Matrix Multiplication

Order Matters!

$A = \begin{bmatrix} 7 \\ -8 \\ 0 \\ 4 \end{bmatrix}$ $B = \begin{bmatrix} 6 & -3 & 11 \\ 0 & 5 & -4 \end{bmatrix}$ $C = \begin{bmatrix} 2 & -7 & 0 \\ 3 & 8 & 4 \\ 5 & 9 & -6 \end{bmatrix}$

Order _____ Order _____ Order _____

To be able to multiply matrices, the _____ of the first matrix must be the same as the _____ of the second matrix.

The order of the product (the new matrix) will be the _____ of the first matrix and the _____ of the second matrix.

Find the order of each of the matrices below and determine if you could multiply them or not. If so, state the order of the product.

$A = \begin{bmatrix} 5 & -3 \\ -2 & 4 \end{bmatrix}$ $B = \begin{bmatrix} 0 & 1 \\ 4 & -2 \end{bmatrix}$ $C = \begin{bmatrix} 8 \\ 11 \end{bmatrix}$ $D = \begin{bmatrix} 1 & 3 & 2 \\ -3 & 1 & 4 \\ 2 & 1 & -2 \end{bmatrix}$ $E = \begin{bmatrix} 2 & -5 \\ 4 & 10 \\ 13 & -8 \end{bmatrix}$

AB =

___x___ x ___x___

BC =

___x___ x ___x___

CD =

___x___ x ___x___

DE =

___x___ x ___x___

DEA =

___x___ x ___x___ x ___x___

Multiplying matrices is **NOT** like adding or subtracting. There are a few extra steps you must take in order to successfully multiply them.

Start with two matrices that can be multiplied.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}\begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix}$$

Move the first matrix down.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}\begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}\begin{bmatrix} \text{Answer} \\ \text{goes} \\ \text{here} \end{bmatrix}$$

Pick a position in the answer matrix and follow across from the left and vertically from above to figure out which numbers you will use. Multiply pairs beginning with the outermost numbers. Do that for each pair, and then add them up. That sum goes in the position where the arrows meet.

$$\begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix}$$

$$\begin{bmatrix} \cancel{1} & \cancel{2} & \cancel{3} \\ 4 & 5 & 6 \end{bmatrix}\begin{bmatrix} 58 \\ \end{bmatrix}$$

$$1 \cdot 7 + 2 \cdot 9 + 3 \cdot 11 = 58$$

Remember not to use the numbers in your answer matrix when computing other spaces. For example, the 58 was not used when finding the 64.

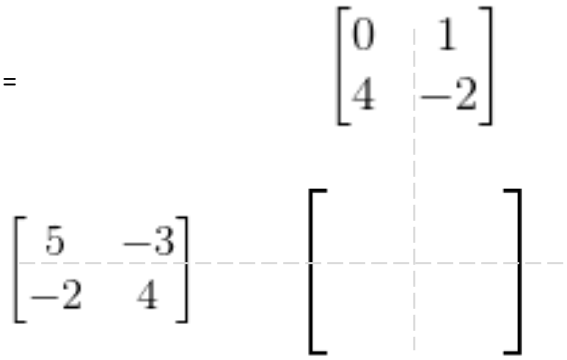
$$\begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix}$$

$$\begin{bmatrix} \cancel{1} & \cancel{2} & \cancel{3} \\ 4 & 5 & 6 \end{bmatrix}\begin{bmatrix} \cancel{58} & 64 \\ \end{bmatrix}$$

Now let's practice actually multiplying matrices together.

A = $\begin{bmatrix} 5 & -3 \\ -2 & 4 \end{bmatrix}$ B = $\begin{bmatrix} 0 & 1 \\ 4 & -2 \end{bmatrix}$ C = $\begin{bmatrix} 8 \\ 11 \end{bmatrix}$

1. A x B =



2. B x A =

3. B x C =

Three teams are in a track meet. They will receive 10 points for a 1st place finish, 8 points for a 2nd place finish, 6 points for a 3rd place finish, and 4 points for a 4th place finish. The total amount of each finish for 10 events is listed in the matrix below. How many points will each team score? Which team will win the meet?

$$\begin{array}{r} \\ \text{Madison Central} \\ \text{Madison Southern} \\ \text{Berea} \\ \text{Model} \end{array} \begin{array}{c} \begin{array}{cccc} 1^{st} & 2^{nd} & 3^{rd} & 4^{th} \end{array} \\ \begin{bmatrix} 2 & 4 & 2 & 2 \\ 5 & 2 & 3 & 0 \\ 2 & 3 & 0 & 5 \\ 1 & 1 & 5 & 3 \end{bmatrix} \end{array}$$

George Washington received two new units for the battle against the British and needed to outfit them before sending them off. Looking at his records, he knew that each rifle costs $60, each powder horn costs $2, and each uniform costs $35. The first unit needs 14 rifles, 30 powder horns, and 18 uniforms. The second unit needs 16 rifles, 25 powder horns, and 20 uniforms. Write two matrices that represent this information and multiply them accordingly to find the total cost of equipment for each unit.