

Determine whether the following series converge or diverge. If they converge, determine the sum. If using the telescoping method, be sure to write out the partial sums.

1.
$$\sum_{k=1}^{\infty} \frac{2^{2k}}{5^k}$$

2.
$$\sum_{k=1}^{\infty} e^{-k}$$

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

4.
$$\sum_{k=1}^{\infty} \frac{5}{k(k+3)}$$

5.
$$\sum_{k=0}^{\infty} (\tan^{-1}(k+1) - \tan^{-1} k)$$

6.
$$\sum_{k=1}^{\infty} (\sin 100)^k$$

7.
$$\sum_{k=1}^{\infty} \ln \left(\frac{k^2 + 1}{2k^2 + 1} \right)$$

8.
$$\sum_{k=0}^{\infty} \frac{2+k}{1-2k}$$

9.
$$\sum_{k=0}^{\infty} (\sqrt{2})^{-k}$$

10.
$$\sum_{k=1}^{\infty} \tan^{-1} k$$

11.
$$\sum_{k=1}^{\infty} \frac{1}{4 + e^{-k}}$$

12.
$$\sum_{k=1}^{\infty} \pi^k$$