

MBMT Algebra Round – Brahmagupta

April 16, 2023

Full Name _____

Student ID Number _____

**DO NOT BEGIN UNTIL YOU ARE
INSTRUCTED TO DO SO.**

This round consists of **8** questions. You will have **30** minutes to complete the round. Each question is *not* worth the same number of points. Questions answered correctly by fewer competitors will be weighted more heavily. Please write your answers in a reasonably simplified form.

- _____ 1 Carlos is piloting his drone. Each move, his drone can either move up 4 feet, or move down 2 feet. What is the least number of moves in which Carlos can move his drone up exactly 10 feet from its starting position?
- _____ 2 You are playing Guess the Number with Mr. Schwartz. You start with 10 and that is not his number. You then add 5, multiply by n , divide by 5, and get 9, which is Mr. Schwartz's number. What is n ?
- _____ 3 Chris and David are comparing their levels from a game, which are integers greater than 2. They find that 21 more than the sum of their levels is equal to the product of their levels. If Chris's level is odd, compute David's level.
- _____ 4 Let f be a linear function ($f(x) = ax + b$ for some a and b). If $f(z) = 8$, $f(f(z)) = 20$, and $f(f(f(z))) = 44$, what is the value of z ?
- _____ 5 Initially, on a whiteboard, the numbers 2023 and 1 are written side by side. 2023 is written to the left. During each of the next 100 days, Aiden will erase the smaller number on the whiteboard and replace it with twice the original number. By the end of 100 days, how many times will he have erased a number from the left spot?
- _____ 6 In an arithmetic sequence a_n , the terms a_1 , a_2 , and a_5 form a geometric sequence. Given that $a_1 = 2$, what is the largest possible value of a_{10} ? (An arithmetic sequence is a list of numbers where the difference between consecutive terms is constant. A geometric sequence is a list of numbers where the ratio between consecutive terms is constant.)
- _____ 7 Find the sum of the squares of the roots to the equation $2x^3 + 4x^2 + x + 3 = 0$.
- _____ 8 For real a and b , let $f(x) = (2a - x)(x + 3)$. $f(x)$ has a maximum value of $2b$. Furthermore, let $g(x) = bx^2 + 8x - 6$, where $g(x)$ has a vertex with y -coordinate $-b$. Find the maximum value of $a^2 \cdot b$.