1 Patterns with Exponents

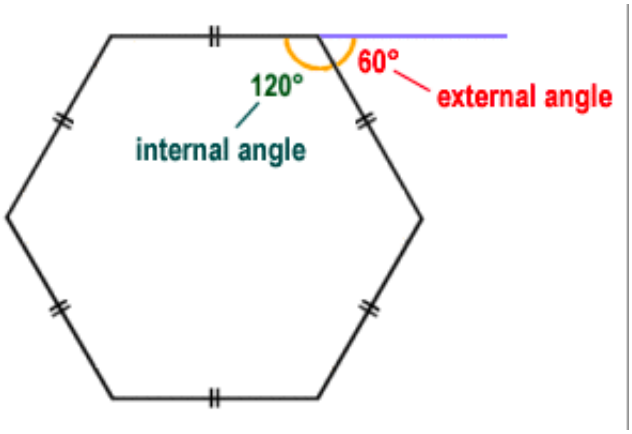
A base is a number that you multiply. An exponent tells us how many times to multiply by that number. For example, in 2^3, 2 is the base and 3 is the exponent, and it means 2*2*2, since we multiply three 2's together. When we say "2 to the power of 3," we mean 2^3.

1. What is the last digit in 9^{123}? (This means $9 \times 9 \times \ldots 9 \times 9$ where there are 123 9's.) *9*
2. What is the last digit in 5^{11}? *5*
3. What is the last digit in 7^{2013}? *7*
4. What is the **second to last** digit in 6^{17}? *3*
5. What is the **last two** digits in 7^{999}? *43*
6. Find the sum of
   a) the first 10 multiples of 2 *110*
   b) the first 10 multiples of 3 *165*
   c) the first 10 multiples of 5 *275*
7. **Bonus:** What is the last two digits in 41^{2789}?

2 Other Questions

1. Find the sum of the numbers from 1 to 19. Hint: Don't actually add them all...
2. Now, find the sum of the numbers from 1 to 99.
3. For each set of pictures, what number will you write in the place of X to continue the pattern?

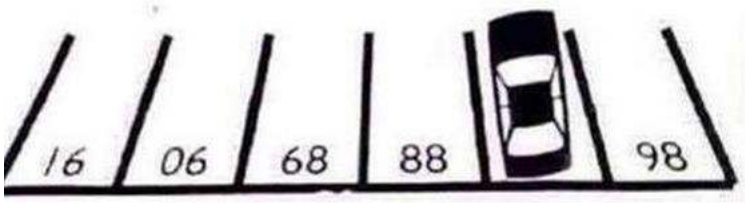
4. As the below picture shows, polygons have both internal and external angles. In a regular polygon, all the sides have the same length and all the angles have the same measure; for example, a triangle would have external angles of 120 degrees, a square 90 degrees, and a pentagon 72 degrees. With this in mind, take a look at the following pattern, which contains the external angles of various polygons: 120, 90, 72, 60, x, 45, 40, 36, y, 30, z, ... What are the values of x, y, and z? (Hint: Fractions might be easier to work with here!) *Respectively, 360/7, 360/11, 360/13*



5. What are the next six numbers in this pattern? *0, 4, 2, 3, 4, 4, 6, 3, 8, 5, 10, 3, 12, 6, 14, 8, ... The next 6 numbers are 16, 7, 18, 8, 20, 6. (even number followed by number of letters in even number)*

6. What is the sum of all the odd numbers from 37 to 135, inclusive? ("Inclusive" means that you count 37 and 135 as well.) *4300*

7. What is the number under the car?



3 References

Berkeley Math Circle