

Assume all sequences and series start at term 1, unless otherwise noted.

- 1. If sequence a_n is increasing and the rate at which sequence a_n is increasing is increasing, order the following from least to greatest (given that all 3 are distinct): the arithmetic mean (AM) of a_1 and a_3 , the geometric mean (GM) of $\,a_1\,$ and $\,a_3\,$, and the harmonic mean (HM) of $\,a_1\,$ and $\,a_3\,$.
 - A) AM, GM, HM
- B) AM, HM, GM C) GM, HM, AM
- D) HM, GM, AM
- E) NOTA
- 2. How many of the first 100 rows of Pascal's Triangle have an odd number of odd numbers?
 - A) 0
- B) 1
- C) 50
- D) 100
- E) NOTA

- $3. \quad \lim_{x \to 0} \frac{x \cos x e^x \sin x}{x^2}$
 - A) -1
- B) 0
- C) $\frac{1}{2}$
- D) 1
- E) NOTA

- 4. Find $\frac{d^5}{dx^5} \tan^{-1}(x)$ at x = 0.

- C) 120
- D) -120
- E) NOTA

- For what values of x does the sequence $a_n = \sin^n(x)$ diverge?
 - A) x = 0

- B) $x = k\pi, k \in \mathbb{Z}$ C) $x = 2k\pi, k \in \mathbb{Z}$ D) $x = \frac{(2k+1)}{2}\pi, k \in \mathbb{Z}$ E) NOTA
- 6. Let the polynomial function f(x) contain the points $(a, \sum_{n=0}^{\infty} (-1)^n n^2)$, for all positive even integers a. Find f''(2).

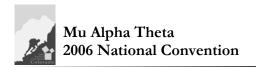
 - A) $\frac{1}{4}$ B) $\frac{1}{2}$
- C) 1
- D) 2
- E) NOTA

- 7. Given $\sum_{r=1}^{\infty} \frac{1}{n^2} = \pi^2 / 6$, $\sum_{r=1}^{\infty} \frac{(-1)^{n+1}}{n^2} =$
 - A) $\pi^2/_{24}$ B) $\pi^2/_{12}$ C) $\pi^2/_{8}$ D) $\pi^2/_{6}$

- E) NOTA
- 8. Which of the following tests cannot be used to show the convergence of $\sum_{i=1}^{\infty} \frac{2}{(x^2+1)}$?
 - A) Integral
- B) Direct Comparison

C) Limit Comparison

- D) P-series
- E) NOTA



| 9. | $S(x) = \sum_{n=1}^{\infty} f(n)$ is well defined for any natural number n. $\lim_{x \to \infty} S(x) = 3\pi$; find $\lim_{x \to \infty} f(x)$ | | | | | | | | |
|--|---|-------|-----------------------------------|--------|--|-------|--|----------------------|--|
| | A) 3π D) Does not exist | B) | π | | Cannot be unique NOTA | ely d | etermined | | |
| 10. | $\sum_{x=-4}^{4} n + 4 =$ | | | | | | | | |
| | A) 4 | B) | 24 | C) | 36 | D) | 56 | E) NOTA | |
| 11. | 1. $S_n = \sqrt{n}^{\sqrt{n}}$ for integers n . The product $(S_{-1})(S_1)$ lies on which of the following intervals: | | | | | | | | |
| | A) (−∞,1) | B) | [-1,0) | C) | [0,1) | D) | [1,∞) | E) NOTA | |
| 12. | 2. The arithmetic mean of Ψ and Ω is $x^2 + 1$ and the geometric mean is $2x + 1$. If the harmonic mean of Ψ and Ω is 4, find the value of x . | | | | | | | | |
| | A) -1/4 | B) | 1/4 | C) | 3/4 | D) | Cannot be determ | nined E) NOTA | |
| 13. Let $A = 3^2 + 5^2 + + 103^2$. Let $B = 2^2 + 4^2 + + 104^2$. Find $B - A$. | | | | | | | | | |
| | A) 5,457 | B) | 5,458 | C) | 5,459 | D) | 5,461 | E) NOTA | |
| 14. | 4. Find the sum of the terms in the first 10 rows of Pascal's Triangle? | | | | | | | | |
| | A) 1023 | B) | 1024 | C) | 2047 | D) | 2048 | E) NOTA | |
| 15. | 15. Which of the following converges the slowest as $n \to \infty$. | | | | | | | | |
| | $A)\sum_{n=1}^{\infty}\frac{1}{n^3}$ | B) | $\sum_{n=1}^{\infty} \frac{1}{n}$ | C) | $\sum_{n=1}^{\infty} (-e)^{-n}$ | D) | $\sum_{n=1}^{\infty} \frac{2n}{n^3 + 1}$ | E) NOTA | |
| 16. | $\sum_{n=0}^{\infty} \frac{2}{n^2 + 4n + 3} =$ | | | | | | | | |
| | A) $\frac{2}{3}$ | B) | 5/6 | C) | 11/12 | D) | $\frac{3}{2}$ | E) NOTA | |
| 17. | a_n is an infinite geor | netri | c sequence with fi | rst te | $\frac{1}{2}$ erm $\frac{1}{2}$ cot x and co | omm | on ratio $\sin^2 x$. | b_n is an infinite | |

geometric sequence with first term $\sin(2x)$ and common ratio $\sin^2 x$. Given that $0 < x < \frac{\pi}{4}$, $\sum_{i=1}^{\infty} a_i - \sum_{j=1}^{\infty} b_j$ is on which of the following intervals?

- A) $(-\infty, -1)$
- B) (-1,0)
- C) (0,1)
- D) $(1,\infty)$
- E) NOTA

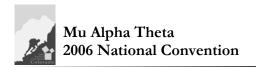
For the purposes of #18-20, sequence f_n is defined such that $f_1 = 1$, $f_2 = 1$, and $f_{n+2} = f_n + f_{n+1}$.

| 18. | 8. As $n \to \infty$, f_n best resembles which of the following types of sequences? | | | | | | | | |
|-----|--|----------------------------------|----------------------|-----------------------|---------|--|--|--|--|
| | A) Arithmetic | B) Geometric | C) Harmonic | D) Constant | E) NOTA | | | | |
| 19. | 9. How many elements of the set $\{f_1, f_2, f_3f_{100}\}$ are odd? | | | | | | | | |
| | A) 34 | B) 50 | C) 66 | D) 67 | E) NOTA | | | | |
| 20. | The largest value of <i>i</i> | k such that $f_{k+1} \ge 2f_k$ | lies on which of the | e following intervals | ? | | | | |
| | A) [1,9] | B) [10,40] | C) [41,75] | D) (75, ∞) | E) NOTA | | | | |
| | 21. Which of the following is closest to $\prod_{n=1}^{20} \frac{n^2 - 7n - 44}{2n^3 + 4n^2 + 2n}$ | | | | | | | | |
| | A) $\frac{1}{2}$ | B) $\frac{1}{2^{20}}$ | C) $\frac{1}{40}$ | D) 0 | E) NOTA | | | | |
| | | | | d^2 c | | | | | |

- 22. Let g(x) be the MacLauren series expansion of $\ln(3x+3)$. Evaluate $\frac{a}{dx^2} \int g(x) dx$ evaluated at x=2.
 - A) 1 B) 3 C) $\frac{1}{3}$ D) $\frac{1}{9}$ E) NOTA
- 23. Which of the following infinite series has the greatest sum?

A)
$$\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n}$$
 B) $\sum_{n=1}^{\infty} (\frac{1}{2})^n$ C) $\sum_{n=0}^{\infty} (-\frac{2}{3})^n$ D) $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^3}$ E) NOTA

- 24. Find the sum of an infinite geometric series with first term 42 and common ratio -2.
 - A) 84 B) 63 C) 56 D) 21 E) NOTA



25. Which of the following is/are true?

i. According to the Integral Test, if $\sum_{n=1}^{\infty} g(n)$ converges, it equals $\int_{-\infty}^{\infty} g(x) dx$

ii.
$$|\sum_{n=7}^{\infty} \frac{(-1)^n}{n}| < \frac{1}{7}$$

iii. $|\sum_{n=1}^{\infty} f(n)| \le \sum_{n=1}^{\infty} |f(n)|$ if f(x) is defined on reals.

iv. There exists a function g(x) such that $\sum_{n=1}^{\infty} g(n)$ and $\sum_{n=1}^{\infty} \frac{1}{g(n)}$ both converge, given g(x) is defined and nonzero on reals.

- A)II, IV only
- B) II, III only
- C) I, II, III only
- D) I, II, III, IV
- E) NOTA

26.
$$\lim_{z \to \infty} \sum_{y=0}^{z} \int_{y}^{y+1} \frac{1}{x^2} dx$$

- A) $(\ln 2)^2$ B) $\pi^2/_{12}$ C) $\ln 4$ D) $\pi^2/_{6}$
- E) NOTA

27. $a_1 = 1$. $a_{n+1} = 2a_n + 1$. which of the following is expressions denotes a_n ?

- A) $2^{n} + 1$

- D) 2^{n+1}
- E) NOTA

28. a_n is the sequence 3, 7, 13, 21, 31, 43, 57.... Let polynomial function $f(n) = a_n$, for all natural numbers n. Find $f(-\frac{1}{2})$

- A) $-\frac{7}{4}$ B) $\frac{3}{4}$
- C) 1
- D) $\frac{7}{4}$
- E) NOTA

29. Which of the following type of sequence is not necessarily monotonic?

- A) Arithmetic
- B) Geometric
- C) Harmonic
- D) Constant
- E) NOTA

30. Find $\sum_{i=1}^{\infty} \frac{4}{2^n}$.

- A) 16
- B) 8
- C) 6
- D) 4
- E) NOTA