

## BACCALAURÉAT Session 2018 Académie de Caen DNL Mathématiques/Anglais

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### Cyclic numbers

*Would you like to see a neat number trick? Take the number 142857 and multiply it by any number from 1 to 6. The result always has the same digits in the same order, if we say the first digit comes after the last. More generally, a cyclic number is positive integer in which cyclic permutations of the digits are successive multiples of the number.*

### Tasks

1. Explain to the jury what a cyclic number is.
2. Explain whether 076923 is a cyclic number or not.

### Magic number 142857

Watch the video extract from the website "<http://www.numberphile.com>".

3. Perform this trick for the jury, asking them for a number  $n$  that is not a multiple of 7.
4. Explain what happens if  $n$  is a multiple of 7.
5. **Proof** - *In the following,  $n$  is a whole number less than  $10^6$ .*

- a. If  $n$  is a multiple of 7, say  $n=7 \times q$ , verify the following equality:

$$142857 \times 7q = 10^6 \times (q-1) + 10^6 - q$$

What if  $q=1$  or 2?

Explain to the jury why this trick won't work for a multiple of 7.

- b. Writing  $n=7 \times q+r$  (where  $r$  is in the range 1 to 6), explain why the trick works if  $n$  is not a multiple of 7.