

For all questions, E. NOTA means “none of the above answers is correct.”

1. The greatest root of the equation

$$2x^3 - 3x^2 - 11x + 6 = 0$$

- A. 1 B. 2 C. 3
D. 6 E. NOTA

2. Simplify: $\sqrt{16+16x^2} - \sqrt{9+9x^2}$

- A. $\sqrt{1+x^2}$ B. $7+x^2$ C. $\sqrt{7+7x^2}$
D. $1+x$ E. NOTA

3. Let n be the number of distinct values of p such the solutions of the equation $x^2 + px + 2p = 0$ are equal. Then $n =$

- A. 0 B. 1 C. 2
D. 3 E. NOTA

4. Find the range of the function

$$y = -2x^2 + 12x - 24.$$

- A. $(-\infty, -24]$ B. $[-24, \infty)$ C. $(-\infty, -6]$
D. $(-\infty, -3]$ E. NOTA

5. If $f(x+y) = f(x)f(y)$ and $f(1) = -2$, find $f(3)$.

- A. -8 B. -4 C. 1
D. 4 E. NOTA

6. Which of the following is equal to the expression

$$\frac{1}{x+2} - \frac{3}{x-1} + \frac{1}{x^2+x-2} ?$$

- A. $\frac{-2x+6}{x^2+x-2}$ B. $\frac{-2x-6}{x^2+x-2}$ C. $\frac{2x+6}{x^2+x-2}$
D. $\frac{2x-6}{x^2+x-2}$ E. NOTA

7. If $f(x) = -x^2 + 1$, $g(x,y) = x(1+y)$, find $g(f(2), 3)$.

- A. -12 B. 8 C. 12
D. 20 E. NOTA

8. Suppose the function f is defined so that

$$f(x) = \begin{cases} 3x & \text{if } x \leq 1 \\ (x-1)^2 & \text{if } x > 1 \end{cases}$$

If a is negative, then $f(1-a) =$

- A. $(2-a)^2$ B. a^2 C. $3-3a$
D. $3a$ E. NOTA

9. If $f\left(\frac{1}{x+3}\right) = \frac{1}{2-5x}$ for $x > 1$, then $f(x) =$

- A. $\frac{x}{-13x+5}$ B. $\frac{x}{-19x-7}$ C. $\frac{x}{15x-7}$
D. $\frac{x}{17x-5}$ E. NOTA

10. A line contains the vertex of the parabola $y = -2x^2 + 4x - 1$ and the origin. Find the equation of the line.

- A. $x = y$ B. $x = -y$ C. $y = 0$
D. $x = 0$ E. NOTA

11. Where defined, $\frac{a^{-1}+b^{-1}}{(a+b)^{-1}}$ is equivalent to

- A. 1 B. $\frac{(a+b)^2}{ab}$ C. $\frac{1}{ab}$
D. $\frac{a^2+b^2}{ab}$ E. NOTA

12. Solve for x where defined:

$$\frac{\sqrt{x+1} + \sqrt{x-1}}{\sqrt{x+1} - \sqrt{x-1}} = 3$$
 A. 1 B. $\frac{4}{3}$ C. $\frac{5}{3}$
 D. 2 E. NOTA
13. For $P(x) = 2x^n - 3x^{n-1} + \dots + 5x^2 + 14x - 15$, there are how many possible rational roots?
 A. 1 B. 3 C. 8
 D. 16 E. NOTA
14. Find the equation of the linear function that contains the point $(-1, 3)$ and is perpendicular to $2x - \frac{1}{2}y = 5$.
 A. $4x - y = -7$ B. $x - 4y = -13$
 C. $2x - \frac{1}{2}y = \frac{7}{2}$ D. $x + 4y = -11$
 E. NOTA
15. How many integer solutions are there to the equation $14x^4 - 8x^3 + 28x = 3$?
 A. 0 B. 1 C. 2
 D. 4 E. NOTA
16. The graph of $y = \frac{2x+5}{3x+7}$ has vertical asymptote
 A. $x = \frac{2}{3}$ B. $x = -\frac{5}{2}$ C. $x = -\frac{7}{3}$
 D. $x = 0$ E. NOTA
17. If $x^2 - 3x + 2 = (x - k)^2 + p$, what is the value of p ?
 A. -1 B. $-\frac{1}{4}$ C. -2
 D. 2 E. NOTA
18. Find the sum of the non-real roots for $2x^4 - 3x^3 - 13x^2 + 37x - 15 = 0$ when one of the real roots is -3 .
 A. 2 B. 3 C. 4
 D. 6 E. NOTA
19. If the polynomial $ax^4 + bx^2 + c$ has 5 as a root, where a, b, c are nonzero real, what is the remainder when the polynomial is divided by $x - 5$?
 A. -5 B. c C. 5
 D. $5c$ E. NOTA
20. Determine the domain for $f(x) = \sqrt{x^3 - x}$.
 A. $[-1, 0] \cup [1, \infty)$ B. $[0, \infty)$
 C. $[-1, \infty)$ D. $(-\infty, 0] \cup [1, \infty)$
 E. NOTA
21. If $f(x) = \frac{1}{(x+3)}$ for $x \neq -3$, find $f^{-1}(x)$.
 A. $x + 3$ B. $\frac{1}{x-3}, x \neq 3$ C. $\frac{1}{3} + x$
 D. $\frac{1}{x} - 3, x \neq 0$ E. NOTA
22. Let r_1 be the remainder after dividing $y^2 + 2y + 4s$ by $y - 1$. Let r_2 be the remainder after dividing $y^2 + sy + 2s^2$ by $y - 1$. Find all values of s for which $r_1 = r_2$. The sum of these values for s is
 A. $\frac{1}{2}$ B. $1\frac{1}{2}$ C. $2\frac{1}{2}$
 D. $3\frac{1}{2}$ E. NOTA

23. If $f(x) = 2^x$, $g(x) = \log_2 x$, find $f(g(x))$, $x > 0$.
- A. 2 B. x C. $(2^x)^x$
D. $2\log_2 x$ E. NOTA
24. The roots of $x^2 + Ax + B = 0$ are 4 and 5.
The roots of $x^2 + Cx + D = 0$ are 2 and 9.
Which is a root of $x^2 + Ax + D = 0$?
- A. -3 B. 4 C. 6
D. $\frac{11 + \sqrt{41}}{2}$ E. NOTA
25. Given that function f consists of the ordered pairs $\{(1,2), (-1,4), (2,5)\}$ and function g of $\{(1,2), (2,-1)\}$, find $f(g(2))$.
- A. -1 B. 2 C. 4
D. 5 E. NOTA
26. Let $P(x) = x^3 + ax^2 + bx + c$ where a, b, c are real. The graph of the polynomial intersects the x -axis at $x = -2$ and $x = 1$, and intersects the y -axis at $y = 0$. Find the value of $P(-1)$.
- A. -2 B. 1 C. 2
D. 3 E. NOTA
27. If $f(x) = x^{-\frac{2}{3}}$, find $f(8)$.
- A. -4 B. $-\frac{1}{4}$ C. $\frac{1}{4}$
D. $\frac{\sqrt{2}}{32}$ E. NOTA
28. Suppose $(f \circ g)(x) = x^2 + 1$ and $f(x) = x - 3$. Find $g(x)$.
- A. $x^2 - x + 2$ B. $x^2 + 4$ C. $x^2 + x - 2$
D. $6x - 8$ E. NOTA
29. The graph of $y = -\frac{\sqrt{16+x^2}}{2}$ is
- A. the lower half of an ellipse.
B. a parabola.
C. the left half of a hyperbola.
D. the lower half of a hyperbola.
E. NOTA
30. The maximum value of the function $f(x) = -x^2 - 5x + 2$ is
- A. $-\frac{17}{4}$ B. 0 C. 2
D. $\frac{33}{4}$ E. NOTA