

1. Factorial Practice

Given a positive integer n , n factorial (written $n!$) is a shorthand for the product of all positive integers less than or equal to the given integer n .

$$n! = n \cdot (n - 1) \cdot (n - 2) \cdot \cdots \cdot 3 \cdot 2 \cdot 1$$

For example, $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$. (By convention, we say that $0! = 1$.)

1. Evaluate the following.

(a) $5!$

(b) $6!$

(c) $\frac{6!}{5!}$

(d) $\frac{5!}{6!}$

(e) $\frac{102!}{100!}$

2. Simplify each of the following. Assume n is a positive integer.

(a) $\frac{(n + 2)!}{n!}$

(b) $\frac{(n - 3)!}{n!}$

(c) $\frac{(2n + 2)!}{(2n)!}$

(d) $\frac{(2n + 2)!}{2n!}$

(e) $\frac{(n!)^2}{((n + 1)!)^2}$

2. Series Classification Practice

Determine whether each series converges absolutely, converges conditionally, or diverges. Justify your answer.

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

$$2. \sum_{n=1}^{\infty} \frac{1 + 2 \sin n}{n^3}$$

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

$$4. \sum_{n=1}^{\infty} (-1)^{n+1} \frac{\sqrt{n^2 + 1}}{n + 1}$$

3. Ratio Test Practice

For each of the following series, use the Ratio Test to determine whether the series converges or diverges.

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

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

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

$$4. \sum_{n=1}^{\infty} \frac{n!}{n^n}$$