Name: ____ Period: __________ Date: _______________

Matrix Multiplication, Inverses, and Determinants Guided Notes

Matrix Multiplication

If **A** and **B** are two matrices, then their multiplication is possible if the number of columns in matrix **A** is equal to the number of rows in the matrix **B**. If **A** has dimensions $m \times r$ and **B** has dimensions $r \times n$, then their product **AB** has dimensions $m \times n$.

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $B = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$, then matrix multiplication AB is:

$$\boldsymbol{AB} = \begin{bmatrix} \boldsymbol{a} & \boldsymbol{b} \\ \boldsymbol{c} & \boldsymbol{d} \end{bmatrix} . \begin{bmatrix} \boldsymbol{e} & \boldsymbol{f} \\ \boldsymbol{g} & \boldsymbol{h} \end{bmatrix} = \begin{bmatrix} \boldsymbol{ae+bg} & \boldsymbol{af+bh} \\ \boldsymbol{ce+dg} & \boldsymbol{cf+dh} \end{bmatrix}$$

Problem 1: Find $\boldsymbol{AB}$ if $\boldsymbol{A} = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ and $\boldsymbol{B} = \begin{bmatrix} -1 & 2 & 4 \\ 2 & 1 & -1 \end{bmatrix}$.

Determinant of a Matrix

The determinant of a matrix is the difference of the product of secondary diagonal entries from the main diagonal entries.

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $\mathbf{det}(\boldsymbol{A}) = \boldsymbol{ad - cb}$

Identity Matrix

The identity matrix is a $n \times n$ matrix whose main diagonal has all entries equal to 1, and all other elements are 0s.

$$\boldsymbol{I}_{2\times 2} = \begin{bmatrix} \mathbf{1} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} \end{bmatrix}$$

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Inverse of a Matrix

The inverse of a matrix $\boldsymbol{A}$ is a matrix $\boldsymbol{B}$**,** such that:

$$\boldsymbol{AB} = \boldsymbol{BA} = \boldsymbol{I}$$

Where I is the identity matrix.

Mathematically:

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $\boldsymbol{A^{-1}} = \frac{\mathbf{1}}{\mathbf{det}(\boldsymbol{A})}\begin{bmatrix} \boldsymbol{d} & -\boldsymbol{b} \\ -\boldsymbol{c} & \boldsymbol{a} \end{bmatrix}$

where $\det(A) = ad - cb$

Problem 2: Find the inverse of matrix $A = \begin{bmatrix} 2 & -2 \\ 3 & -6 \end{bmatrix}$, if it exists.