

# Matrix Multiplication – Extension

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Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Commutative Property

In mathematics (scalar mathematics) it is known that multiplication is commutative. This means that the product of  $2 \times 3 = 6$  and  $3 \times 2 = 6$ . If  $a = 2$  and  $b = 3$ , then  $a \times b = 6$  and  $b \times a = 6$  and thus  $a \times b = b \times a$ .

## Matrix Multiplication is not Commutative

In general, when multiplying matrices, the product of the two matrices are not the same. The order of the multiplication matters.

In general,  $AB \neq BA$ .

This can be shown in the following examples.

### CASE 1:

$$AB = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

$$BA = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

### CASE 2:

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

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

## Additional Problems & Questions

1. Given the following calculate the operations and solve for the variable to make the statements true.

a) Given that the following matrices are equal, find the values of  $x$ ,  $y$  and  $z$ .

$$A = \begin{bmatrix} 4 & 0 \\ 6 & -2 \\ 3 & 1 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} x & 0 \\ 6 & y + 4 \\ \frac{z}{3} & 1 \end{bmatrix}$$

b) Find the value of  $a$ ,  $b$ ,  $c$  and  $d$  for the two identical matrices:  $\begin{bmatrix} 2 & -6 \\ -a & 8 \end{bmatrix} = \begin{bmatrix} 2b & 4c \\ 15 & 3d \end{bmatrix}$

c) Give given the following multiplication find the value of  $t$ :  $[2 \quad t \quad -5] \begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix} = [7]$