

For all questions, answer choice "E) NOTA" means none of the above answers is correct.

1. If the row of Pascal's triangle with only a single 1 is labeled row 0, in which row will the first number greater than 40 appear?

- A) 6 B) 7 C) 8 D) 9 E) NOTA

2. Which of the following is the binomial expansion of $(x + 2y)^6$?

- A) $x^6 + 12x^5y + 60x^4y^2 + 160x^3y^3 + 240x^2y^4 + 192xy^5 + 64y^6$
B) $x^6 + 12x^5y + 60x^4y^2 + 160x^3y^3 + 60x^2y^4 + 12xy^5 + y^6$
C) $x^6 + 6x^5y + 15x^4y^2 + 20x^3y^3 + 15x^2y^4 + 6xy^5 + y^6$
D) $x^6 + 12x^5y + 60x^4y^2 + 160x^3y^3 + 120x^2y^4 + 24xy^5 + 64y^6$
E) NOTA

3. Evaluate: $\sum_{j=0}^8 \binom{8}{j}$

- A) 128 B) 256 C) 308 D) 512 E) NOTA

4. Which of the following could be the first three terms of an arithmetic sequence, in order?

- A) $\frac{1}{5}, \frac{3}{5}, 1$ B) 2, 4, 8 C) $\frac{1}{3}, \frac{3}{5}, \frac{27}{25}$ D) $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ E) NOTA

5. Which of the following could be the second term of a geometric sequence with first term $\sqrt{2}$ and fourth term $\sqrt{2}$?

- A) $\frac{1}{2}(\sqrt{2} + \sqrt{6}i)$ B) $\frac{1}{2}(\sqrt{2} - \sqrt{6}i)$ C) $\frac{1}{2}(\sqrt{6} - \sqrt{2}i)$ D) $-\frac{1}{2}(\sqrt{2} + \sqrt{6}i)$ E) NOTA

6. The roots of $f(x) = x^3 - 15x^2 + 71x - 105$ form an arithmetic progression. What is the common difference for this progression?

- A) 0.5 B) 1 C) 1.5 D) 2 E) NOTA

7. Given $a_{n+1} = \sqrt{12 - a_n}$ and $a_1 = 1$, find the value of $\lim_{n \rightarrow \infty} a_n$.

- A) 3 B) π C) $2 + \sqrt{3}$ D) 4 E) NOTA

8. Consider a sequence $\{a_n\}$. Let $\{b_n\}$ be the sequence of partial sums of terms of $\{a_n\}$ (i.e., $b_1 = a_1$, $b_2 = a_1 + a_2$, $b_3 = a_1 + a_2 + a_3, \dots$). Given that $\lim_{n \rightarrow \infty} b_n = 2$, which of the following is a true statement?

- A) $\sum_{n=1}^{\infty} b_n$ converges B) $\sum_{n=1}^{\infty} a_n$ converges C) $\{b_n\}$ diverges D) $\lim_{n \rightarrow \infty} a_n = 2$ E) NOTA

9. Evaluate: $1 + \frac{2}{1 + \frac{2}{1 + \frac{2}{1 + \dots}}}$

- A) 1 B) 1.5 C) 2 D) 3 E) NOTA

10. Fill in the blank: The series $\sum_{n=1}^{\infty} \frac{1}{n}$ _____ and the sequence $\left\{\frac{1}{n}\right\}_{n=1}^{\infty}$ _____.

- A) converges; converges B) converges; diverges C) diverges; converges
D) diverges; diverges E) NOTA

11. Fill in the blank: The series $\sum_{n=1}^{\infty} \frac{1}{n^2}$ _____ and the sequence $\left\{\frac{1}{n^2}\right\}_{n=1}^{\infty}$ _____.

- A) converges; converges B) converges; diverges C) diverges; converges
D) diverges; diverges E) NOTA

12. Fill in the blank: For integers $n \geq 1$, $0 < c_n < a_n < b_n$. If the series $\sum_{n=1}^{\infty} b_n$ converges, then the series $\sum_{n=1}^{\infty} a_n$ _____. If the series $\sum_{n=1}^{\infty} c_n$ diverges, then the series $\sum_{n=1}^{\infty} a_n$ _____.

- A) converges; converges B) converges; diverges C) diverges; converges
D) diverges; diverges E) NOTA

13. Which of the following is true regarding the series $\sum_{n=1}^{\infty} \frac{4n^3 + 3n^2 - 7n + 19}{6n^5 + 15n^4 + 126n^3 + 11n^2 + 12}$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

14. Which of the following is true regarding the series $\sum_{n=1}^{\infty} \frac{1}{2^n - n^{10}}$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

15. Which of the following is true regarding the series $\sum_{n=2}^{\infty} \frac{(-1)^n}{n \ln n}$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

16. Which of the following is true regarding the series $\sum_{n=1}^{\infty} (-1)^n \sin n$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

17. Which of the following is true regarding the series $\sum_{n=1}^{\infty} \frac{(-10)^n}{(n+1)4^{2n+1}}$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

18. Which of the following is true regarding the series $\sum_{n=1}^{\infty} \left(\frac{1}{n}\right)^n$?

- A) converges absolutely B) converges conditionally C) diverges
D) not enough information E) NOTA

19. What are the first four nonzero terms in the Maclaurin series expansion for $\sin(x^2)$?

A) $1 - \frac{x^4}{2!} + \frac{x^{16}}{4!} - \frac{x^{64}}{6!}$

B) $x^2 - \frac{x^8}{3!} + \frac{x^{32}}{5!} - \frac{x^{128}}{7!}$

C) $1 - \frac{x^4}{2!} + \frac{x^8}{4!} - \frac{x^{12}}{6!}$

D) $x^2 - \frac{x^6}{3!} + \frac{x^{10}}{5!} - \frac{x^{14}}{7!}$

E) NOTA

20. What is the second-degree Taylor polynomial of the function $f(x) = \sin(\cos x)$ centered at $a = 0$?

- A) $\sin 1 - \frac{x^2}{2} \cos 1$ B) $\sin 1 - x^2 \cos 1$ C) $\sin 1 + \frac{x^2}{2} \cos 1$ D) $\sin 1 + x^2 \cos 1$ E) NOTA

21. Using the third-degree Taylor polynomial e^{x^3} centered at $a = 0$, approximate the value of $\int_0^2 e^{x^3} dx$.

- A) 4 B) 8 C) 9 D) 12 E) NOTA

22. Using the linearization of $y = \sin x + \cos x + \tan x + \csc x + \cot x$ at $a = \frac{\pi}{4}$, approximate the value of y when $x = \sqrt{2}$.

- A) $\frac{\sqrt{2}}{4}(8 - \pi)$ B) $\frac{\sqrt{2}}{2}(2 - \pi)$ C) $\frac{\sqrt{2}}{4}(8 + \pi)$ D) $\frac{\sqrt{2}}{2}(2 + \pi)$ E) NOTA

23. Find the sum of the first 30 terms of the Fibonacci sequence ($F_1 = F_2 = 1$, $F_{n+1} = F_n + F_{n-1}$ for all integers $n \geq 2$), given that the 32nd term of the sequence is 2,178,309.

- A) 2,178,311 B) 2,178,310 C) 2,178,309 D) 2,178,308 E) NOTA

24. The first triangular number is 1. Which of the following gives the sum of the first n triangular numbers?

- A) $\binom{n+1}{2}$ B) $\left(\sum_{k=1}^n k^3\right)^{\frac{1}{3}}$ C) $\binom{n+2}{3}$ D) $\left(\sum_{k=1}^n k^2\right)^{\frac{1}{2}}$ E) NOTA

25. Find the radius of convergence of the series $\sum_{n=1}^{\infty} \left(\frac{2^n 4^n}{n} (x-2)^n\right)$.

- A) 1 B) 0.5 C) 0.25 D) 0.125 E) NOTA

26. Find the interval of convergence of the series $\sum_{n=1}^{\infty} \frac{(-x)^n}{n}$.

- A) $(-1, 1)$ B) $(-1, 1]$ C) $[-1, 1)$ D) $[-1, 1]$ E) NOTA

27. Evaluate: $\sum_{n=0}^{\infty} \frac{1}{2^n n!}$

- A) 1 B) 0.5 C) 0.25 D) 0.125 E) NOTA

28. Evaluate: $\sum_{n=0}^{\infty} 9^{-n}$

- A)
- $\frac{1}{8}$
- B)
- $\frac{9}{8}$
- C)
- $\frac{9}{10}$
- D)
- $\frac{10}{9}$
- E) NOTA

29. Evaluate: $\sum_{n=1}^{\infty} \frac{n}{4^n}$

- A)
- $\frac{9}{20}$
- B)
- $\frac{4}{9}$
- C)
- $\frac{2}{5}$
- D)
- $\frac{17}{42}$
- E) NOTA

30. Which of the following is a power series representing the function $f(x) = \frac{1}{1+x^2}$?

Assume the appropriate interval of convergence.

- A)
- $\sum_{n=0}^{\infty} ((-1)^n x^{2n})$
- B)
- $\sum_{n=0}^{\infty} (-x)^{2n}$
- C)
- $\sum_{n=0}^{\infty} ((-1)^n x^{2n+1})$
- D)
- $\sum_{n=0}^{\infty} x^{2n+1}$
- E) NOTA