  $(AB)^{-1} = B^{-1}A^{-1}$

**Solution:**

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

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

$$B^t = \begin{bmatrix} 2 & 4 \\ -3 & -5 \end{bmatrix}^t = \begin{bmatrix} 2 & -3 \\ 4 & -5 \end{bmatrix}$$

$$\begin{aligned} AB &= \begin{bmatrix} 3 & 2 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} 2 & 4 \\ -3 & -5 \end{bmatrix} \\ &= \begin{bmatrix} 3 \times 2 + 2 \times (-3) & 3 \times 4 + 2 \times (-5) \\ 1 \times 2 + (-1) \times (-3) & 1 \times 4 + (-1) \times (-5) \end{bmatrix} \\ &= \begin{bmatrix} 6 - 6 & 12 - 10 \\ 2 + 3 & 4 + 5 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 5 & 9 \end{bmatrix} \end{aligned}$$

$$\begin{aligned} (AB)^t &= \begin{bmatrix} 0 & 2 \\ 5 & 9 \end{bmatrix}^t \\ &= \begin{bmatrix} 0 & 5 \\ 2 & 9 \end{bmatrix} \quad \text{----- (i)} \end{aligned}$$

$$\begin{aligned} B^t A^t &= \begin{bmatrix} 2 & -3 \\ 4 & -5 \end{bmatrix} \begin{bmatrix} 3 & 1 \\ 2 & -1 \end{bmatrix} \\ &= \begin{bmatrix} 2 \times 3 + (-3) \times 2 & 2 \times 1 + (-3) \times (-1) \\ 4 \times 3 + (-5) \times 2 & 4 \times 1 + (-5) \times (-1) \end{bmatrix} \\ &= \begin{bmatrix} 6 - 6 & 2 + 3 \\ 12 - 10 & 4 + 5 \end{bmatrix} \\ &= \begin{bmatrix} 0 & 5 \\ 2 & 9 \end{bmatrix} \quad \text{----- (ii)} \end{aligned}$$



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From (i) and (ii), it is clear that  $(AB)^t = B^t A^t$

(ii)  $(AB)^{-1} = B^{-1}A^{-1}$

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

$$|A| = 3 \times (-1) - 1 \times 2 = -3 - 2 = -5 \neq 0$$

$$\begin{aligned} A^{-1} &= \frac{\text{Adj } A}{|A|} \\ &= \frac{\begin{bmatrix} -1 & -2 \\ -1 & 3 \end{bmatrix}}{-5} = \begin{bmatrix} \frac{1}{5} & \frac{2}{5} \\ \frac{1}{5} & -\frac{3}{5} \end{bmatrix} \end{aligned}$$

$$B = \begin{bmatrix} 2 & 4 \\ -3 & -5 \end{bmatrix}$$

$$|B| = 2 \times (-5) - 4 \times (-3) = -10 + 12 = 2 \neq 0$$

$$\begin{aligned} B^{-1} &= \frac{\text{Adj } B}{|B|} \\ &= \frac{1}{2} \begin{bmatrix} -5 & -4 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} -\frac{5}{2} & -2 \\ \frac{3}{2} & 1 \end{bmatrix} \end{aligned}$$

$$\begin{aligned} AB &= \begin{bmatrix} 3 & 2 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} 2 & 4 \\ -3 & -5 \end{bmatrix} \\ &= \begin{bmatrix} 3 \times 2 + 2 \times (-3) & 3 \times 4 + 2 \times (-5) \\ 1 \times 2 + (-1) \times (-3) & 1 \times 4 + (-1) \times (-5) \end{bmatrix} \\ &= \begin{bmatrix} 6 - 6 & 12 - 10 \\ 2 + 3 & 4 + 5 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 5 & 9 \end{bmatrix} \end{aligned}$$

$$|AB| = 0 \times 9 - 2 \times 5 = 0 - 10 = -10 \neq 0$$

$$\begin{aligned} (AB)^{-1} &= \frac{\text{Adj } AB}{|AB|} \\ &= \frac{1}{-10} \begin{bmatrix} 9 & -2 \\ -5 & 0 \end{bmatrix} \end{aligned}$$



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$$= \begin{bmatrix} \frac{-9}{10} & \frac{1}{5} \\ \frac{1}{2} & 0 \end{bmatrix} \text{----- (i)}$$

Now by solving  $B^{-1}A^{-1}$

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

From (i) and (ii), it is clear that  $(AB)^{-1} = B^{-1}A^{-1}$



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