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Q1

(a) $AB = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 2 & 1 \\ 3 & 1 & 0 \end{pmatrix} \begin{pmatrix} 0 \\ 2 \\ -1 \end{pmatrix}$

$= \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix} \#$

(b) $B^T A^T = (0 \ 2 \ -1) \begin{pmatrix} 1 & 0 & 3 \\ 2 & 2 & 1 \\ 3 & 1 & 0 \end{pmatrix}$

$= (1 \ 3 \ 2) \#$

(c) $\begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} = B^2 = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

$B^3 = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

Such that $B^{2023} = B^3 \cdot B^{2020} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \#$

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