Flanders Math Olympiad 2015

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by gnej

1 The sides and vertices of a pentagon are labelled with the numbers 1 through 10 so that the sum of the numbers on every side is the same. What is the smallest possible value of this sum?

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2 Consider two points Y and X in a plane and a variable point P which is not on XY. Let the parallel line to YP through X intersect the internal angle bisector of $\angle XYP$ in A, and let the parallel line to XP through Y intersect the internal angle bisector of $\angle YXP$ in B. Let AB intersect XP and YP in S and T respectively. Show that the product $|XS| * |YT|$ does not depend on the position of P.

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3 A group of people is divided over two busses in such a way that there are as many seats in total as people. The chance that two friends are seated on the same bus is $\frac{1}{2}$.
a) Show that the number of people in the group is a square.
b) Show that the number of seats on each bus is a triangular number.

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4 Show that for $n \geq 5$, the integers $1, 2, \ldots n$ can be split into two groups so that the sum of the integers in one group equals the product of the integers in the other group.
