

$$\begin{aligned}
 M_n &= \sum_{j=0}^n \frac{4}{\pi} 2^{2j} \frac{1}{(n-j)!} \left(\frac{\pi}{2}\right)^{n-j} < \frac{4}{\pi} e^{\pi/8} 2^{2n} < 1.9 \cdot 2^{2n}.
 \end{aligned}$$

$$\sum_{j=0}^n (n-j+4) \frac{4}{\pi} 2^{2j} \frac{1}{(n-j)!} \left(\frac{\pi}{2}\right)^{n-j} < \left(\frac{16}{\pi} + \frac{1}{2}\right) e^{\pi/8} 2^{2n} < 8.3 \cdot 2^{2n}$$