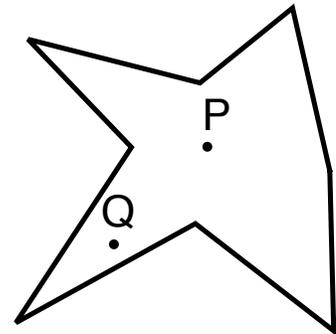


WISCONSIN MATHEMATICS, SCIENCE & ENGINEERING TALENT SEARCH

PROBLEM SET 2 (2016-2017)

November 2016

1. We have a list of positive integers that add up to 1000. What is the largest possible value of the product of these numbers?
2. Is it possible to cut a cube into 2016 (not necessarily identical) smaller cubes?
3. Prove that $2^{(2^{2^2})} - 2^{(2^2)}$ divides $n^{(2^{(2^2)})} - n^{(2^2)}$ for all positive integer n .
4. We have an 8 feet by 5 feet room. We divide it up into an 8×5 grid of 40 squares with side length 1 foot. We would like to cover the room with 13 rectangular tiles of size 3 feet by 1 foot and an additional square shaped tile of one foot by one foot. (Each tile must be aligned with our grid and tiles cannot overlap with each other.) Determine which, if any, locations in the room we can place the square tile so that we can cover the rest of the room with the 13 rectangular tiles.
5. An irregularly shaped flat yard is surrounded by a tall fence built from connected straight pieces. We call a location *sightful* if it is inside the yard and a surveyor (shorter than the fence) can see every part of the inside of the fence from that location. (The surveyor is allowed to turn around on the spot). If A is a sightful location and B is a sightful location, show that every point on the straight path from A to B is sightful. (In the figure the point P is sightful, while the point Q is not.)



You are invited to submit a solution even if you get just one problem. Please do not write your solutions on this problem page. Remember that solutions require a proof or justification.

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