1. If 1 BTC is worth \$62,000 and 3 ADA are worth \$1.05, how many ADA are 2 BTC worth (rounded down)?
A. 39,365 B. 78,730 C. 118,095 D. 314, 920 E. 354,285

2. Ali and Brenna play a game. A fair coin is flipped repeatedly until either there is a head followed immediately by a tail in which case Ali wins, or there are two consecutive tails in which case Brenna wins. What is the probability that Brenna wins this game?
A. 1/4 B. 1/3 C. 1/2 D. 2/3 E. 3/4

3. A point (a, b) is a lattice point if both a and b are integers. A lattice point is called **visible** if the line segment from (0, 0) to the point does NOT pass through any other lattice points. Which of the following lattice points is visible?
A. (28, 14) B. (28, 15) C. (28, 16) D. (28, 18) E. (28, 21)

4. How many integers N with $0 \leq N \leq 2024$ can be written as a difference of nonnegative integer powers of 2? (For example, this includes 112 because $112 = 128 - 16 = 2^7 - 2^4$)
A. 44 B. 55 C. 62 D. 72 E. 81

5. By placing three sum (+) or difference (–) operations within the string 123456789, a number of different results can be achieved. For example, 123 + 456 – 78 – 9 = 492, and 12 + 3456 – 7 + 89 = 3550. If $a \pm b \pm c \pm d = 2024$ in such a string, what is the value of c?
A. 4 B. 5 C. 6 D. 7 E. 8

6. How many pairs of positive integers a, b with $a < b$ have 24 as the least common multiple of a and b?
A. 2 B. 4 C. 6 D. 8 E. 10

7. A sequence $\{s_n\}$ is formed where the n^{th} term of the sequence is the n^{th} whole number whose representation in binary contains exactly two 1's. The first two terms in this sequence are $s_1 = 3$ (11 in binary), and $s_2 = 5$ (101 in binary). What is s_{50}?
A. 640 B. 1040 C. 1280 D. 2064 E. 2560

8. Suppose $T(t) = 125e^{-kt} + 75$ gives the temperature in °F of a cup of coffee, t minutes after it is poured. If the lid is off, $k = 0.1$. If the lid is on, $k = 0.02$. Let t_{off} and t_{on} be the time it takes, in minutes, for the coffee to cool to 150°F with the lid off or on, respectively. What is $\frac{t_{\text{on}}}{t_{\text{off}}}$?
A. 0.2 B. 1.2 C. 2 D. 5 E. 10

9. Consider a binary operation * on the integers which is associative, commutative, and distributive over addition (which means that $a*(b + c) = a*b + a*c$). If 3*(4*5) = 10, find 4*(5*6).
A. 5 B. 10 C. 20 D. 30 E. 40

10. Three people (X, Y, Z) are in a room with you. One is a knight (knights always tell the truth), one is a knave (knaves always lie), and the other is a spy (spies may either lie or tell the truth). X says, "Z is a knave." Y says, "X is a knight." Z says, "I am the spy." Which of the following correctly identifies all three people?

A.	B.	C.	D.	E.
X is the knave Y is the knight Z is the spy	X is the spy Y is the knave Z is the knight	X is the spy Y is the knight Z is the knave	X is the knight Y is the spy Z is the knave	Impossible to determine from given information.

11. In ΔABC, AB + AC = 31, AC + BC = 27, and AB + BC = 38. Find the area of ΔABC.
A. 72 B. 76 C. 80 D. 84 E. 90

12. A 3-digit number is to be typed into a system manually (transcribed). If a digit was transcribed incorrectly, then there is a 90% chance that the next digit will also be transcribed incorrectly. Otherwise, there is only a 2% chance that a given digit will be transcribed incorrectly. Let P be the probability that a given 3-digit number has *exactly* one wrong digit. Which of the following is true?
A. $0 \le P < 0.01$ B. $0.01 \le P < 0.02$ C. $0.02 \le P < 0.03$ D. $0.03 \le P < 0.04$ E. $0.05 \le P$

13. The equation $a^4 + b^3 + c^2 = 2024$ has a unique solution in positive integers. Find $a + b + c$ for this solution.
A. 48 B. 49 C. 50 D. 51 E. 52

14. Two lines, $y = mx + b$ and $y = bx - m$ ($m \neq 0$, $b \neq 0$) are perpendicular. Find the x-coordinate of their point of intersection.
A. $\frac{1+m}{1-m}$ B. $\frac{1-m}{1+m}$ C. $\frac{1+m}{m-1}$ D. $\frac{1+m^2}{1-m^2}$ E. $\frac{1-m^2}{1+m^2}$

15. How many of the following statements are true?

I. 0 is an even integer.
II. $x^3 + 27 = 0$ has exactly three distinct solutions in the complex numbers.
III. The union of the set of rational numbers and the set of irrational numbers equals the set of real numbers.
IV. Given two distinct real numbers a and b, we can always find a real number c with $a < c < b$.

A. 0 B. 1 C. 2 D. 3 E. 4

16. In the system of equations $\begin{cases} xy + z = 105 \\ x + yz = 107 \end{cases}$, for how many distinct integer values of y does the system have a solution in the integers?
A. 0 B. 1 C. 2 D. 3 E. 4

17. If $\sqrt{21 - 20i} = a + bi$, find $|a - b|$.
A. 1 B. 2 C. 5 D. 6 E. 7

18. Two of the solutions to the equation $(2x - 5)(x - 2)(x + 1)(x + 2) = 20$ are single digit integers and the other two can be represented in the form $\frac{a \pm \sqrt{b}}{c}$, where a, b, c are integers, $c > 0$, and b is prime. Find $a + b + c$.
A. 40 B. 42 C. 44 D. 46 E. 48

19. If a circle is inscribed in a square, the regions between them are each concave. If a square is inscribed in a circle, the regions between them are each convex. Suppose a circle is inscribed in a square, then a square is inscribed in that circle, then a circle in that square, and so on. What is the ratio of the total area of the concave regions to the total area of the convex regions?
A. $\frac{\pi}{\pi-2}$ B. $\frac{4}{\pi-2}$ C. $\frac{\pi-2}{4-\pi}$ D. $\frac{2}{4-\pi}$ E. $\frac{4-\pi}{\pi-2}$

20. In the diagram below, each variable p through x represents a different integer from 1 to 9. The operations (note that / is used for division) in each row performed from left to right and in each column from top to bottom (not using order of operations) result in the numbers at the end of each row and the bottom of each column. Find the value of $p + t + x$.
A. 13 B. 14 C. 16 D. 17 E. 19

p	+	q	+	r	17
+		−		+	
s	+	t	/	u	12
×		×		×	
v	−	w	×	x	30
77		2		60	