** Mathematics Assignment 1**

**Investigating Mersenne Numbers**

**Date:** Due

**Overview:**

Numbers of the form 2n – 1, where *n* is a whole number exponent greater than 1, are called **Mersenne numbers** after Father Marin Mersenne, a French monk who wanted to find a formula that would represent all prime numbers.

**Preparation Work and Tasks:**

1. Complete the table. Identify the Mersenne primes. Explain how you know the other numbers are composite. **(/3)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***n*** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 2n – 1 |  |  |  |  |  |  |  |  |  |  |

1. Circle the prime numbers in your table. What do you notice about the exponent for each Mersenne number that is prime? **(/2)**
2. Why might you expect that the Mersenne number 211 – 1 will be prime? Show that 211 – 1 is composite. (Hint: Try dividing by prime numbers between 20 and 30). **(/2)**
3. Calculate the prime factorization of the Mersenne numbers 212 – 1, 214 – 1, and 215 – 1 to show that each is a composite number. **(/3)**
4. Calculate 3n – 1 for *n* equals 2 to 10. Explain how you know that the numbers are composite. **(/3)**
5. Will 3n – 1 ever be a prime number for any whole number value of *n* greater than 1? Explain your reasoning. **(/2)**
6. In 2001, Canadian student Michael Cameron discovered the Mersenne prime number 213 466 917 – 1. It contains 4 053 946 digits and begins with the digits 92. Show how to use the scientific notation to express an approximation of this prime number. **(/2)**
7. In May 2004, the Mersenne prime number 224 036 583 – 1 was discovered. It can be expressed as about 2.99 × 107 235 732. How many digits are in the standard form of this number? Explain your reasoning. **(/2)**
8. Determine the time in seconds it takes you to enter a 10-digit number into a calculator. Estimate the number of days it would take you to enter the number in Part H into a computer or calculator. **(/2)**
9. Calculate the square root of the first 10 powers of 2. How can you tell by examining the exponent that the square root of a power of 2 is a whole number? **(/2)**
10. Explain how you know that the square root of a Mersenne prime is not a whole number. **(/2)**

**Evaluation:**

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| **Category** | **Level 4** | **Level 3** | **Level 2** | **Level 1** | **%** |
| Depth of Understanding | Demonstrates thorough understanding of concepts. | Demonstrates considerable understanding of concepts. |  |  | 20 |
| Problem Solving / Thinking | Use of procedure includes almost no errors or omissions. | Use of procedures is mostly correct, but there may be a few minor errors and / or omissions. |  |  | 20 |
| Application of Learning | Demonstrates sophisticated ability to make connections between mathematics learning and the real world. | Demonstrates considerable ability to make connections between mathematics learning and the real world. |  |  | 20 |
| Explanation and Justification of Concepts, Procedures, and Problem Solving | Provides thorough, clear and insightful explanations / justifications, using a range of words, pictures, symbols, and / or numbers. | Provides complete, clear and logical explanations / justifications, using appropriate words, pictures, symbols, and / or numbers. |  |  | 20 |
| Use of Mathematical Vocabulary | Uses a broad range of mathematical vocabulary to communicate clearly and precisely. | Uses mathematical vocabulary with considerable clarity and precision. |  |  | 20 |