Prove that for an $n \times n$ matrix A, its determinant can be computed by the formula

$$det(A) = \Sigma_{\sigma \in S_n} sign(\sigma) \cdot a_{1\sigma(1)} \cdot a_{2\sigma(2)} \cdot \ldots \cdot a_{n\sigma(n)}$$

Hint : Define $det'(A)$ by the above formula and check that det' satisfies the following properties

a) det' is linear in each row of A when the remaining rows are fixed.

b) $det'(A_1) = -det'(A)$ if A_1 is obtained from A by switching two rows of A.

c) Use a) and b) to conclude that $det'(A) = det(A)$ for any A.