During this test, the following conventions will hold:

The imaginary unit is represented by i. That is, $i^2 = -1$.
All angle measures are assumed to be in Radians unless given with a degree symbol $(°)$.
The value $\cos(\theta) + i\sin(\theta)$ will be abbreviated $cis(\theta)$.
If $z = a + bi = r \cdot cis(\theta)$, define the following operations: $\Re(z) = a$, $\Im(z) = b$, $\arg(z) = \theta$.
The set of integers is represented by $\mathbb{Z}$ (of course). The set of Gaussian Integers is represented by $\mathbb{G}$.
All variables and functions are assumed to be over the complex numbers unless noted otherwise.
"E. NOTA" means "None Of Those Answers is correct," implying that the right answer is not a listed choice.

First, before we get into the math of things, let's start with a little history and vocabulary:

1. In which century did Descartes first use the term "imaginary" to describe numbers such as i?
   A. the 15th B. the 16th C. the 17th D. the 18th E. NOTA

2. What mathematician's name is used in the name for the complex numbers' coordinate system?
   A. Gauss B. Euler C. Argand D. Descartes E. NOTA

3. Proven by Argand and Gauss, which theorem states that every non-zero polynomial with complex coefficients of degree n has exactly n complex zeros (counting multiplicities)?
   A. Complex Roots Theorem B. Fundamental Theorem of Polynomials
   C. Rational Root Theorem D. Fundamental Theorem of Algebra E. NOTA

4. What is the common name of the following property of complex numbers? (note: $r, n \in \mathbb{Z}$)
   $$[r \cdot cis(\theta)]^n = r^n cis(n\theta)$$
   A. Complex Power Formula B. Polar Power Formula
   C. Gauss' Formula D. De Moivre's Formula E. NOTA

And now, math:

5. Mr. Snube was born in 1957. That means he is 51 years old. What is i^{195751}?
   A. 1 B. -1 C. i D. $-i$ E. NOTA

6. True or False: For all complex numbers z_1 and z_2, the following equation holds: $|z_1||z_2| = |z_1 z_2|$.
   A. True B. False E. NOTA

7. $e^{xi} + 1 = 0$. Solve for x over the set of complex numbers.
   A. π B. $\{n\pi \mid n \in \mathbb{Z}\}$
   C. 0 D. $\{(2n+1)\pi \mid n \in \mathbb{Z}\}$ E. NOTA

8. $\sqrt{-24} \cdot \sqrt{-6} = ?$
   A. 12 B. -12 C. $12i$ D. $-12i$ E. NOTA

9. $\sqrt{(-24)(-6)} = ?$
   A. 12 B. -12 C. $12i$ D. $-12i$ E. NOTA

10. What is the distance between 15 and $8i$ on the complex plane?
    A. $15 - 8i$ B. $-15 + 8i$ C. 7 D. 17 E. NOTA

11. If $i^{6x+17} = i^{5x+2}$, solve for x over the integers.
    A. -15 B. 1 C. {-15, 1} D.$\{ 4k + 1 \mid k \in \mathbb{Z}\}$ E. NOTA

12. If I roll 2 fair six-sided dice and let the sum of the numbers facing up be S, what is the probability that the number $i^{S/2}$ is a positive integer?
    A. $5/36$ B. $1/2$ C. $1/4$ D. $1/11$ E. NOTA

13. If $z^2 = i$, which of the following is a solution for z?
    A. i B. $-i$ C. $\frac{\sqrt{2}}{2} + \frac{i\sqrt{2}}{2}$ D. $\frac{\sqrt{2}}{2} - \frac{i\sqrt{2}}{2}$ E. NOTA

14. Which of the following is equal to i^i?
    A. $-i$ B. i C. $e^{\frac{\pi}{2}}$ D. $\frac{1}{e^{\frac{\pi}{2}}}$ E. NOTA

15. Find the sum of the absolute values of the complex zeroes of $2x^5 - 3x^4 + 5x^3 - 10x^2 - 12x + 8$.
    A. 0 B. $\frac{3}{2}$ C. 4 D. $\frac{15}{2}$ E. NOTA

16. How many non-real zeros does $x^7 - 3x^6 - 6x^4 - 2x^2 - 5$ have (counting multiplicity)?
    A. 0 B. 1 C. 6 D. Cannot Be Determined E. NOTA

17. Find the solution set over the positive integers for all x satisfying $i^{(2x^2+x+3)} = i^{(x^2+2x+1)}$.
    A. no solution B. {1, 2} C. {2} D. {2, 3} E. NOTA

18. How many numbers have the property that their additive inverse is equal to their multiplicative inverse?
    A. cannot be determined B. 1
    C. 2 D. 4 E. NOTA

19. Given $i^{n!} = a$ for all $n \geq b$, with $n \in \mathbb{Z}$ (and $i^{(n-1)!} \neq a$), what is $|a+bi|$?
    A. $\sqrt{5}$ B. 5 C. $\sqrt{10}$ D. $\sqrt{17}$ E. NOTA

20. For any $z_1, z_2 \in \mathbb{C}$, with $z_1 \neq z_2$, which of the following must be true?
    I. Either $\Re(z_1) < \Re(z_2)$ or $\Re(z_2) < \Re(z_1)$
    II. Either $\Im(z_1) < \Im(z_2)$ or $\Im(z_2) < \Im(z_1)$
    III. $\arg(z_1) \neq \arg(z_2)$
    IV. $|z_1| \neq |z_2|$
    V. Either $\Re(z_1) \neq \Re(z_2)$ or $\Im(z_1) \neq \Im(z_2)$
    A. **I** and **II** only B. **III** and **IV** only
    C. **V** only D. **I, II, III, IV,** and **V** E. NOTA

21. Find $y - x$, given that x and y are real numbers and $(3+2i)x + (4+5i)y = 10+14i$.
    A. $2+3i$ B. $1-2i$ C. 4 D. $-3i$ E. NOTA

22. Which of these is a third root of 27*i*?

A. $3e^{\frac{5\pi i}{6}}$ B. $3e^{\frac{\pi i}{2}}$ C. $3e^{\frac{\pi i}{3}}$ D. $3e^{\frac{2\pi i}{3}}$ E. NOTA

23. What is the area of the triangle in the complex plane with vertices at the numbers 3+5*i*, 7-2*i*, and -9+11*i*?

A. 30 B. 56 C. 60 D. No Triangle is Formed E. NOTA

24. Imagine a two-dimensional coordinate system in which each coordinate is a complex number. What is the distance between points (0,*i*) and (*i*,0)?

A. 1 B. $\sqrt{2}$ C. $\sqrt{3}$ D. 2 E. NOTA

25. Solve for *x*: $\pi i - \ln(4) = \ln(x) + \ln(x-1)$.

A. 3/4 B. 1/2 C. -1/2 D. no solution E. NOTA

26. For how many distinct complex numbers *z* is the following true? $0 = \sum_{k=1}^{4} z^k$

A. Infinite B. Two C. Three D. Four E. NOTA

27. Which of the following is equal to the complex conjugate of $rcis(\theta)$?

A. $-rcis(\theta)$ B. $r\cosh(\theta)$ C. $rcis(-\theta)$ D. $-rcis(-\theta)$ E. NOTA

28. Two-by-two matrices can be used to represent the complex numbers. Given that the complex number 1 is represented by the matrix $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, which of the following could be chosen to represent *a* + *bi*?

A. $\begin{bmatrix} a & b \\ a & b \end{bmatrix}$ B. $\begin{bmatrix} a & a \\ b & b \end{bmatrix}$ C. $\begin{bmatrix} a & b \\ b & a \end{bmatrix}$ D. $\begin{bmatrix} a & -b \\ b & a \end{bmatrix}$ E. NOTA

29. Simplify: $(-2+2i\sqrt{3})(-3\sqrt{3}-3i)$

A. $-24\sqrt{3}-24i$ B. $12\sqrt{3}-12i$

C. $24\sqrt{3}-24i$ D. $-12\sqrt{3}+12i$ E. NOTA

30. Evaluate: $\arg((289-289i)^{175})$

A. $\frac{\pi}{4}$ B. $\frac{\pi}{2}$ C. $\frac{5\pi}{4}$ D. $\frac{7\pi}{4}$ E. NOTA