Note that choice E) NOTA stands for "None of the above" answers is correct

1. How many times do $y = x$ and $y = x^3$ intersect?

A) 0 B) 1 C) 2 D) 3 E) NOTA

2. Let $f(x) = 2x^2 + 19$ and $g(x) = x^3 + 4x + 9$. Evaluate $(f \circ g)(3)$.

A) 2323 B) 4627 C) 124021 D) 47047334 E) NOTA

3. Given $f(x) = \sqrt[3]{x}$, find the value of $f(f(f(3)))$.

A) $3^{1/9}$ B) $9^{1/27}$ C)$27^{1/81}$ D)$81^{1/36}$ E) NOTA

For Questions 4-6, consider the following two functions: $f(x) = x^2$ and $g(x) = 2^x$

4. Find $f(g(3))$.

A) 16 B) 64 C) 256 D) 512 E) NOTA

5. Find $2g(2f(2))$.

A) 16 B) 64 C) 256 D) 512 E) NOTA

6. How many real solutions exist for $f(x) = g(x)$?

A) 1 B) 2 C) 3 D) 4 E) NOTA

7. If $f(3x - 1) = x^3 + x^2 - x - 1$, find the value of $f(5)$.

A) 0 B) 32 C) 9 D) 144 E) NOTA

8. What is the remainder when $P(x) = x^5 + 4x^3 + 2x^2 + x + 9$ is divided by $x - 2$?

A) 17 B) 74 C) 83 D) 115 E) NOTA

9. Find the number of vertical asymptotes in

$$\frac{3x^4 + 10x^3 + 5x^2 - 10x - 8}{3x^4 + 25x^3 + 70x^2 + 80x + 32}$$

A) 1 B) 2 C) 3 D) 4 E) NOTA

10. Which of the following are correct?

I. A function can have vertical asymptotes as well as a point discontinuity(-ies).
II. Jump discontinuities occur when the denominator and numerator both have a factor that can cancel out to remove division by zero.
III. The function defined in question #9 is a continuous function
IV. Point discontinuities are the same as removable singularities
V. A piecewise function can make a continuous function.

A) I, II, IV B) I, II, IV, V C) II, IV, V D) I, IV, V E) NOTA

11. Given $f(x) + 2f(\frac{1}{x}) = 3x$, find the value of $f(4)$.

A) $-\frac{45}{4}$ B) $-\frac{7}{2}$ C) $-\frac{31}{4}$ D) $-\frac{21}{2}$ E) NOTA

12. Let $F_n = F_{n-1} + F_{n-2}$ for n ≥ 2 and $F_0 = 1$ and $F_1 = 1$. As n gets larger and larger, what value does $\frac{F_n}{F_{n-1}}$ approach?

A) $\frac{1+\sqrt{2}}{2}$ B) $\frac{1+\sqrt{3}}{2}$ C) $\frac{1+\sqrt{5}}{2}$ D) $\frac{1+\sqrt{7}}{2}$ E) NOTA

13. If $g(x) = \frac{x^4-4x^2}{4x^4-x^2}$, find $g(\sqrt{\frac{2}{3x}})$.

A) $\frac{12x-2}{3x-8}$ B) $\frac{3x-8}{12x-2}$ C) $\frac{8x-3}{2x-12}$ D) $\frac{2x-12}{8x-3}$ E) NOTA

For Questions 14-16, use the following information: $f(x)$ is an odd function and $g(x)$ is an even function

14. Which of the following are true for $f(x)$?

I. $f(x) = f(-x)$
II. $f(x) = -f(-x)$
III. $f(x)$ is symmetrical about the origin
IV. $f(x)$ is symmetrical about the x-axis

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

15. Which of the following are true for $g(x)$?

I. $g(x) = g(-x)$
II. $g(x) = -g(-x)$
III. $g(x)$ is symmetrical about the origin
IV. $g(x)$ is symmetrical about the x-axis

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

16. Which of the following are true for $f(g(x))$?

I. $f(g(x)) = f(g(-x))$
II. $f(g(x)) = -f(g(-x))$
III. $f(g(x))$ is symmetrical about the origin
IV. $f(g(x))$ is symmetrical about the x-axis

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

17. Given $f(x) = sin(x)$ and $g(x) = cos(x)$, what is $(f(x))^4 - (g(x))^4$ in terms of $g(x)$?

A) $1 - \big(g(x)\big)^4$ B) $1 - 2\big(g(x)\big)^2$ C) $2\big(g(x)\big)^2 - 1$ D) $\big(g(x)\big)^4 - 1$ E) NOTA

18. Which of the following describes the solution to $(x + y)^4 = x + y$, where variables are real?

A) Two parallel lines B) two perpendicular lines C) three parallel lines D) four parallel lines E) NOTA

19. What is the largest value of $f(x) = -2x^2 + 8x + 13$?

A) 13 B) 17 C) 21 D) 25 E) NOTA

20. Braxton owns a factory that produces gazorpazorps. The price of each gazorpazorp can be calculated with the function $P(x) = 3x + 9$ where x is the number of gazorpazorps produced during one day. The cost function to operate the factory each day is $C(x) = 4x^2 - 7x + 3$. How many gazorpazorps should Braxton produce daily to maximize profits?

A) 3 B) 4 C) 8 D) 16 E) NOTA

21. Solve the following equation:

$$y = \sqrt{1 + 2\sqrt{1 + 3\sqrt{1 + 4\sqrt{1 + 5\sqrt{\ldots}}}}}$$

A) $y = 3$ B) $y = 5$ C) $y = 4$ D) $y = 2$ E) NOTA

22. Stewie and Kenny are figuring out a math problem. Given the product of the roots and the sum of the roots of a parabola, they were supposed to find the function. However, Stewie misread the product of the roots and got $y = x^2 - 14x + 48$ and Kenny misread the sum of the roots and got $y = x^2 - 13x + 40$. What is the sum of the square of the roots of the function?

A) 89 B) 100 C) 116 D) 120 E) NOTA

23. Find the area enclosed by the function $f(x) = 3\sqrt{3 + 2x - x^2}$ and the x-axis.

A) 3π B) 6π C) 12π D) 24π E) NOTA

24. Let $f(x) = x!$. There exists at least one integer n such that $f(n)$ has 6 terminating zeros. Using the largest possible value of n that satisfies the previous condition, what is the sum of the least n positive even integers?

A) 625 B) 650 C) 841 D) 870 E) NOTA

25. Find the sum of the coefficients of the function $h(x, y) = (2x^3 - 5y)^7$

A) -2097 B) 729 C) -6561 D) 243 E) NOTA

26. If $F(x) = 3log_9(x)$ and $G(x) = x^2 - 6x + 1$, find the value(s) of x when $G(F^{-1}(x)) = 28$.

A) 3 B) 81 C) 243 D) 729 E) NOTA

27. Find the sum of the digits of $F(3)$ for

$$F(x) = \sum_{n=0}^{6} x^{n+1} - \sum_{n=0}^{6} x^n$$

A) 15 B) 16 C) 17 D) 18 E) NOTA

28. G(x) is a function whose roots are each 3 greater than those of $f(x) = x^4 - x^3 - 7x^2 + 2x - 5$. Find the coefficient of the x^2 term of $G(x)$.

A) 19 B) 34 C) -13 D) 56 E) NOTA

29. Let's say $P(x) = 2x^2 - 5x - 13$. Let $Q(x)$ be the result when $P(x)$ has been translated up 9 units, then translated left 3 units, then reflected across the line $y = x$ (Q is no longer a function). Find the shortest distance between the origin and all possible points $(21, Q(21))$.

A)$\sqrt{445}$ B) $\sqrt{461}$ C)$2\sqrt{97}$ D)$2\sqrt{317}$ E) NOTA

30. How many of the following are one to one?

I. $x = y^2 + 7$
II. $y = |\log x|$
III. $y = \sqrt{x^2}$
IV. $y^2 = 9 - x^2$

A) 1 B) 2 C) 3 D) 4 E) NOTA