1. The line L with equation y = ax + b is perpendicular to the line with equation y = bx + a ($ab \neq 0$). The x-intercept of L is

A. $\frac{1}{a}$ B. $\frac{1}{a^2}$ C. $\frac{-1}{a}$ D. $\frac{-1}{a^2}$ E. -1

2. Find the largest value of k for which $4x^2 + 9y^2 \geq kxy$ for all real values of x and y.

A. 4 B. 6 C. 8 D. 12 E. 26

3. In volleyball, attack percentage = (kills - errors)/(total attempts). If a player hits 0.450 on 20 attempts, what is her maximum possible number of kills?

A. 11 B. 12 C. 13 D. 14 E. 15

4. The sum of four consecutive positive integers is a perfect square. In which interval does the smallest such perfect square lie?

A. [1, 50] B. [51, 100] C. [101, 150] D. [151, 200] E. None; no such sum exists

5. A sample of six integers with median m, unique mode m + 2, and range 7 has an integer mean. What is the mean?

A. m - 3 B. m - 2 C. m - 1 D. m E. m + 1

6. If $\sin \alpha = \frac{3}{5}$ (α in QI), find $\tan \beta \neq 0$, where β is an angle with $\sin(\alpha + \beta) = -\sin \alpha$.

A. $\frac{-24}{7}$ B. $\frac{-7}{24}$ C. $\frac{7}{24}$ D. $\frac{24}{7}$ E. $\frac{25}{24}$

7. At a pizza parlor, customers pick from one up to four toppings chosen from olives, pepperoni, mushrooms, and ham. If a customer randomly selects one of the parlor's possible pizzas, the probability that the pizza includes olives is

A. $\frac{2}{5}$ B. $\frac{7}{16}$ C. $\frac{7}{15}$ D. $\frac{1}{2}$ E. $\frac{8}{15}$

8. A 9-digit number N with no zeros has the property that any 3 consecutive digits form a 3-digit number which is prime. The ones digit of the least such N is

A. 1 B. 3 C. 5 D. 7 E. 9

9. The six faces of a fair die are labeled with the letters A, M, A, T, Y, and C (one letter per face). The die is rolled four times. Find the probability that at least one A and at least one M appear.

A. 31/81 B. 32/81 C. 11/27 D. 34/81 E. 35/81

10. In right ΔABC ($\angle B = 90°$), BC = 1. In right ΔACD ($\angle C = 90°$) $\angle ADC = \angle ACB = \alpha$. Represent CD as a single trigonometric function of α.

A. $\sin \alpha$ B. $\csc \alpha$ C. $\tan \alpha$ D. $\cot \alpha$ E. $\sec \alpha$

11. The sum of the squares of the three roots of $P(x) = x^4 + 3x^3 + 2x^2 + 3x + 1$ is

A. 5 B. 7 C. 10 D. 14 E. 25

12. The polynomial P(x) in Problem 11 has a real root of the form $\frac{a+\sqrt{b}}{2}$. Find $a + b$.

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

13. The equation $a^4 + b^3 + c^2 = 2009$ has two solutions in positive integers a, b, and c. Find the largest prime factor of any of the six values of a, b, or c.

A. 2 B. 3 C. 5 D. 7 E. 11

14. The system $\begin{cases} \frac{3}{x} + \frac{2}{y} = 11 \\ x + 4y = 2 \end{cases}$ has two solutions, (a, b) and (c, d). Find $ac + bd$.

A. $\frac{6}{11}$ B. $\frac{7}{11}$ C. $\frac{8}{11}$ D. $\frac{9}{11}$ E. $\frac{10}{11}$

15. In kite ABCD, AB = AD, BC = CD, and E, F, G, and H are the midpoints of sides AB, BC, CD, and AD, respectively. Let P be the point of intersection of the segments EG and FH. If the area of AHPE = 50 and the area of CFPG = 42, find the area of HDGP.

A. 42 B. 44 C. 46 D. 48 E. 50

16. Five distinct nonzero decimal digits sum to 20. If the digits are combined without repetition to form all possible 1-, 2-, and 3-digit numbers, find the sum of the numbers thus formed. Write your answer in the corresponding blank on the answer sheet.

17. Let S = {123, 124, ..., 987} be the set of all three-digit numbers with distinct non-zero digits. For which number N below does S not contain at least two different numbers consisting of the same three digits, both divisible by N?

A. 5 B. 7 C. 11 D. 13 E. 37

18. The sum of the 250 consecutive perfect squares starting with a^2 ($a > 0$) equals the sum of the next 249 consecutive perfect squares. Find a. Write your answer in the corresponding blank on the answer sheet.