

N-CN Complex number patterns

Task

For this task, the letter i denotes the imaginary unit, that is, $i = \sqrt{-1}$.

- For each integer k from 0 to 8, write i^k in the form $a + bi$.
- Describe the pattern you observe, and algebraically prove your observation. In particular, simplify i^{195} .
- Write each of the following expression in the form $a + bi$:
 - $i^2 + i + 1$
 - $i^3 + i^2 + i + 1$
 - $i^4 + i^3 + i^2 + i + 1$
 - $i^5 + i^4 + i^3 + i^2 + i + 1$
 - $i^6 + i^5 + i^4 + i^3 + i^2 + i + 1$
 - $i^7 + i^6 + i^5 + i^4 + i^3 + i^2 + i + 1$
 - $i^8 + i^7 + i^6 + i^5 + i^4 + i^3 + i^2 + i + 1$
- Describe the pattern you observe, and algebraically prove your observation. In particular, compute

$$i^{195} + i^{194} + \dots + i^2 + i + 1.$$



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