Flanders Math Olympiad 2001

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1 may be challenge for beginner section, but anyone is able to solve it if you really try.

show that for every natural $n > 1$ we have: $(n-1)^2 |\ n^{n-1} - 1$

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2 Consider a triangle and 2 lines that each go through a corner and intersects the opposing segment, such that the areas are as on the attachment. Find the "?"
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`gif`

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3 In a circle we enscribe a regular 2001-gon and inside it a regular 667-gon with shared vertices.

Prove that the surface in the 2001-gon but not in the 667-gon is of the form $k.sin^3\left(\frac{\pi}{2001}\right).cos^3\left(\frac{\pi}{2001}\right)$ with k a positive integer. Find k.

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4 A student concentrates on solving quadratic equations in $\mathbb{R}$. He starts with a first quadratic equation $x^2 + ax + b = 0$ where a and b are both different from 0. If this first equation has solutions p and q with $p \leq q$, he forms a second quadratic equation $x^2 + px + q = 0$. If this second equation has solutions, he forms a third quadratic equation in an identical way. He continues this process as long as possible. Prove that he will not obtain more than five equations.
