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Analyses and Formulas for the Set of Composite Numbers and the Set of Prime Numbers

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Abstract: Composite numbers and prime numbers were studied. They are said to be in infinite sets. 0 and 1 are neither prime nor composite; other natural numbers are either prime numbers or composite numbers. A conclusion was first made by observation then, analysis. Then, the author had created two formulas: one for the set of composite numbers and another for the set of prime numbers. This is also a proof that there are infinitely many prime numbers.

Keywords: Arithmetic progression, Composite Number, Natural Number, Prime Number, Set, Union

Introduction

A set is defined as a finite or infinite collection of objects. (Stover & Weisstein 1999) Euclid's second theorem demonstrated that there are an infinite number of primes. (Weisstein 1999) Composite numbers and Prime numbers belong to infinite sets. By observation and no need for reiteration, even numbers except for 2, numbers ending in 5 or 0 aside from the numbers 0 and 5, ... are composite numbers. Other rules for determining composite numbers may be formed. Prime numbers can be generated by sieving processes such as the sieve of Eratosthenes (Horsley 1772), the sieve of Atkin (Atkin 2004), and the sieve of Sundaram (Ramaswami Aiyar 1934). Another form is the wheel factorization (Pritchard 1981, 1982, 1983 and 1987).

The largest known prime as of January 2013 is the Mersenne prime $2^{57\,885\,161}-1$, which has a whopping $17\,425\,170$ decimal digits. (Weisstein 1999)

OBJECTIVES

1. To create a formula for the set of composite numbers.
2. To create a formula for the set of prime numbers.

Methodology

Composite Numbers

Observing composite numbers, the author arrived to a conclusion. Positive integers other than 1 which are not prime are called composite numbers. (Weisstein 1999).
The set of composite numbers is an infinite set which is the union of all positive integer arithmetic progressions that differ by the root number and all the root numbers are removed but the exception of the positive integer arithmetic progression that differ by the root number one.
Note: Root number is the initial number.

Set A_1 = 2, 3, 4, 5, ...
Set A_2 = 4, 6, 8, 10, ...
Set A_3 = 6, 9, 12, 15, ...
Set A_4= 8, 12, 16, 20, ...
.
.
.

In mathematics, an arithmetic progression (AP) or arithmetic sequence is a sequence of numbers such that the difference of any two successive members of the sequence is a constant." (Weisstein 1999) In set theory, the union (denoted as ∪) of a collection of sets is the set of all distinct elements in the collection. (Weisstein 1999)

(1) Set of composite numbers = $A_2 U A_3 U A_4 U$...

Prime Numbers

A prime number (or a prime) is a natural number greater than 1 that has no positive divisors other than 1 and itself. (Weisstein 1999). Observing prime numbers, the author arrived to a conclusion. The set of prime numbers is an infinite set which is the positive integer arithmetic progression that differs by the root number one but the root number is removed and without the set of composite numbers.

(2) Set of Prime number = $A_1 \backslash (A_2 U A_3 U A_4 U \ldots)$

Results

The formulas were infinite ones. The formula for the set of composite numbers will show all composite numbers. The formula for the set of prime numbers will show all prime numbers.

Discussion

Computer algorithms may be derived using the formulas. The greatest prime number may be derived using the formula for the set of prime numbers. These formulas may help to check the validities of other formulas for the set of prime numbers and the set of composite numbers.

Conclusion

The formula for the set of composite numbers is correct in showing all the composite numbers. Euclid's proof that there are infinitely many prime numbers is considered a particularly nice proof. The formula for the set of prime numbers is correct in showing all the prime numbers. This is also a proof that there are infinitely many prime numbers.

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