



★ NATIONAL LEVEL ★

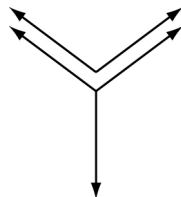
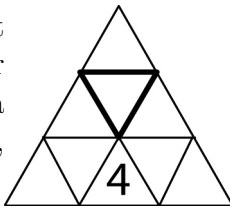
January 2010

The Mandelbrot Competition

Round Three Test

Name: _____

Time Limit:
40 minutes

1. Warren constructs wooden puzzles as a hobby. He can build four puzzles per hour, and can make ten puzzles from a single board of wood, which costs \$13. If he works steadily for five hours and sells every puzzle that he builds for \$7.50 each, what is his hourly profit, to the nearest dollar?		①
2. How many letters of the alphabet either do not appear within the word INFINITESIMAL or do not appear in the word GARGANTUAN, but don't not appear in both?		①
3. The geometric object at right consists of five rays. All angles in the diagram measure 120° , and the rays that point in the same direction are parallel. What is the largest number of points in which a circle could intersect this configuration of rays? (Count all points of intersection with all five rays.)		②
4. There is a unique positive integer n with the property that if we were to add up all the prime numbers that divide either n or $n + 1$, their sum would be exactly $n - 1$. Determine this number n .		②
5. Write the digits from 1 to 9 in the small triangles so that the sum of any "three-in-a-row," in any direction, is either even or a multiple of 7. (Three numbers in a row occupy a shape that is congruent to $\triangle \nabla \triangle$.) If the 4 is placed as shown, which digit must appear within the highlighted triangle?		②
6. Let T_n be the number of ways to color each square in a row of n squares either red, white or blue so that no three consecutive squares contain all three colors. It so happens that $T_7 = 717$ and $T_8 = 1731$. Determine T_{10} .		③
7. Triangle ABC has sides of length $AB = 6$, $AC = 5$ and $BC = 4$. Let I be the incenter of $\triangle ABC$; that is, the center of the inscribed circle. What is the radius of the circle through points C , I and A ?		③

SCORE: