Geometric Series - Converging or Diverging

$\sum_{n=3}^{\infty} 5\left(\frac{2}{3}\right)^{n-1}$ $\quad r = \frac{2}{3}$ $\quad -1 < r < 1$ means geometric sequence converges

$r = \frac{2}{3} \rightarrow -1 < \frac{2}{3} < 1$ $\quad \therefore$ converges

$\frac{a}{1-r}$ $\quad 5\left(\frac{2}{3}\right)^{3-1} = \frac{20}{9} \rightarrow a$

$\frac{20/9}{1-\frac{2}{3}} = \frac{20/9}{\frac{3}{3}-\frac{2}{3}} = \frac{60}{9}$

$\sum_{n=1}^{\infty} \frac{\pi^n}{3^{n+2}} = \sum_{n=1}^{\infty} \frac{\pi^n}{3^n 3^2} = \frac{1}{9}\sum_{n=1}^{\infty} \frac{\pi^n}{3^n} = \frac{1}{9}\sum_{n=1}^{\infty}\left(\frac{\pi}{3}\right)^n$

$r = \frac{\pi}{3}$ $\quad \frac{\pi}{3} > 1$ $\quad -1 < r < 1$

$\therefore$ diverging