1. In a certain video game, 5 silver coins are worth the same as 2 gold coins, 1 silver coin is worth the same as 9 copper coins, and 2 diamonds are worth the same as 11 gold coins. Player 1 bids 3 diamonds for a cloak that is being sold at auction. Player 2 also wants to buy the cloak and only has copper coins. What is the minimum number of copper coins that Player 2 must bid in order to outbid Player 1?

A. 12 B. 41 C. 42 D. 371 E. 372

2. How many positive integers from 1 to 1,000,000 inclusive have **exactly** one digit that is a 7?

A. 294,354 B. 354,294 C. 468,559 D. 559,468 E. 700,000

3. Suppose $x > 1$ and the side lengths of a triangle are $x, \frac{x^2-1}{2}, \frac{x^2+1}{2}$. Determine the radius of the largest circle which can be inscribed in the triangle, in terms of x.

A. $\frac{x}{2}$ B. $\frac{x\sqrt{2}}{2}$ C. $\frac{1}{2}\sqrt{x^2-1}$ D. $\frac{1}{2}(x-1)$ E. $\frac{1}{2}\sqrt[4]{x^4-1}$

4. Suppose b and c are real numbers. Determine the number of sequences $1, b, c$ which are both arithmetic and geometric.

A. 0 B. 1 C. 2 D. 4 E. Infinitely many

5. The graph of the function $f(x) = \frac{2x^2+bx-9}{x-3}$ is a line with slope 2 except for a removable discontinuity (hole) at $x = 3$. The graph of the function $g(x) = ax^2 + 4x + 3$ has its vertex at $x = 2$. Find $a + b$.

A. -4 B. -2 C. 0 D. 2 E. 4

6. Line 1 has a y-intercept of $(0, a)$ and its equation is $3x + 4y = 12$. Line 2 has equation $y = mx + b$, where $b > a$. The two lines are parallel and the perpendicular distance between the two lines is 2. Find $m + b$.

A. 17/4 B. 18/4 C. 19/4 D. 5 E. 21/4

7. One 4-digit perfect square and two distinct 3-digit perfect squares are converted into the words WERE, ARE, and ERA by replacing identical digits with identical letters and different digits with different letters. Find the digit that corresponds to W.

A. 2 B. 3 C. 5 D. 6 E. 7

8. The two nonreal solutions to the equation $x^5 - x^3 + 64x^2 - 64 = 0$ can be expressed in the form $a \pm bi\sqrt{c}$, where a, b, and c are positive integers and c is prime. Find $a + b + c$.

A. 7 B. 9 C. 11 D. 15 E. 53

9. The expression $\frac{\tan t - \sin t \cos t}{\tan t}$ is equivalent to which of the following everywhere that it is defined?

A. 1 B. $\cos t$ C. $\sin t$ E $\cos^2 t$ E. $\sin^2 t$

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 knight.", Y says "I am the spy.", and Z says "Y is the knave." Which of the following correctly identifies all three people?

A.	B.	C.	D.	E.
X is the knave	X is the knight	X is the spy	X is the knight	X is the spy
Y is the knight	Y is the knave	Y is the knight	Y is the spy	Y is the knave
Z is the spy	Z is the spy	Z is the knave	Z is the knave	Z is the knight

11. The equation $a^3 + b^2 + c^2 = 2023$ has three distinct solutions of the form (a, b, c) where a, b, and c are positive integers and $b < c$. Only one integer appears in more than one solution. Which integer is it?

A. 1 B. 4 C. 5 D. 7 E. 11

12. A person rolls a fair six-sided die four times. What is the probability that the largest of the four rolls (possibly achieved more than once) is 5?

A. 41/144 B. 625/1296 C. 671/1296 D. 927/1296 E. 125/144

13. Suppose 20 puzzle pieces are lying on a table. Fifteen are face down, and the other five are face up. If someone randomly selects 5 different pieces (regardless of their current orientation) and flips each of them over simultaneously, what is the probability that at least 8 of the pieces will be face-up?

A. 411/1292 B. 4823/15504 C. 819/1292 D. 9828/15504 E. 7189/7752

14. Determine the sum of all positive integers b for which the sum of all distinct real solutions to $(x^2 + 10x + b)^{x^2+6x+2} = 1$ is -26.

A. 0 B. 1 C. 38 D. 40 E. 351

15. Suppose a positive integer N has exactly 2023 positive integer divisors. What is the largest integer value that $\log_{10}(N)$ **must** be greater than?

A. 14 B. 16 C. 18 D. 20 E. 22

16. A standard stop sign is constructed as follows: eight equally-spaced points are chosen on a circle of diameter 32 inches, and adjacent points are connected to form a regular octagon (an eight-sided figure with eight equal sides and eight equal angles). Find the area in square inches of a standard stop sign.

A. $512\sqrt{2}$ B. $1024(2 - \sqrt{2})$ C. $1024\sqrt{2}$ D. $512\sqrt{3}$ E. $512(3 - \sqrt{3})$

17. At the beginning of each year for ten years, a deposit of N dollars is made in a financial account that earns interest at an annual rate of 6% compounded annually. To the nearest dollar, what is the smallest value of N that would result in a balance of at least $1,000,000 at the end of the tenth year?

A. $55, 839 B. $60,000 C. $66,667 D. $71,574 E. $94,340

18. Suppose circles C_1 and C_2 share center C but have radius r_1 and radius r_2, respectively, with $r_1 < r_2$. If the tangent to C_1 at a point P crosses C_2 at the point Q, and the line containing segment QC also crosses C_2 at the point R, determine the ratio of the area of triangle PQR to the area of triangle PCQ.

A. $1/\sqrt{2}$ B. $\sqrt{2}$ C. $\sqrt{3}$ D. 2 E. $2\sqrt{2}$

19. How many of the following four statements are true?

I. For all irrational numbers k, k^2 is an irrational number.
II. For all real numbers r, r^2 is positive.
III. For all complex numbers z, z^2 is a real number.
IV. For all real numbers r, $r^2 > r$.

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

20. Triangles ACD and BCD are inscribed in a semicircle with diameter CD. If the measures of AD, BD, and CD are 14, 40, and 50 (respectively) and the measure of AB is greater than 25, find the area of their union.

A. 625 B. 637.5 C. 652.5 D. 673.5 E. 675