

The Kaprekar Constant for 3-Digit numbers

The 3-digit **Kaprekar** number (constant) is an amazing number. It is also a very useful tool/exercise for younger students to review:

- the ordering of digits from largest to smallest (descending order),
- and vice versa (ascending order).
- and as additional classwork/homework practice in the operation of subtraction.

Here are the steps to find the **3-digit Kaprekar constant**:

- Pick any 3-digit number, except one that has all the same three digits (ex. 222)
- Arrange the three digits in descending order (from largest to smallest)
- Below that 'new' number, rearrange the digits in ascending order (from smallest to largest). *Steps #2 and #3 give students practice with ordering digits.*
- Subtract the smaller number from the larger number.
- Take the answer (the difference) and repeat steps #2, #3, and #4.
- Repeat these steps until you cannot go any further. (You'll know!)
- Once you have arrived at the **Kaprekar** constant, count how many steps it took.

Example:

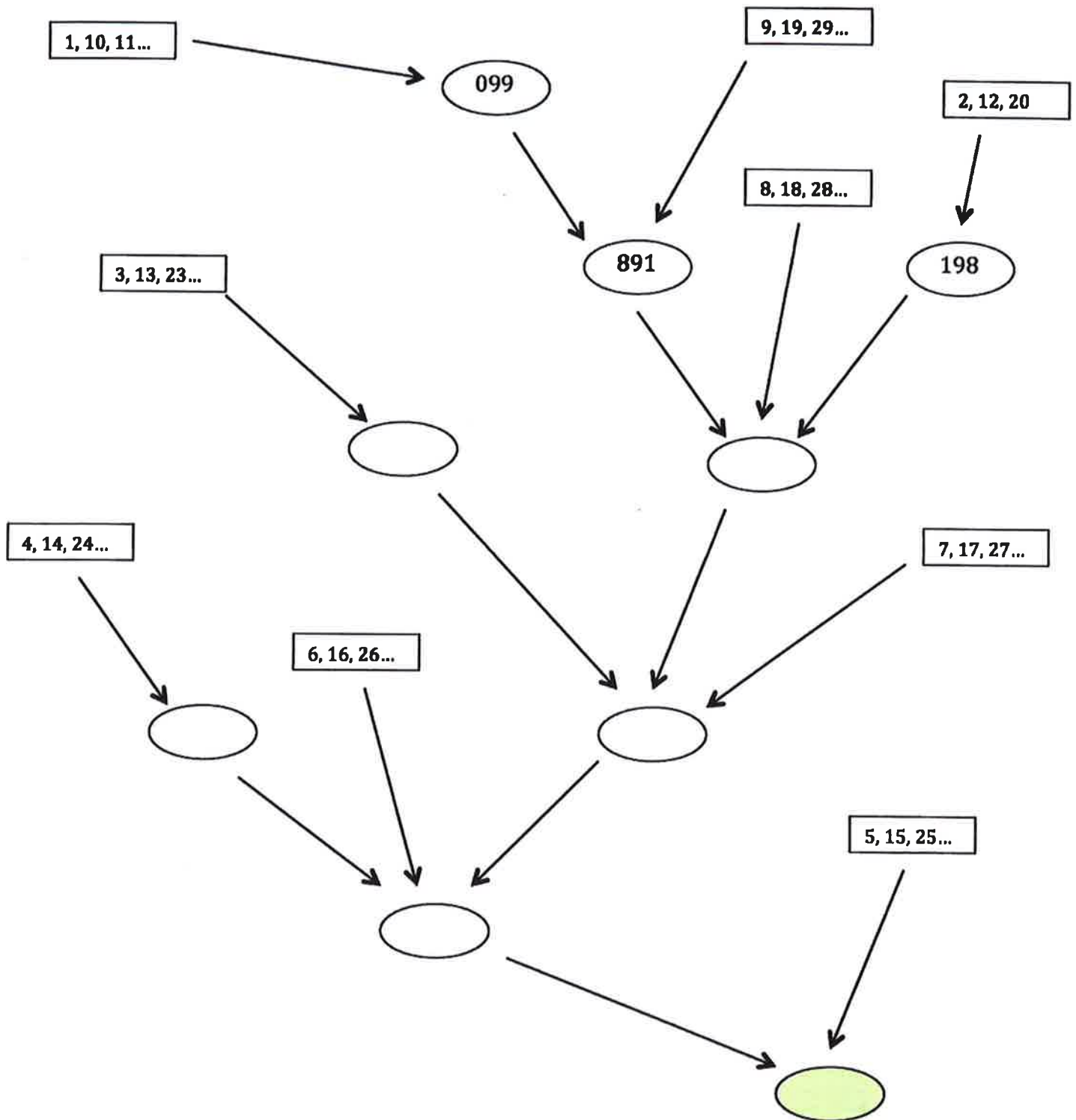
$$\begin{array}{r} 792 \quad \gg \gg \quad 972 \\ \quad \quad \quad - 279 \\ \hline \quad \quad \quad 693 \quad \gg \gg \quad 963 \\ \quad \quad \quad \quad \quad - 369 \\ \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad \quad 594 \quad \gg \gg \quad 954 \\ \quad \quad \quad \quad \quad \quad \quad - 459 \\ \quad \quad \quad \quad \quad \quad \quad \hline \quad \quad \quad \quad \quad \quad \quad 495 \quad \gg \gg \quad ??? \end{array}$$

Questions:

- How many steps did it take to arrive at the **Kaprekar** constant? _____
- Can you find numbers that take:

- | | |
|----------------------|--|
| a) 1 step | Number (s) _____ |
| b) 2 steps | Number (s) _____ |
| c) 3 steps | Number (s) _____ |
| d) 4 steps | Number (s) _____ |
| e) 5 steps | Number (s) _____ |
| f) 6 steps | Number (s) _____ |
| g) More the 6 steps? | Number: <i>There are no numbers that take more than 6 steps!</i> |

Pathways to the Kaprekar constant (for Three Digits)



Note: Two-digit numbers do not have a **Kaprekar** constant. For any starting 2-digit number with differing digits, the pattern enters this loop (45, 9, 81, 63, 27, 45...).

What is the **Kaprekar** constant for 4-digit numbers? _____

Pathways to the Kaprekar constant (for Three Digits) (Answer Key)

