$\lvert r \rvert > 1$ diverge. $\lvert r \rvert < 1$ converged $Sum = f(x) = \frac{a}{1-r}$ a: 1st term	Determine if the geometric series converges or diverges. If the series converges find the value of the series. 1) $\sum_{n=0}^{\infty} 3\left(\frac{3}{2}\right)^n = 3 + \frac{9}{2} + \frac{27}{4} + \cdots$ common ratio: $\boxed{r = \frac{3}{2} > 1 \text{ diverges} \quad \lvert r \rvert = 3/2 > 1}$ 2) $\sum_{n=1}^{\infty} \frac{9}{4}\left(\frac{1}{4}\right)^n = \frac{9}{16} + \frac{9}{64} + \frac{9}{256} + \cdots$ $r = \frac{1}{4} < 1$ converges $\quad Sum = \frac{\frac{9}{16}}{1-\frac{1}{4}} = \frac{\left(\frac{9}{16}\right)}{\left(\frac{3}{4}\right)} = \frac{36}{48} = \frac{3}{4}$ $\lvert r \rvert = \frac{1}{4} < 1$
$Sum =$ $f(x) = \frac{\frac{x^2}{\cancel{x^2+4}}\cancel{(x^2+4)}}{(x^2+4)\left(1 - \frac{x^2}{\cancel{x^2+4}}\cancel{(x^2+4)}\right)}$ $= \frac{x^2}{x^2+4-x^2}$ $\boxed{f(x) = x^2/4}$	12) $\sum_{n=1}^{\infty} \left(\frac{x^2}{x^2+4}\right)^n = \frac{x^2}{x^2+4} + \left(\frac{x^2}{x^2+4}\right)^2 + \left(\frac{x^2}{x^2+4}\right)^3 + \cdots$ $r = \frac{x^2}{x^2+4}$ $\quad \left(\boxed{-1 < \frac{x^2}{x^2+4} < 1}\right) x^2+4$ $-x^2-4 < x^2 < x^2+4$ $-x^2-4 < x^2$ $+x^2 \quad +x^2$ $\frac{-4}{2} < \frac{2x^2}{2}$ $-2 < x^2$ $x^2 < x^2+4$ $-x^2 \quad -x^2$ $0 < 4$ $\boxed{I.O.C: -\infty < x < \infty}$

Determine if the series converges or diverges using either the nth term test or recognizing if the series is geometric.

A) $\sum_{n=1}^{\infty} \frac{5n+2}{3n-1}$

Diverges $\lim_{n\to\infty} \frac{5n+2}{3n-1} = \frac{5}{3} \neq 0$

B) $\sum_{n=1}^{\infty} \left(\frac{2}{5^n}\right)$

$\lim_{n\to\infty} \frac{2}{5^n} = 0$ Do another test

$\sum_{n=1}^{\infty} 2\left(\frac{1}{5}\right)^n$ converges $|r| = \frac{1}{5} < 1$

C) $\sum_{n=1}^{\infty} \left(\frac{4^n}{50}\right)$

diverges $\lim_{n\to\infty} \frac{4^n}{50} = \infty \neq 0$

$\sum_{n=1}^{\infty} \frac{1}{50}(4^n)$ diverges $|r| = 4 > 1$

D) $\sum_{n=1}^{\infty} \left(\frac{2n!}{5n!+3}\right)$

$\lim_{n\to\infty} \frac{2n!}{5n!+3} = \frac{2}{5} \neq 0$

Diverges

What you'll Learn About
The Integral Test/P-Series Test/Comparison Test

converges because the area converges

$\sum \frac{1}{n^2} = \frac{\cancel{n}}{n\cancel{(n+1)}}$

Integral Test

A) $\sum_{n=1}^{\infty} \frac{1}{n^2} = 1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \frac{1}{25} + \cdots$

$\lim_{b\to\infty} \int_1^b \frac{1}{x^2} = \lim_{b\to\infty} \int_1^b x^{-2} = \lim_{b\to\infty} \left[-x^{-1}\right]_1^b$

$= \lim_{b\to\infty} \left[-\frac{1}{x}\right]_1^b = \lim_{b\to\infty} \left[\frac{-1}{b} - (-1)\right] = 1$

Area Converges

B) $\sum_{n=1}^{\infty} \frac{1}{n}$

C) $\sum_{n=1}^{\infty} \frac{1}{n^{1/3}}$