Ans 1: Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \Rightarrow A^T = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$

$A^T \times A = \begin{bmatrix} a^2 + c^2 & ab + cd \\ ab + cd & b^2 + d^2 \end{bmatrix}$

$AA^T = \begin{bmatrix} a^2 + b^2 & ac + bd \\ ac + bd & c^2 + d^2 \end{bmatrix}$

$\therefore \quad A^T A \neq A A^T$

Ans 2: $AA^T = A^T A$ can happen for two conditions

i) If $A = I$, then

$AA^T = A^T A$

ii) If A is a square matrix and every element in A is same

Let $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \qquad A^T = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

$AA^T = A^T A$