

Test each series for convergence or divergence. Identify the test used and show all your work.

1. 
$$\sum_{n=1}^{\infty} \frac{n^2 - 1}{n^2 + n}$$

9. 
$$\sum_{n=0}^{\infty} \frac{n!}{2 \cdot 5 \cdot 8 \cdot \dots \cdot (3n + 2)}$$

2. 
$$\sum_{n=1}^{\infty} \frac{1}{n^2 + n}$$

10. 
$$\sum_{i=1}^{\infty} \frac{1}{\sqrt{i(i+1)}}$$

3. 
$$\sum_{k=1}^{\infty} \frac{(-3)^{k+1}}{2^{3k}}$$

11. 
$$\sum_{n=1}^{\infty} (-1)^n 2^{1/n}$$

4. 
$$\sum_{k=1}^{\infty} k^{-1.7}$$

12. 
$$\sum_{k=1}^{\infty} (-1)^k \frac{\ln k}{\sqrt{k}}$$

5. 
$$\sum_{n=1}^{\infty} \frac{n}{e^n}$$

13. 
$$\sum_{n=1}^{\infty} \frac{(-2)^{2n}}{n^n}$$

6. 
$$\sum_{n=2}^{\infty} \frac{2}{n(\ln n)^3}$$

14. 
$$\sum_{j=1}^{\infty} \frac{2^j}{(2j+1)!}$$

7. 
$$\sum_{n=1}^{\infty} \frac{3^n n^2}{n!}$$

15. 
$$\sum_{n=1}^{\infty} (\sqrt[2]{2} - 1)^n$$

8. 
$$\sum_{j=1}^{\infty} \frac{3^j}{5^j + j}$$

16. 
$$\sum_{n=1}^{\infty} \sin n$$

## Answers

1. Diverges by  $n$ th term test.
2. Converges by either direct or limit comparison with  $\sum_{n=1}^{\infty} \frac{1}{n^2}$
3. Converges by alternating series or ratio test or rewriting as geometric series.
4. Converges:  $p$ -series.
5. Converges by ratio test or root test.
6. Converges by integral test.
7. Converges by ratio test.
8. Converges by direct comparison with  $\sum_{n=1}^{\infty} \left(\frac{3}{5}\right)^n$
9. Converges by ratio test.
10. Diverges by limit comparison with harmonic series.
11. Diverges by  $n$ th term test.
12. Converges: alternating series.
13. Converges by root test.
14. Converges by ratio test.
15. Converges by root test.
16. Diverges by  $n$ th term test.