Suppose $X_1, X_2, \ldots$ are i.i.d Poisson(1) random variables, and let $S_n = X_1 + \cdots + X_n$.

a)Compute $E\left[\left(\frac{S_n - n}{\sqrt{n}}\right)^-\right]$ exactly, where $x^- = (-x) \vee 0$.

b) Explain why $\left(\frac{S_n - n}{\sqrt{n}}\right)^- \implies N^-$, where $\implies$ denotes convergence in distribution, and $N \sim N(0, 1)$.

c) Show that $E\left[\left(\frac{S_n - n}{\sqrt{n}}\right)^-\right] \to E(N^-) = \frac{1}{\sqrt{2\pi}}$.

d) Conclude that $n! \sim n^n e^{-n}\sqrt{2\pi n}$