Magnetic Numbers

A Magician's Trick

Sometimes mathematicians discover numbers with special properties. Here's a procedure leading to a number that seems to have magnetic properties.

1. Choose any positive three-digit number whose first and third digits are not equal.
2. Make a second number by reversing the digits of the three-digit number.
3. Find the difference between the larger and smaller of the two numbers.
4. Reverse the digits of the difference.
5. Add the difference and the number made by reversing the digits.

Here's an example that follows the procedure:

1. Choose 369.
2. Reverse the digits to get the second number, 963.
3. The difference between the two numbers is 963 – 369 = 594.
4. Reverse the digits to get the next number, 495.
5. Add the difference, 594, and the next number, 495, to get 1089.

What does this have to do with magnetic properties? Makeup a few examples of your own. If you don't make any mistakes, the result will *always* be 1089. No matter what number you choose in step 1, the sum you get in step 5 is always 1089. Calling 1089 a *magnetic number* does seem like a good choice of names.

The procedure leading to 1089 has been used as a magician's trick. If you only do it one time and pretend to be deep in thought while reading the mind of someone doing the arithmetic, you can fool most audiences. The proof that this procedure always produces 1089 is an exercise for second-year algebra students.

The Kaprekar Procedure

Now let's consider a different procedure. The following procedure is a little more involved because it requires repeating most of the steps several times. Can you discover the magnetic number for this procedure?

1. Choose any four-digit number whose digits are not all equal, and name it the *key number*.
2. Make another four-digit number by arranging the four digits of the key number in descending order.
3. Make another four-digit number by arranging the four digits of the key number in ascending order.
4. Make a new four-digit number by subtracting the number made in step 3 from the number made in step 2. This new four-digit number then becomes the new key number.
5. Repeat steps 2 through 5.