Name: ______________________ **Score:** ________/________/50 **Grade:** ______

The accuracy round is 40 minutes long. Questions are weighted by difficulty.

1. ______________

2. ______________

3. ______________

4. ______________

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6. ______________

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8. ______________

9. ______________

10. ______________

11. ______________

Special Thanks to:

1. Let $X = 2022 + 022 + 22 + 2$. When X is divided by 22, there is a remainder of R. What is the value of R?

2. When Amy makes paper airplanes, her airplanes fly 75% of the time. If her airplane flies, there is a $\frac{5}{6}$ chance that it won't fly straight. Given that she makes 80 airplanes, what is the expected number airplanes that will fly straight?

3. It takes Joshua working alone 24 minutes to build a birdhouse, and his son working alone takes 16 minutes to build one. The effective rate at which they work together is the sum of their individual working rates. How long in seconds will it take them to make one birdhouse together?

4. If Katherine's school is located exactly 5 miles southwest of her house, and her soccer tournament is located exactly 12 miles northwest of her house, how long, in hours, will it take Katherine to bike to her tournament right after school given she bikes at 0.5 miles per hour? Assume she takes the shortest path possible.

5. What is the largest possible integer value of n such that $\frac{4n+2022}{n+1}$ is an integer?

6. A caterpillar wants to go from the park situated at $(8, 5)$ back home, located at $(4, 10)$. He wants to avoid routes through $(6, 7)$ and $(7, 10)$. How many possible routes are there if the caterpillar can move in the north and west directions, one unit at a time?

7. Let $\triangle ABC$ be a triangle with $AB = 2\sqrt{13}, BC = 6\sqrt{2}$. Construct square $BCDE$ such that $\triangle ABC$ is not contained in square $BCDE$. Given that $ACDB$ is a trapezoid with parallel bases $\overline{AC}, \overline{BD}$, find AC.

8. How many integers a with $1 \leq a \leq 1000$ satisfy $2^a \equiv 1 \pmod{25}$ and $3^a \equiv 1 \pmod{29}$?

9. Let $\triangle ABC$ be a right triangle with right angle at B and $AB < BC$. Construct rectangle $ADEC$ such that $\overline{AC}, \overline{DE}$ are opposite sides of the rectangle, and B lies on $\overline{DE}$. Let $\overline{DC}$ intersect $\overline{AB}$ at M and let $\overline{AE}$ intersect $\overline{BC}$ at N. Given $CN = 6, BN = 4$, find the $m + n$ if MN^2 can be expressed as $\dfrac{m}{n}$ for relatively prime positive integers m, n.

10. An elimination-style rock-paper-scissors tournament occurs with 16 players. The 16 players are all ranked from 1 to 16 based on their rock-paper-scissor abilities where 1 is the best and 16 is the worst. When a higher ranked player and a lower ranked player play a round, the higher ranked player always beats the lower ranked player and moves on to the next round of the tournament. If the initial order of players are arranged randomly, and the expected value of the rank of the 2nd place player of the tournament can be expressed as $\frac{m}{n}$ for relatively prime positive integers m, n what is the value of $m+n$?

11. **Estimation (Tiebreaker):** Estimate the number of twin primes (pairs of primes that differ by 2) where both primes in the pair are less than 220022.