г) $\lim\limits_{n\to\infty} \dfrac{2^{2n}(n!)^2\sqrt{n}}{(2n+1)!} = (*)$

$n! \sim n^n \cdot e^{-n}\sqrt{2\pi n}$

$(2n+1)! \sim (2n+1)^{2n+1} e^{-(2n+1)} \sqrt{2\pi(2n+1)}$

$$(*) = \lim_{n\to\infty} \frac{2^{2n}\ n^{2n}\cdot e^{-2n}\ 2\pi n\sqrt{n}}{(2n+1)^{2n+1}\ e^{-2n-1}\ \sqrt{2\pi(2n+1)}} =$$

$$= \lim_{n\to\infty} \frac{(2n)^{2n}}{(2n+1)^{2n}} \frac{e\quad 2\pi n\sqrt{n}}{(2n+1)\sqrt{2\pi(2n+1)}} =$$

$$\downarrow$$

$$\frac{2\pi e}{4\sqrt{\pi}} = \frac{\sqrt{\pi}e}{2}$$

$$= \frac{\sqrt{\pi}e}{2}\lim_{n\to\infty}\left(\frac{2n}{2n+1}\right)^{2n} = \frac{\sqrt{\pi}e}{2}\lim_{n\to\infty}\left(1+\frac{2n-2n-1}{2n+1}\right)^{2n} =$$

$$= \frac{\sqrt{\pi}e}{2}\lim_{n\to\infty}\left(1+\frac{1}{-(2n+1)}\right)^{2n} = \frac{\sqrt{\pi}e}{2}\lim_{n\to\infty}\left(1+\frac{1}{-(2n+1)}\right)^{-(2n+1)\frac{2n}{-(2n+1)}}$$

$$= \frac{\sqrt{\pi}e}{2}\lim_{n\to\infty} e^{\frac{-2n}{2n+1}} = \frac{\sqrt{\pi}e}{2}\cdot e^{-1} = \frac{\sqrt{\pi}}{2}$$