For all questions, answer choice "E. NOTA" means none of the above answers is correct.

1. Find the values of k so that the equation $3kx^2 - 4kx + 1 = 0$ has no real roots.

   A. $k > 5$ B. $-5 < k < \frac{3}{4}$ C. $-5 < k < 5$ D. $0 < k < \frac{3}{4}$ E. NOTA

2. Find the sum of the solutions of the equation $4x^5 - 8x^4 + 7x^3 - 41x^2 + 6x - 5 = 0$.

   A. 2 B. –2 C. 8 D. –8 E. NOTA

3. If $\log_x y + \log_y x = 2.9$ and $xy = 128$, find the value of $x + y$.

   A. 32 B. 36 C. 40 D. 48 E. NOTA

4. If $2^x = \frac{1}{4}$, what is the value of x^x?

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

5. Let a and b be distinct real numbers such that $\frac{a}{b} + \frac{a+3b}{b+3a} = 2$. Find the ratio $a:b$.

   A. 1:2 B. 3:1 C. 1:3 D. 2:1 E. NOTA

6. Find the number of positive real roots of the equation $x^4 + x^3 - 3x^2 - 4x - 4 = 0$.

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

7. The real solution(s) to $|x|^2 - \sqrt{x^2} - 6 = 0$ can be found in which of the following intervals?

   A. $[-6, 21]$ B. $(-4, 1]$ C. $[-2, 20)$ D. $\left(-\frac{1}{3}, \frac{1}{3}\right)$ E. NOTA

8. In the days of yore, it cost 85¢ to attend a football game. At this cost, 5000 fans would attend. For each 5¢ increase, the attendance decreased by 200 fans. How much should have been charged for maximum revenue if the stadium held a maximum of 8000 fans?

   A. $1 B. $1.05 C. $1.15 D. 95¢ E. NOTA

9. If x is an integer and the inequalities $2x - \sqrt{2} < 6$ and $1 - 2x < -4$ are both true, what is the value of x?

   A. 0 B. 5 C. 4 D. 3 E. NOTA

10. Find the value of n for which ${}_nP_4 = 20\left({}_{n-1}C_2\right)$.

    A. 5 B. 6 C. 10 D. 4 E. NOTA

11. Find the sum of the solutions to $x+2=\sqrt{4+x\sqrt{8-x}}$.

A. –9 B. –1 C. –2 D. 0 E. NOTA

12. A triangle has 10 and 14 as two of its side lengths. Which of the following could not be the length of the third side?

A. 4.2 B. 23 C. 17 D. 4 E. NOTA

13. Solve for *x*: $\sqrt{2}x^2+\sqrt{3}x-\sqrt{2}=0$.

A. $\dfrac{-\sqrt{3}\pm\sqrt{11}}{4}$ B. $\dfrac{-\sqrt{3}\pm\sqrt{\sqrt{3}-8}}{2\sqrt{2}}$ C. $\dfrac{-\sqrt{6}\pm\sqrt{22}}{4}$ D. $-\dfrac{\sqrt{6}}{4}\pm\dfrac{\sqrt{10}}{4}i$ E. NOTA

14. Solve for *x*: $\begin{vmatrix} 1 & 3 & 4 \\ 2 & 2 & -1 \\ x-4 & x-2 & -2 \end{vmatrix}=28$.

A. 3 B. –42 C. –1 D. 31 E. NOTA

15. Find the product of the real solutions to $(\log x)^3=\log(x^{16})$.

A. 10^{-4} B. 1 C. 13 D. 0 E. NOTA

16. In terms of *a*, which ordered pair satisfies $\begin{cases} ax+3y=6 \\ -2x-y=4 \end{cases}$?

A. $\left(\dfrac{6}{a-6},\dfrac{4(a+3)}{a-6}\right)$ B. $\left(\dfrac{18}{a+6},\dfrac{a+3}{a-2}\right)$ C. $\left(\dfrac{a-6}{18},\dfrac{6-a}{4(a+3)}\right)$

D. No such ordered pair exists E. NOTA

17. How many ordered quadruples of nonnegative integers (*a*, *b*, *c*, *d*) are there such that $a+b+c+d=10$?

A. 286 B. 1001 C. 715 D. 342 E. NOTA

18. How many integral pairs (x, y) are there to $x^2-y^2=270$?

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

19. A two-digit number is multiplied by 23, which yields a four-digit number whose first and last digits are 1 and whose second and third digits are the original two-digit number. If the original two-digit number is *XY*, find $X+Y$. (*XY* does not represent the product of *X* and *Y*.)

A. 13 B. 14 C. 12 D. 10 E. NOTA

20. Find the sum of the values of *x* which satisfy $81^{x^3+2x^2}=\left(\dfrac{1}{27}\right)^{-\frac{5}{3}x}$.

A. 2.5 B. –3 C. 0 D. –2 E. NOTA

21. Find the length of the solution interval for $1 \le 3 - 4x \le 11$.

A. 1.75 B. 2 C. 2.25 D. 3.5 E. NOTA

22. Find the ratio $\frac{z}{y}$ given $\begin{cases} \frac{1}{x}+\frac{1}{y}=\frac{1}{3} \\ \frac{1}{x}+\frac{1}{z}=\frac{1}{5} \\ \frac{1}{y}+\frac{1}{z}=\frac{1}{7} \end{cases}$. A. 17 B. 23 C. 29 D. 31 E. NOTA

23. Suppose *a*, *b*, and *c* are integers such that (i.) $0<a<b$ and (ii.) the polynomial $x(x-a)(x-b)-17$ is divisible by $(x-c)$. Find the minimum value of $a+b+c$.

A. 14 B. 17 C. 21 D. 24 E. NOTA

24. How many integers are in the solution set of $\log_4(x-2) \le 2$?

A. 16 B. 17 C. 18 D. 19 E. NOTA

25. Let *a* and *b* be two positive integers such that *b* is a multiple of *a*. Find the value of $b^2 - a^2$ if $\log\left(\frac{b}{a}\right)^{\frac{b}{2}} + \log\left(\sqrt{\frac{a}{b}}\right)^{9a} = 1$.

A. 357 B. 396 C. 1600 D. 5967 E. NOTA

26. Find the value of $a+b+c+d$ if *a*, *b*, *c*, and *d* are positive integers that satisfy $\begin{cases} ab+cd=38 \\ ac+bd=34 \\ ad+bc=43 \end{cases}$.

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

27. $\frac{3}{17}<\frac{n}{68}<\frac{32}{51}$ is true for how many integer values of *n*?

A. 28 B. 29 C. 30 D. 32 E. NOTA

28. Which of the following is a true statement?

A. $2^{\frac{1}{6}}<3^{\frac{1}{10}}<6^{\frac{1}{15}}$ B. $2^{\frac{1}{6}}<6^{\frac{1}{15}}<3^{\frac{1}{10}}$ C. $3^{\frac{1}{10}}<6^{\frac{1}{5}}<2^{\frac{1}{6}}$ D. $3^{\frac{1}{10}}<2^{\frac{1}{6}}<6^{\frac{1}{15}}$ E. NOTA

29. Two of the solutions of $2x^4+x^3+5x^2+4x-12=0$ are imaginary numbers. The other two solutions must satisfy which of the following equations?

A. $2x^2-x-4=0$ B. $2x^2-2x+1=0$ C. $2x^2+x-3=0$ D. $2x^2+3x-2=0$ E. NOTA

30. Find the area of the closed region in the *xy*-plane described by $x^2+y^2 \le 4x+4\sqrt{3}y$.

A. 8π B. 9π C. 12π D. 16π E. NOTA