Let $x_1, x_2, \ldots, x_k$ be vectors of m-dimensional Euclidian space, such that $x_1 + x_2 + \cdots + x_k = 0$. Show that there exists a permutation π of the integers $\{1, 2, \ldots, k\}$ such that

$$\left\| \sum_{i=1}^{n} x_{\pi(i)} \right\| \leq \left(\sum_{i=1}^{k} \|x_i\|^2 \right)^{1/2}$$

for each $n = 1, 2, \ldots, k$. Note that $\|\cdot\|$ denotes the Euclidian norm.