

1. Does $\sum_{n=2}^{\infty} (-1)^{n+1} \frac{1}{n \ln n}$ converge absolutely, converge conditionally, or diverge?

2. Does $\sum_{n=1}^{\infty} \frac{(-1)^{n+1} (n!)^2}{(2n)!}$ converge absolutely, converge conditionally, or diverge?

3. Does $\sum_{n=1}^{\infty} \frac{(n-1)!}{(n+2)^2}$ converge or diverge?

4. Does $\sum_{n=1}^{\infty} \frac{4^n}{(3n)^n}$ converge or diverge?

5. Does $\sum_{n=1}^{\infty} a_n$ converge or diverge, if $\{a_n\}$ is defined by $a_1 = 1$, $a_{n+1} = \frac{1+\tan^{-1}n}{n} a_n$? (Hint: the Ratio Test is good with recursively-defined terms.)

6. Does $\sum_{n=1}^{\infty} \frac{2^n}{n^3}$ converge or diverge?

7. Does $\sum_{n=1}^{\infty} \left(\frac{1}{n} - \frac{1}{n^2}\right)^n$ converge or diverge?

Challenge: If $a_n = \begin{cases} n/2^n & \text{if } n \text{ is a prime number} \\ 1/2^n & \text{otherwise} \end{cases}$, does $\sum_{n=1}^{\infty} a_n$ converge or diverge?

Q: What goes up and down but doesn't move?