

Time limit: 15 minutes.

Instructions: This tiebreaker contains 3 short answer questions. All answers must be expressed in simplest form unless specified otherwise. You will submit answers to the problem as you solve them, and may solve problems in any order. You will not be informed whether your answer is correct until the end of the tiebreaker. You may submit multiple times for any of the problems, but **only the last submission for a given problem will be graded**. The participant who correctly answers the most problems wins the tiebreaker, with ties broken by the time of the last correct submission.

No calculators.

1. How many possible values of n are there from 1 to 50 such that $xy - 4x - 6y = n$ has 8 ordered pair integer solutions (x, y) ?
2. Gordon and Joey each have two fair 8-sided dice where each side is labeled with a positive integer. Gordon's two dice are each labeled with the numbers from 1 to 8 exactly once. One of Joey's dice has a side labeled with the number 10 while the other 15 sides have labels in the positive integers. Gordon and Joey each roll both of their dice and take the sum of two numbers on the top face of each dice. For any number n , the probability that the sum of Gordon's numbers equaling n is the same as the probability that the sum of Joey's numbers equaling n . What is the product of the numbers on Joey's dice that does not have a 10 on one of its sides?
3. Let k_1, k_2, k_3, k_4 be arbitrary circles, such that k_1 is externally tangent to k_2 and k_4 at points A and D , and k_3 is externally tangent to k_2 and k_4 at points B and C . $\angle BCD = 60^\circ$. Find the measure of $\angle BAD$ (in degrees).