(Q4)

Proof. First suppose A is invertible. Then $\operatorname{rank} A = \operatorname{rank} T_A = n$. Then since $\operatorname{rank} T_A = n$, T_A is an isomorphism and thus bijective.

Now assume T_A is invertible. Then $\operatorname{rank} T_A = n = \operatorname{rank} A$. Then since $\operatorname{rank} A = n$, it is also invertible. $\blacksquare$