NOTA = None of the Above

1. Evaluate: $\left[\frac{1}{2}\left(\sqrt{2}-i\sqrt{2}\right)\right]^{i}$

   (A) $e^{-\frac{\pi}{4}}$ (B) $e^{\frac{\pi}{4}}$ (C) $e^{-\frac{\pi}{2}}$ (D) $e^{\frac{\pi}{2}}$ (E) NOTA

2. Which of the following are sixth roots of 1?

      I. $\frac{\sqrt{3}}{2}+\frac{1}{2}i$

      II. $\frac{\sqrt{2}}{2}+\frac{\sqrt{2}}{2}i$

      III. $\frac{1}{2}+\frac{\sqrt{3}}{2}i$

      IV. $-\frac{\sqrt{3}}{2}+\frac{1}{2}i$

   (A) I & II   (B) II & IV   (C) I, II & III   (D) I, III & IV   (E) NOTA

3. A triangle has sides of lengths 7, 9, and 12. What is the area of the triangle?

   (A) $7\sqrt{5}$ (B) $14\sqrt{5}$ (C) $14\sqrt{10}$ (D) $54\sqrt{2}$ (E) NOTA

4. Simplify: $\left[\left(a^{\log_5 b}\right)\left(b^{\log_5 a}\right)\right]^{\log_b 5}$, $a>0, b>0$

   (A) ab (B) a^2 (C) b^2 (D) ab^2 (E) NOTA

5. What is the largest number that leaves the same remainder when divided into 1108, 1252, 1684, and 2332?

   (A) 36   (B) 72   (C) 144   (D) 288   (E) NOTA

6. For: $f(x)=Arc\cot(x)$, give the value of $f(-\sqrt{3})$.

   (A) $-\frac{\pi}{3}$ (B) $-\frac{\pi}{6}$ (C) $\frac{2\pi}{3}$ (D) $\frac{\pi}{6}$ (E) NOTA

7. In a class of 10 boys and 15 girls, the average score on a biology test is 90. If the average score for the girls is x, what is the average score for the boys in terms of x?

(A) $200 - \dfrac{2}{3}x$ (B) $225 - \dfrac{3}{2}x$ (C) $250 - 2x$ (D) $250 - 3x$ (E) NOTA

8. Determine the sum of all values of x $\left(0 \le x < 2\pi\right)$ for which $2\cos^2 3x + \cos 3x - 1 = 0$?

(A) π (B) 3π (C) 7π (D) 9π (E) NOTA

9. If $n(q) = 3 - 2q$ and $p\left(n(q)\right) = \dfrac{3 - 2q}{3 + 2q}$, what is the value of $p(7)$?

(A) $\dfrac{17}{3}$ (B) $\dfrac{44}{9}$ (C) $-\dfrac{1}{3}$ (D) -7   (E) NOTA

10. Determine the sum of the squares of the roots of: $3x^4 - 8x^3 - 83x^2 + 148x - 60 = 0$.

(A) $\dfrac{15}{4}$ (B) $\dfrac{122}{9}$ (C) $\dfrac{562}{9}$ (D) 5   (E) NOTA

11. Evaluate: $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} + \begin{bmatrix} 4 & -2 & 3 \\ 7 & -9 & 4 \\ 1 & 1 & -6 \end{bmatrix}$

(A) $\begin{bmatrix} 3 & 4 & 6 \\ 11 & 14 & 10 \\ 6 & 7 & 15 \end{bmatrix}$ (B) $\begin{bmatrix} 4 & 2 & -7 \\ 3 & 5 & -2 \\ 12 & -7 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 2 & 0 \\ -3 & 4 & 2 \\ -6 & -7 & 15 \end{bmatrix}$ (D) $\begin{bmatrix} 5 & 0 & 6 \\ 11 & -4 & 10 \\ 8 & 9 & 3 \end{bmatrix}$ (E) NOTA

12. What is the trace of: $\begin{bmatrix} 1 & 2 & 6 & -4 \\ 5 & -8 & 7 & 7 \\ -9 & 10 & -14 & 12 \\ 13 & 10 & -15 & 16 \end{bmatrix}$?

(A) -7   (B) -5   (C) -2   (D) 5   (E) NOTA

13. "May I have a large container of coffee?" is a memory device designed by American educators to enable students to remember the first eight digits of what number?

(A) π (B) e (C) $\sqrt{2}$ (D) i (E) NOTA

14. What is the cross product of the vectors <4, 7, -3> and <-2, -2, -7>?

(A) $\langle 17,12,-8 \rangle$ (B) $\langle 43,-22,6 \rangle$ (C) $\langle -8,27,14 \rangle$ (D) $\langle 19,-4,61 \rangle$ (E) NOTA

15. A cube made of green material is painted white, and then cut into 512 congruent cubes. How many of the smaller cubes have exactly two white faces?

(A) 64   (B) 72   (C) 188   (D) 216   (E) NOTA

16. How long is the semi-major axis of the following ellipse: $x^2 + 9y^2 - 4x + 24y - 236 = 0$?

(A) 14   (B) 16   (C) 18   (D) 20   (E) NOTA

17. **Catalan Numbers** are defined explicitly by: $C_n = \dfrac{1}{n+1}\dbinom{2n}{n}$ (with $n > 0$) and prove to be useful in solving certain counting problems. Find the product of the first three Catalan Numbers.

(A) 4   (B) 6   (C) 8   (D) 10   (E) NOTA

18. What is the probability that the coefficient of a term selected at random from the terms of the complete binomial expansion of $(2x+3y)^{100}$ is divisible by 12?

(A) $\dfrac{49}{50}$ (B) $\dfrac{98}{101}$ (C) $\dfrac{99}{100}$ (D) $\dfrac{99}{101}$ (E) NOTA

19. Find a pair of polar coordinates for the point whose rectangular coordinates are: $(-2, 2\sqrt{3})$.

(A) $(-4, \dfrac{\pi}{3})$ (B) $(4, \dfrac{5\pi}{6})$ (C) $(4, \dfrac{\pi}{6})$ (D) $(-4, \dfrac{5\pi}{6})$ (E) NOTA

20. Determine the eccentricity of the conic represented by: $y^2 + 4y - x^2 - 6x - 21 = 0$.

(A) $\dfrac{3}{2}$ (B) -1   (C) $\dfrac{\sqrt{2}}{4}$ (D) $\sqrt{2}$ (E) NOTA

21. The number *e* serves as the base of the system of natural logarithms. What Scottish mathematician invented logarithms in 1617, but only included a list of natural logarithms in an addendum to his report?

(A) Napier   (B) Cartwell   (C) Goldiez   (D) Witte   (E) NOTA

22. Bill is five years older than Mary and in three years will be seven times Mary's age ten years ago. How old is Bill now?

(A) 18   (B) 19   (C) 20   (D) 21   (E) NOTA

23. In the Mu Alpha Theta Survivor Contest, five contestants named A, B, C, D, and E are placed in a room. They cast one vote each, and each of the five votes is received by a contestant. A and B receive a total of 3 votes. D and E receive a total of 2 votes. A and D receive a total of 2 votes. A and E receive a total of 2 votes. Who received the most votes?

(A) D   (B) C   (C) B   (D) A   (E) NOTA

24. Which of the following is characteristic of a binomial distribution, but NOT of a geometric distribution?

(A) There is a fixed number of observations.
(B) The observations are all independent.
(C) Each observation has only two outcomes: "success," or "failure."
(D) The probability of success is the same for each observation.
(E) NOTA

25. Find the product of the positive divisors of 340.

(A) 340^3 (B) 340^4 (C) 340^6 (D) 340^{10} (E) NOTA

26. Given points A(−1,1), B(2,3) and C(4,−7), find the coordinates of the point of intersection of the medians of triangle ABC.

(A) $\left(\dfrac{5}{3}, -1\right)$ (B) (3,0)   (C) $\left(\dfrac{8}{3}, \dfrac{10}{3}\right)$ (D) (0,4)   (E) NOTA

27. If $\langle a,b \rangle$ is a unit vector parallel to $\langle 3,4 \rangle$, which of the following is true?

(A) $a = 1$ and $b = 1$ (B) $\dfrac{a}{b} = -\dfrac{4}{3}$ (C) $\dfrac{a}{b} = \dfrac{3}{4}$ (D) $3a = 4b$ (E) NOTA

28. The graph of $f(x) = 4\sin(2x)$ would coincide with the graph of $g(x) = 4\sin\left(2x - \dfrac{\pi}{3}\right)$ if the graph of f(x) were shifted:

(A) $\dfrac{\pi}{3}$ units to the left

(B) $\dfrac{\pi}{3}$ units to the right

(C) $\dfrac{\pi}{6}$ units to the right

(D) $\dfrac{2\pi}{3}$ units to the right

(E) NOTA

29. Find the y-coordinate of the y-intercept of the slant asymptote for the following equation.
$$y = \frac{2x^3 + 8x^2 - 22x - 60}{x^2 - 5x + 6}$$

(A) 3   (B) 6   (C) 9   (D) 18   (E) NOTA

30. Change the given vector equation of a line to Cartesian form. $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 5 \\ -8 \end{pmatrix} + t \begin{pmatrix} 6 \\ 10 \end{pmatrix}$

(A) 5x+8y=4   (B) 5x-3y=49   (C) 8x+5y=4   (D) 3x-5y=49   (E) NOTA