CIS 3362 Quiz #4: Number Theory

Date: 10/22/2025

Name: _____

1) (6 pts) Determine the Prime Factorization of 1,843,956,000.

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2) (8 pts) Determine φ(1,843,956,000) **and give your answer in prime factorized form.**

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3) (6 pts) Determine the remainder when 47^{12208} is divided by 719. Note that 719 is prime. **For full credit use Fermat's Theorem.**

4) (6 pts) Determine the remainder when 48^{355743} is divided by 65219. **For full credit use Euler's Theorem.**

5) (15 pts) We spend a good deal of class time on the discrete log problem. In particular, we covered an algorithm that utilizes O($\sqrt{p}$) time and memory to solve the problem, which if faster than the typical O(p) brute force solution. Utilize this technique to determine the value of x which satisfies the following equation:

$$2^x \equiv 6 \ (mod\ 101)$$

Specifically, please use increments of 11 for your stored memory. (So work out 2^{11}, 2^{22}, 2^{33}, ..., 2^{110} mod 101) and store these in the table provided below. Then, below that, show your incremental work until you get to the answer.

Exponent	2^{exp} mod 101

x = _____

6) (8 pts) Use the Pollard-Rho Factoring Algorithm to determine the prime factorization of 13231. In the algorithm, at each iteration, values of a and b are determined, and then a gcd is computed. The first row of the table has been filled out for you. Please fill in each other row of the table. In order to help you, it is given that the algorithm succeeds on iteration #7. Use the space below the table for your scratch work and put the final prime factorization (2 primes) in the provided slots below.

Iteration	a	b	relevant gcd
1	5	26	1
2			1
3			1
4			1
5			1
6			1
7			

13231 = _____ x _____

7) (1 pts) What type of tea can be purchased at Dang Boba and Musubi House?

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