1. Show that the volume of an $n$–dimensional sphere ($V_n$) of radius $R$ is given by

$$V_n = \begin{cases} 
\frac{2^{2k+1}(k)!}{(2k+1)!} R^{2k+1} & \text{if } n = 2k + 1 \text{ is odd}, \\
\frac{\pi^k}{2^k} R^{2k} & \text{if } n = 2k \text{ is even}.
\end{cases}$$