Step-1

Permutation matrix: Matrix P has single 1 in every row and every column. It has the rows of identity matrix I in any order.

Step-2

Consider P has 1s on the anti-diagonal from $(1,n)$ to $(n,1)$ and let A be any matrix then describe PAP.

Matrix P with 1s on the anti-diagonal from $(1,n)$ to $(n,1)$ will be:

$$P=\begin{bmatrix} 0 & 0 & 0 & \cdots & 1 \\ 0 & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 0 & 1 & 0 & \cdots & 0 \\ 1 & 0 & 0 & \cdots & 0 \end{bmatrix}$$

Here, $P=P^T$. Recall that $P^T=P^{-1}$, so $P=P^{-1}$.

Step-3

Let A be any matrix. Multiplication with matrix P, (PA) destroys the symmetry of matrix A. To recover the symmetry it is multiplied by a permutation matrix Q (PAQ). This matrix Q is none other than P^T. So, PAP^T guarantees to be symmetric.

Therefore, PAP becomes a symmetric matrix.