For all questions, answer choice (E) NOTA means that none of the given answers is correct. Good Luck!

1. Given that the y-intercept of the equation $y = \frac{8}{9}x + \frac{22}{3}$ is (0, b), find b.

   (A) $\frac{22}{7}$ (B) $\frac{1}{2}$ (C) $\frac{8}{9}$ (D) $\frac{22}{3}$ (E) NOTA

2. What percent of 360 is 133.2?

   (A) 28% (B) 40% (C) 34% (D) 37% (E) NOTA

3. Rationalize the denominator of $\frac{5\sqrt{3}+2\sqrt{6}}{3\sqrt{3}-8\sqrt{6}}$.

   (A) 21 (B) -21 (C) $\frac{47-46\sqrt{2}}{119}$ (D) $\frac{-47-46\sqrt{2}}{119}$ (E) NOTA

4. Find $\frac{xy}{z}$ in the following system of equations.

$$2x + y - 2z = -1$$
$$x - 2y + 3z = 6$$
$$3x - 3y - z = 5$$

   (A) -27 (B) -1 (C) 37 (D) -37 (E) NOTA

5. Find the value of $f^{-1}(11)$, if $f(x) = -9x + 5$.

   (A) $\frac{1}{2}$ (B) $\frac{3}{4}$ (C) $-\frac{2}{3}$ (D) $\frac{4}{5}$ (E) NOTA

6. On a particularly odd morning, Akhil finds that he has shrunk. He measures his height and realizes he is now three feet tall. He goes out for his morning jog, and he sees that his shadow is eight feet long. Considering that the streetlight he is standing next to is 32 feet tall, how many feet long is the streetlight's shadow? (Assume the sun is consistent in its emittance, and that height and shadow length are directly proportional).

   (A) $\frac{128}{3}$ (B) $\frac{256}{3}$ (C) 408 (D) 1024 (E) NOTA

7. Karthik is very fond of paneer, and he can only eat his paneer once you have deciphered the quadratic: $4x^2+8x-7 = 0$. Find the value of the product of the roots of this quadratic divided by the sum of the roots of this quadratic so Karthik can eat his paneer.

   (A) $\frac{1}{2}$ (B) $-\frac{7}{8}$ (C) $-\frac{7}{4}$ (D) 2 (E) NOTA

8. Tanmay is very well known for forgetting his homework. He is looking around his house for it right now and needs your help. Let the y-coordinate of the y-intercept of $y = 2x + 4$ be a and the x-coordinate of its x-intercept be b. The location of Tanmay's homework is at the point $(3a, b + 7)$ on the Cartesian plane. How far is the homework from Tanmay right now, if Tanmay is at the origin?

   (A) 13 (B) 14 (C) 20 (D) 25 (E) NOTA

9. Given that the operation x@y is defined as $\sqrt[3]{x} - y^4$, compute 512@12.

   (A) -20728 (B) 19845 (C) -18045 (D) 201632 (E) NOTA

10. If 12 artists can paint 4 paintings in 15 hours, how long will it take for 23 artists to paint 13 paintings? (Express your answer as a decimal to the nearest hundredth)

    (A) 68.42 (B) 12.34 (C) 98.40 (D) 54.23 (E) NOTA

11. What is the percent increase from 4.2 to 72.5? (Express your answer to the nearest whole number)

(A) 1626% (B) 1544% (C) 1744% (D) 1726% (E) NOTA

12. 12. Let a be the median of the set 14, 19, 12, 21, 17, 14, 20 and b be the mean of the same set. Find the value of ab. (Express your answer to the nearest whole number)

(A) 276 (B) 192 (C) 284 (D) 360 (E) NOTA

13. Compute the product of the exponents of the prime numbers in the prime factorization of 32412.

(A) 4 (B) 9 (C) 12 (D) 2 (E) NOTA

14. Let $f(x) = x^2 - 2020$. Find the sum of the squares of the roots of the polynomial $f(f(x))$.

(A) 2020 (B) 8080 (C) 4040 (D) 1010 (E) NOTA

15. Shrung is extremely bored, so he decides to take out a piece of graphing paper. He draws a random triangle ABC on the Cartesian Plane, and it's vertexes are at $A(3, 4)$, $B(2, 6)$, and $C(5, 7)$. Compute the sum of the squares of the side lengths of the triangle.

(A) 17 (B) 18 (C) 24 (D) 28 (E) NOTA

16. Compute i^{2020}, where $i = \sqrt{-1}$.

(A) i (B) $-i$ (C) 1 (D) -1 (E) NOTA

17. Find the product of the solutions to the equation $x = \dfrac{1}{\sqrt{x} + \frac{1}{2+x}}$.

(A) 1 (B) 2 (C) 4 (D) $\sqrt{2}$ (E) NOTA

18. Nitish loves exponential functions. He loves it so much that every day at school he yells, "I LOVE exponential functions!!!" After much yelling, his math teacher, Mrs. Pickett, just had enough. She gave him an exponential function question, but he couldn't solve it. The question is: "Find the domain of the function $f(x) = \dfrac{5}{2 + 3^x}$." If he doesn't solve this, then he will lose his love for exponential functions. Solve this question for Nitish, so he can preserve his passionate love for exponential functions.

(A) $(-\infty, \infty)$ (B) $[0, \infty)$ (C) $(-\infty, 0]$ (D) No solution (E) NOTA

19. Find the range of the same function from the previous question.

(A) $(0, \frac{5}{2})$ (B) $[0, \frac{5}{3})$ (C) $(0, \frac{5}{3}]$ (D) $[0, \frac{5}{2}]$ (E) NOTA

20. Find the value of $\sqrt{90 + \sqrt{90 + \sqrt{90 + \ldots}}}$.

(A) 10 (B) 90 (C) $9\sqrt{2}$ (D) Undefined (E) NOTA

21. Akhil HATES exponents. He believes that they should've never existed, and he makes sure that everyone knows his hateful passion for them. Tanmay decided to taunt and annoy him one day, by asking him a question revolved around exponents. The question is: "Which is largest: $5^6, 10^4, 2^{14}$, or 3^9?" Help Akhil solve this so Tanmay can't tease Akhil.

(A) 5^6 (B) 10^4 (C) 2^{14} (D) 3^9 (E) NOTA

22. Given that a, b, c, and d satisfy the following system of equations and b is a negative integer:

$$\begin{aligned} a + b &= c \\ b + c &= d \\ c + d &= a \end{aligned}$$

Find the least possible value of $a + b + c + d$.

(A) 4 (B) 5 (C) 6 (D) 8 (E) NOTA

23. Mrs. Pickett and Mrs. Cross were doing an algebra problem in their free time. They were asked to find the roots of a quadratic equation. Mrs. Pickett misread the constant term but read the rest correctly. So, the roots she got were 7 and -4. Mrs. Cross misread the linear coefficient but read the rest correctly, and the roots she got were 10 and -4. Obviously, Mrs. Pickett and Mrs. Cross are both having a hard time with this problem, so help them out and find the roots to the actual quadratic from the problem. (Assume that Cross and Pickett both found the correct roots for the mistaken quadratics they read)

(A) $x = 7, 10$ (B) $x = 3, 8$ (C) $x = -8, 3$ (D) x = -5, 8 (E) NOTA

24. Eric loves radicals. The more nested it is, the happier Eric gets. However, he is faced with a nested radical question, but he doesn't know the answer. When he realizes he can't solve it, he is filled with sadness, and his love for radicals is going to fade anytime soon. Simplify the radical, $\sqrt{9 - 2\sqrt{23 - 6\sqrt{10 + 4\sqrt{3 - 2\sqrt{2}}}}}$, so that Eric can keep his love for radicals.

(A) 4 (B) $2\sqrt{3}$ (C) $\sqrt{2} + 1$ (D) $4\sqrt{23}$ (E) NOTA

25. You are given a $2 \times 2 \times 2$ cube, which consists of 8 unit cubes. Imagine it has one vertex at $(0, 0, 0)$ and another at $(2, 2, 2)$. How many paths of length 6 are there from $(0, 0, 0)$ to $(2, 2, 2)$? (Assume that each step of a path can only be taken along an edge of one of the unit cubes that forms the larger cube)

(A) 81 (B) 64 (C) 90 (D) 128 (E) NOTA

26. On a particular day, five students (including Nitish and Shrung) decide to sit in a row of five seats. Everyone is fine with this, except Nitish. He will only sit in the row under one condition: that he is always on the left side of Shrung. How many distinct ways can the five students be seated such that Nitish is somewhere to the left of Shrung?

(A) 45 (B) 60 (C) 75 (D) 90 (E) NOTA

27. What is the remainder when $145^{89} + 3^{2002}$ is divided by 13?

(A) 6 (B) 7 (C) 8 (D) 9 (E) NOTA

28. Six distinct integers are selected randomly from the set of the first 10 natural numbers. Find the probability that, among those selected, the second smallest is 3.

(A) $\frac{2}{5}$ (B) $\frac{3}{7}$ (C) $\frac{3}{10}$ (D) $\frac{1}{3}$ (E) NOTA

29. To solve a tricky programming problem, Dylan writes down all of the distinct positive values of y such that there exists a number x for which $x + 16 = y^2$ and $y + 16 = x^2$. The sum of these values can be expressed as $\frac{\sqrt{a} + \sqrt{b}}{2}$, where a and b are each whole numbers with no perfect square factors greater than 1. Find $a + b$.

(A) 63 (B) 65 (C) 126 (D) 127 (E) NOTA

30. The roots of $x^3 - 63x^2 + cx - 1728 = 0$ form a geometric sequence. Find the value of c.

(A) 478 (B) 967 (C) 687 (D) 756 (E) NOTA