

2009 Mu Individual Ciphering Questions

0. Find the number of permutations of the word Alabama.

1. If  $\frac{dy}{dx} = 3x^2 - \sqrt{x+1} + 2$  and  $f(3) = -2$ , find  $f(x)$ .

2. If the roots of the polynomial  $ax^3 + bx^2 + cx + d = 0$  are  $-2, 1 \pm \sqrt{5}$ , find the sum of  $a + b + c + d$ .

3. Find:  $\lim_{t \rightarrow 0} \frac{4t^2 + 3t \sin t}{t^2}$ .

4. Find all ordered pairs  $(x, y)$  of real numbers for which  $x^2 + xy + x = 14$  and  $y^2 + xy + y = 28$ .

5. A sequence  $a_n$  is defined as follows:  $a_1 = 2, a_n = 3a_{n-1} + 2$  for  $n > 1$ . Find the term  $a_{2009}$ .

6. Evaluate:  $\int_1^4 \frac{x+16}{x^2+2x-8} dx$

7. Find the number of lattice points defined by the region  $|x| + |y| < 4$ . (A lattice point in a rectangular coordinate plane is a point both whose coordinates are integers.)

8. If the domain for  $x$  is complex numbers, find the solution set of  $9x^4 + 20x^2 + 16 = 0$ . Express each element of the solution set in the form  $a + bi$ , where  $a$  and  $b$  are real numbers.

9. In a simple code, each letter of the alphabet is assigned its numerical position in the alphabet. A one word message was received in this code, but was lost. All that the operator remembered was that the message had the form of  $x, x + 7, x + 6, x + 5$ , that the second letter was a vowel, and that the word was an English word. What was the one word message?

10. Find the equation of the tangent line to the graph  $2x^3 - x^2y + y^3 - 1 = 0$  at point  $(\frac{1}{2}, 1)$ .