Bell Ringer

Tuesday 2/4

Using the matrices below, find the sums and differences.

$A = \begin{bmatrix} 4 & 3 \\ -2 & 6 \\ 0 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 1 & -3 \\ -4 & 2 \\ 5 & -1 \end{bmatrix}$ $C = \begin{bmatrix} 1 & 2 \\ -3 & -4 \end{bmatrix}$ $D = \begin{bmatrix} 1 & 5 \\ 2 & 0 \end{bmatrix}$

1. $A + B$ 2. $B - A$ 3. $C + D$ 4. $C - D$

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

$\begin{bmatrix} 5 & 0 \\ -6 & 8 \\ 5 & 0 \end{bmatrix}$ $\begin{bmatrix} -3 & -6 \\ -2 & -4 \\ 5 & -2 \end{bmatrix}$ $\begin{bmatrix} 2 & 7 \\ -1 & -4 \end{bmatrix}$ $\begin{bmatrix} 0 & -3 \\ -5 & -4 \end{bmatrix}$

Solve the matrix equation.

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

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

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Yesterday we added and subtracted matrices... Now lets multiply

Given $A = \begin{bmatrix} 10 & 6 \\ 4 & 3 \end{bmatrix}$, find 2A

$$2A = 2 \cdot \begin{bmatrix} 10 & 6 \\ 4 & 3 \end{bmatrix} = \begin{bmatrix} 20 & 12 \\ 8 & 6 \end{bmatrix}$$

2 is a **scalar** of A. When we multiply an entire matrix by one number, it is called a scalar.

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Find the resulting matrices when multiplied by the scalar.

1. $4 \cdot \begin{bmatrix} 3 & 7 \\ 1 & 1 \\ 9 & 11 \end{bmatrix}$

$\begin{bmatrix} 12 & 28 \\ 4 & 4 \\ 36 & 44 \end{bmatrix}$

2. $\frac{1}{3} \cdot \begin{bmatrix} 0 & 3 \\ 2 & 5 \\ 9 & 1 \end{bmatrix}$

$\begin{bmatrix} 0 & 1 \\ \frac{2}{3} & 5/3 \\ 3 & 1/3 \end{bmatrix}$

3. $11 \cdot \begin{bmatrix} 5 & 1 \\ 0 & 5 \\ 3 & 1 \end{bmatrix}$

$\begin{bmatrix} 55 & 11 \\ 0 & 55 \\ 33 & 11 \end{bmatrix}$

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For multiplication to be defined, the "inner" numbers must match. The result will be determined by the "outer" numbers.

$2 \times 3 \cdot 3 \times 4$ 2×4

$$\begin{bmatrix} 2 & 1 & 4 \\ 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} 6 & 3 & -1 & 0 \\ 1 & 1 & 0 & 4 \\ -2 & 5 & 0 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 27 & -2 & 12 \\ -1 & 6 & 0 & 6 \end{bmatrix}$$

2 x 3 3 x 4 2 x 4

match

result

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Can we multiply these?

$$\underset{2\times2}{\begin{bmatrix}7 & 2\\ 3 & 5\end{bmatrix}} \bullet \underset{2\times2}{\begin{bmatrix}1 & 3\\ 4 & 2\end{bmatrix}} = 2\times2$$

$$\cancel{\underset{3\times1}{\begin{bmatrix}1\\ 0\\ 2\end{bmatrix}} \bullet \underset{3\times1}{\begin{bmatrix}3\\ 4\\ 5\end{bmatrix}}}$$

$$\underset{2\times3}{\begin{bmatrix}2 & 0 & 1\\ 8 & 11 & 3\end{bmatrix}} \bullet \underset{3\times3}{\begin{bmatrix}1 & 4 & 7\\ 2 & 5 & 8\\ 3 & 6 & 9\end{bmatrix}} = 2\times3$$

$$\underset{2\times3}{\begin{bmatrix}5 & 15 & 20\\ 3 & 1 & 0\end{bmatrix}} \bullet \underset{3\times2}{\begin{bmatrix}11 & 3\\ 1 & 17\\ 4 & 9\end{bmatrix}}$$

2x2

When we multiply we multiply across the first matrix, and down the second, adding each product.

$$\begin{bmatrix}a_1 & a_2 & a_3\\ b_1 & b_2 & b_3\end{bmatrix} \bullet \begin{bmatrix}c_1 & d_1\\ c_2 & d_2\\ c_3 & d_3\end{bmatrix} = \begin{bmatrix}(a_1\cdot c_1 + a_2\cdot c_2 + a_3\cdot c_3) & (a_1\cdot d_1 + a_2\cdot d_2 + a_3\cdot d_3)\\ (b_1\cdot c_1 + b_2\cdot c_2 + b_3\cdot c_3) & (b_1\cdot d_1 + b_2\cdot d_2 + b_3\cdot d_3)\end{bmatrix}$$

The result of this is called the dot product

"Dot Product"

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & \end{bmatrix}$$

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1. $\begin{bmatrix} 1 & 2 & 3 \end{bmatrix} \bullet \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix}$

$1 \times 3 \quad 3 \times 1$

$[3 + 8 + 15]$

$[26]$

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2. $\begin{bmatrix} 7 & 2 \\ 3 & 5 \end{bmatrix} \bullet \begin{bmatrix} 1 & 3 \\ 4 & 2 \end{bmatrix}$

2x2 2x2

$\begin{bmatrix} 7+8 & 21+4 \\ 3+20 & 9+10 \end{bmatrix}$

$= \begin{bmatrix} 15 & 25 \\ 23 & 19 \end{bmatrix}$

3. $\begin{bmatrix} 3 & 1 & 2 \\ 4 & 5 & 3 \end{bmatrix} \bullet \begin{bmatrix} 4 & 2 \\ 1 & 3 \\ 0 & 5 \end{bmatrix}$

2x3 3x2

2x2

$\begin{bmatrix} 12+1+0 & 6+3+10 \\ 16+5+0 & 8+15+15 \end{bmatrix}$

$= \begin{bmatrix} 13 & 19 \\ 21 & 38 \end{bmatrix}$

4. $\begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix} \cdot \begin{bmatrix} 10 & 7 \\ 6 & 8 \end{bmatrix}$

$\underbrace{2\times 2 \quad 2\times 2}_{2\times 2}$

$\begin{bmatrix} 20+6 & 14+8 \\ 30+24 & 21+32 \end{bmatrix}$

$\begin{bmatrix} 26 & 22 \\ 54 & 53 \end{bmatrix}$

5. $\begin{bmatrix} 1 & 7 & 5 \\ 8 & 5 & 4 \end{bmatrix} \cdot \begin{bmatrix} 3 & 6 \\ 2 & 1 \\ 3 & 4 \end{bmatrix}$

$\underbrace{2\times 3 \quad 3\times 2}$

$\begin{bmatrix} 3+14+15 & 6+7+20 \\ 24+10+12 & 48+5+16 \end{bmatrix}$

$\begin{bmatrix} 32 & 33 \\ 46 & 69 \end{bmatrix}$

Due Thursday

Multiplying Matrices Name: ________________________ Hour________

Examples:

1. $\begin{bmatrix} 2 & 5 & x \\ 3 & 7 & 2y \end{bmatrix} + \begin{bmatrix} 2 & 5 & x \\ 3 & 7 & 2y \end{bmatrix} + \begin{bmatrix} 2 & 5 & x \\ 3 & 7 & 2y \end{bmatrix} =$

2. How many times did you add that matrix to itself? ______

3. Rewrite problem #1 as a *multiplication problem.*

4. Write the matrix $\frac{9}{10}$[S] and find the answer, where [S] = $\begin{bmatrix} 10 & 2 & 3 \\ 1 & 4 & 9 \end{bmatrix}$

5. $-2\begin{bmatrix} 4 & -1 \\ 1 & 0 \\ 2 & 7 \end{bmatrix} =$

6. $4\begin{bmatrix} -2 & -8 \\ 5 & 0 \end{bmatrix} + \begin{bmatrix} -3 & 8 \\ 6 & -5 \end{bmatrix} =$

7. $\frac{1}{4}\begin{bmatrix} 4 & 16 & 8 \\ 24 & 4 & 12 \end{bmatrix} + \frac{1}{3}\begin{bmatrix} 12 & 3 & 9 \\ 9 & 6 & 15 \end{bmatrix}$

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Multiply:

8. $\frac{1}{2}\begin{bmatrix} 2 & 6 & 4 \\ 9 & n & 8 \end{bmatrix}$

9. $3\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$

10. $3\begin{bmatrix} 2 & 3 & 4 \end{bmatrix}\begin{bmatrix} 5 \\ -6 \\ 7 \end{bmatrix}$

11. $4\begin{bmatrix} 2 & 2 & 2 & 2 \end{bmatrix}\begin{bmatrix} 2 \\ 4 \\ -1 \end{bmatrix}$

12. $\begin{bmatrix} 3 & 6 & 7 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}$

13. $\begin{bmatrix} 3 & -1 & 2 & 6 \end{bmatrix}\begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix}$

Solve for x:

14. $2\begin{bmatrix} 7 & x & 3 \end{bmatrix}\begin{bmatrix} x \\ x \\ 5 \end{bmatrix} = [6]$

$\begin{bmatrix} 14 & 2x & 6 \end{bmatrix}\begin{bmatrix} x \\ x \\ 5 \end{bmatrix} = [6]$

$\rightarrow 14x + 2x^2 + 30 = 6$

$\rightarrow x^2 + 7x + 15 = 3$

$\quad\quad\quad\quad\;\; -3 \quad -3$

$x^2 + 7x + 12 = 0$

$(x+3)(x+4) = 0$

$x+3=0$

$x+4=0$

$x=-3$

$x=-4$

15. $x\begin{bmatrix} 2 & 3 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}$

$\begin{bmatrix} 2x & 3x & 4x \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}$

$\boxed{\begin{bmatrix} 2x^2 + 3xy + 4xz \end{bmatrix}}$

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