



★ NATIONAL LEVEL ★

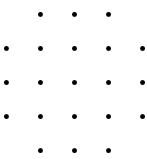
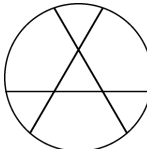
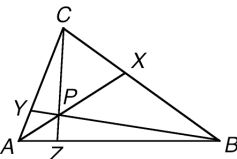
February 2013

The Mandelbrot Competition

Round Four Test

Name: _____

Time Limit:
40 minutes

1. The diagram at right shows twenty-one evenly spaced points arranged in a square grid. How many lines pass through exactly three of the points?		<div>1</div>
2. Find the unique positive integer N between 250 and 300 with the property that the numbers N , $2N$, and $3N$ together use all the digits from 1 to 9 exactly once among the three of them.		<div>1</div>
3. Three chords of a circle intersect one another as shown. Suppose that each chord is split into three segments, each of length 1, by the other chords. Find the area of the circle.		<div>2</div>
4. A certain positive integer requires four digits when written in base 5, but has only seven digits when written in base 2. Furthermore, this number is not a palindrome when written in either base 2 or base 5. Find this number, writing your answer in base 7.		<div>2</div>
5. Solve the following equations for x , writing your answer in simplest form. $(\log_{21} 48)x + (\log_5 13)y = \log_{21} 56,$ $(\log_{13} 3)x + (\log_5 21)y = \log_{13} 7.$		<div>2</div>
6. In the diagram at right (not drawn to scale) points X , Y and Z are located on the sides of $\triangle ABC$ so that segments \overline{AX} , \overline{BY} and \overline{CZ} are concurrent. If $PZ/PC = 2/3$ and $PY/PB = 2/7$, then determine PX/PA .		<div>3</div>
7. In Binaryland there are \$1, \$2, \$4, \$8, \$16, \$32, \$64 bills, and so forth. A cashier has five bills of each value. Suppose a customer wishes to purchase an \$18 item, and hands the cashier a \$64 bill. In how many ways could the cashier make change, if the bills are distinguishable? (For instance, there would be 25 ways to choose a \$1 and \$2 bill, since all the bills look different.)		<div>3</div>

SCORE: