

Note: Throughout the test you may mark "E" for none of these answers.

For all questions, $i^2 = -1$ and all variables are real unless otherwise specified.

1. Evaluate

$$4(3 + 17) - 3(2 \times 6 - 2) + 2(2 + 8 \div 2) \times 2 + 10$$

- A. 84 B. 100 C. 338 D. 642 E. NOTA

2. Which answer is equivalent to the following product?

$$\left(\frac{1+2i}{3-i}\right) \left(\frac{1-2i}{2-i}\right) \left(\frac{2+i}{3+i}\right)$$

- A. $-\frac{3+4i}{8}$ B. $-\frac{5+4i}{8}$ C. $\frac{3+4i}{10}$ D. $\frac{5-4i}{10}$ E. NOTA

3. Which of the following lines is perpendicular to $y = 2 - \frac{4}{3}x$?

- A. $3x + 4y = 10$ B. $4x + 3y = 8$ C. $4x - 3y = 2$ D. $6x - 8y = 1$ E. NOTA

4. The volume of a spherical balloon varies directly with the time spent inflating it. If, after 2 seconds, the diameter is 3 centimeters, what will the diameter be after 16 seconds?

- A. 6 B. 12 C. 24 D. 48 E. NOTA

5. How many negative real roots does the following polynomial have?

$$5x^5 + 4x^3 - 3x^2 + 2x + 1 = 0$$

- A. 0 B. 1 C. 3 D. 4 E. NOTA

For questions 6-8, suppose $f(x) = 1 - 2\sqrt{8 + 2x - x^2}$.

6. What is the domain of f ?

- A. $x < -2$ or $x > 4$ B. $x \leq -2$ or $x \geq 4$ C. $-2 < x < 4$ D. $-2 \leq x \leq 4$ E. NOTA

7. What is the range of f ?

- A. $-5 \leq f(x) \leq 1$ B. $f(x) \leq -5$ or $f(x) \geq 1$ C. $f(x) \leq 1$ D. $f(x) \geq 1$ E. NOTA

8. What is $f^{-1}(-5)$?

- A. -5 B. -2 C. 1 D. 4 E. NOTA

9. How many positive integer factors does 720000 have?

- A. 30 B. 60 C. 120 D. 240 E. NOTA

10. Find the distance from the vertex to the focus of

$$4x = 2y^2 + 2y + 3$$

- A. $\frac{1}{8}$ B. $\frac{1}{2}$ C. 2 D. 8 E. NOTA

11. Suppose A and B are real numbers and $(A + Bi)^2 = i$. What is $A^2 + B^2$?

- A. 0 B. 1 C. $\sqrt{2}$ D. 2 E. NOTA

12. What is the inverse function of $f(x) = 4x + 8$?

- A. $8x + 4$ B. $-4x - 8$ C. $\frac{1}{4}x - 8$ D. $\frac{1}{4}x + 2$ E. NOTA

13. Find the area of the solution set of

$$\begin{aligned}x + y &\leq 5 \\5x + y &\geq 5 \\x - 3y &\geq 1\end{aligned}$$

- A. $\frac{15}{2}$ B. 8 C. $\frac{25}{2}$ D. 16 E. NOTA

14. Find the sum of the roots,

$$\log_2(x^3) - \log_2(4x^2) + (\log_2 x)^2 = 0$$

- A. $\frac{1}{4}$ B. 2 C. $\frac{9}{4}$ D. 4 E. NOTA

15. Evaluate

$$(\log_{11} 9)(\log_5 8)(\log_3 49)(\log_7 125)(\log_2 11)$$

- A. 6 B. 12 C. 24 D. 36 E. NOTA

16. How many distinct values of x satisfy the following equation?

$$2^x + \log_2(x^2 + 4) = 0$$

- A. 0 B. 1 C. 2 D. 4 E. NOTA

17. Define the binary operator \diamond by

$$z_1 \diamond z_2 = |z_1 - z_2|$$

What is $(5 + 3i) \diamond (10 - 9i)$?

- A. 5 B. 9 C. 13 D. 17 E. NOTA

18. Evaluate

$$\left(25^{\frac{3}{2}}\right) \left(8^{\frac{2}{3}}\right) \left(1000^{-\frac{1}{3}}\right)$$

- A. $\frac{1}{5}$ B. 5 C. 50 D. 100 E. NOTA

19. Find the sum of the squares of the roots of

$$x^2 - 5x + 3 = 0$$

- A. 4 B. 14 C. 19 D. 31 E. NOTA

20. Let

$$Y = \prod_{j=1}^{100} 2^j$$

, where $\prod_{j=j_0}^{j_n} a_j$ denotes the product of the values of a_j for all j from j_0 to j_n . Find $\log_4 Y$.

- A. 1000 B. 2525 C. 5050 D. 10000 E. NOTA

21. What is the perpendicular distance from $y = \frac{4}{3}x - 3$ to $(5, 12)$?

- A. 2.6 B. 5 C. 8 D. 13 E. NOTA

22. A family has two different-aged children. Assuming male and female children are equally likely, what is the probability that the elder child is female given that at least one child is male?

- A. $\frac{1}{4}$ B. $\frac{1}{3}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$ E. NOTA

23. Let (x, y) be the intersection point of

$$4x + 3y = 12$$

$$5x + 2y = 8$$

What is $x + y$?

- A. -12 B. $-\frac{12}{11}$ C. $\frac{12}{11}$ D. 12 E. NOTA
24. What choice best describes the graph of the following equation?
- $$\log_2 y = 2 + \log_2 x$$
- A. half-line B. line C. two intersecting lines D. parabola E. NOTA
25. What is the remainder when $x^2 + 3x + 4$ is divided by $x + 2$?
- A. -2 B. -1 C. 0 D. 1 E. NOTA
26. Suppose $z = 1 + 3i$. What is $|z^6|$?
- A. 1 B. 64 C. 1000 D. 4096 E. NOTA
27. Suppose $f(x) = \frac{2x}{2x-1}$, $x \neq \frac{1}{2}$. What is $f(1-x) + f(x)$?
- A. -2 B. 0 C. 2 D. 4 E. NOTA
28. How many integers x between -10 and 10, inclusive, satisfy the following?
- $$|4x + 2| > x + 8$$
- A. 5 B. 7 C. 14 D. 16 E. NOTA
29. What is the characteristic of $\log_{10}\left(\frac{1}{128}\right)$ to the nearest thousandth?
- A. -3 B. -2 C. -0.107 D. 0.893 E. NOTA
30. With how many zeros does $50!$ end?
- A. 10 B. 12 C. 20 D. 50 E. NOTA