

Weekly Challenge #13: Unlucky for Some

Welcome to the Count on Us Secondary Challenge's thirteenth and final weekly challenge. Some numbers are considered special for different reasons. Many hotels have rooms numbered 12 and 14 with nothing in between! Do you have a 'lucky' number? Well, mathematicians consider some numbers more or less interesting than others for various reasons. This challenge will use ideas from a wonderful book called *The Penguin Dictionary of Curious and Interesting Numbers* by David Wells.

1. What is $1^4 + 6^4 + 3^4 + 4^4$?
2. What is $12^2 + 33^2$?
3. What is $4^3 + 0^3 + 7^3$?
4. Invent one more example of this, the powers must be the same, but can be any power.
5. Find the factors of a number (not including itself) and add them up. If the answer is the number itself, then that number is called a *perfect number*. Find the two smallest perfect numbers and show that they are.
6. Mathematicians have been particularly interested in prime numbers. (They have exactly two different factors). Explain why 1 and 9 are NOT prime numbers.
7. (i) What is the only even prime?
(ii) What is the first product of two odd primes?
8. A French Friar called Marin Mersenne found that lots of prime numbers can be found by taking one away from powers of 2. So, $2^1 - 1 = 3$, (*NOT prime*) $2^2 - 1 = 3$, (*prime*) How many of these (called Mersenne numbers) are needed to find 4 prime numbers?
9. Triangle numbers are the sum of whole numbers starting from 1 so, 1 , $1 + 2 = 3$, $1 + 2 + 3 = 6$, ... What is the smallest number which is both a triangle and a square number?
10. What is the sum of the first 100 whole numbers?
11. A palindrome reads the same backwards as forwards (e.g. 16361). What is the smallest palindromic square?
12. What is the smallest palindromic prime of more than two digits?
13. Remember the smallest number expressible as the sum of two cubes in two different ways?
(i) So, what is the smallest number expressible as the sum of two squares in two different ways?
(ii) What is the next smallest?

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