

Use the ratio or root test to prove whether the following converge or diverge.

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

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

3.
$$\sum_{k=1}^{\infty} \frac{k^5 5^k}{k!}$$

4.
$$\sum_{k=1}^{\infty} \left(\frac{n^2 + 1}{2n^2 + 1} \right)^n$$

5.
$$\sum_{k=1}^{\infty} \frac{k^{10}}{10^{k+1}}$$

6.
$$\sum_{k=1}^{\infty} \frac{e^{2k}}{k!}$$

7.
$$\sum_{k=1}^{\infty} \frac{k^{1-3k}}{4^{2k}}$$

8.
$$\sum_{k=1}^{\infty} \left(\frac{4}{\tan^{-1}(k)} \right)^k$$

Determine whether the following converge absolutely, converge conditionally, or diverge.

9.
$$\sum_{k=1}^{\infty} \frac{(-1)^k}{\sqrt{k}}$$

10.
$$\sum_{k=1}^{\infty} \frac{(-1)^{k+1} \arctan k}{k^2}$$

11.
$$\sum_{k=1}^{\infty} \left(\frac{k}{\ln k} \right)^k$$

12.
$$\sum_{k=1}^{\infty} \frac{(-10)^k}{k 9^k}$$