Step-1

Let us consider the group of $n \times n$ permutation matrices. Every matrix has *n* rows and *n* columns. Therefore, for the first row, we have *n* choices for the number 1. Once 1 is fixed, all other places are to be filled by 0's.

Then for the second row, we have $n-1$ choices, for the third row, we have $n-2$ choices and so on! Finally, for the last row we have only one choice.

Thus, in all there are $n!$ distinct permutation matrices possible.

Step-2

(b) From the above discussion, it is clear that there are 3! = 6 permutation matrices in the group of 3×3 permutation matrices. Call this group as *G*.

Let P be any 3×3 permutation matrix.

Consider P, P^2, P^3, ... and so on!

It is clear that all these elements belong to *G*.

Step-3

We have shown that *G* contains six elements. Therefore, the elements P, P^2, P^3, ...cannot be all distinct.

Further, it should be clear that $P^6 = I$, for any $P \in G$.

Step-4

Therefore, we have $k = 6$, so that $P^k = I$.