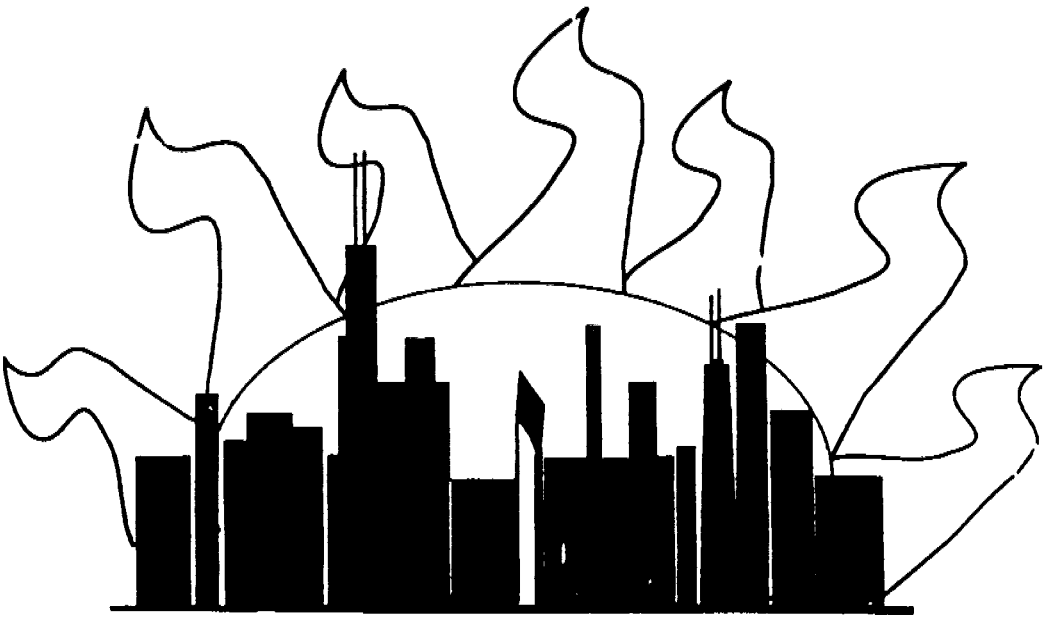
Theta Division **Topic Test 1**

Logic/ Recreational Math



Mu Alpha Theta National Convention
Chicago 1998

Theta Level

General Instructions:

Unless otherwise stated all answers should be written as decimals.
If you are asked to give your answer as a fraction, please give your answer in a/b form where a and b are relatively prime.

Questions

1. I visited a beautiful flower garden yesterday and counted exactly 50 flowers. Each flower was either red or yellow and the flowers were not all the same color. My friend made the following observation: No matter which two flowers you might have picked, at least one was bound to be red. How many red flowers were there?

2. Suppose you are given 12 coins, one of which is counterfeit and weights a little less than the real coins. Using a two-pan balance scale, what is the minimum number of weighings necessary to find the counterfeit coin?

3. How many five-digit whole numbers are there such that the leftmost digit is odd, the next digit to the right is even, and all five digits are different? Consider 0 to be an even digit.

4. In Gauss High School there are 230 students who are in either band or orchestra. The band has 100 female and 80 male members. The orchestra has 80 female and 100 male members. There are 60 females who are members of both the band and orchestra. How many males are NOT in the orchestra but are in the band?

5. A game involves a pile of 11 coins and two players who alternately take turns removing 1, 2, 3, 4, or 5 coins from the pile. The player who removes the last coin(s) wins the game. How many coins should the first player remove in order to guarantee a win?

6. In a *magic square*, the sum of the three entries in any row, column, or diagonal is the same value. Find the value of x in this magic square.

x	19	98
1		

7. All of the even numbers from 2 to 1998, inclusive, except those ending in 0, are multiplied together. What is the units digit of the product?

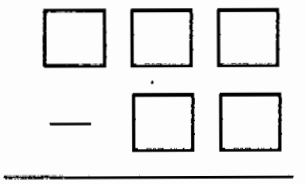
8. A palindrome is a number that reads the same forwards as backwards. On a digital clock the time 1:01, 4:44, 12:21 are considered to be palindromes. In a twelve-hour period, how many of the displayed times will be palindromes?

9. The letters M, U, A, L, P, H, A, T, H, E, T, A, and the digits 1, 9, 9, 8 are cycled as follows and put in a numbered list:

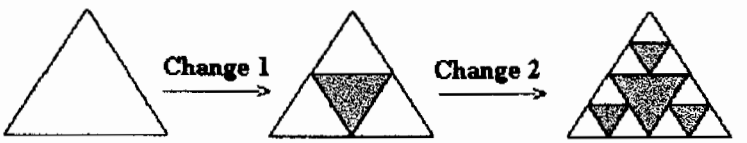
   MUALPHATHETA1998
   Line 1. UALPHATHETAM9981
   Line 2. ALPHATHETAMU9819
   Line 3. LPHATHETAMUA8199

   What is the number of the line on which MUAPLHATHETA1998 will appear for the first time?

10. Using each of the digits 2, 4, 5, 6, 9 in exactly one of the boxes in this subtraction problem, what is the largest difference possible?



11. An equilateral triangle is drawn on white paper. Each time the triangle is changed, one-fourth of each white triangle turns grey as shown in the diagram below.



   After four changes, what fractional part of the original area of the white triangle remains white? Round your answer to four decimal places.

12. The elements of set B are all the possible subsets of set A. Set B has 16 subsets. Find the number of elements in set A.

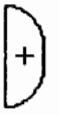
13. If you add a two-digit number to the reverse of its digits eventually you will get a sum that is a palindrome, i.e. 21
+ 12
33

How many additions are necessary for 79 to have a sum that is a palindrome?

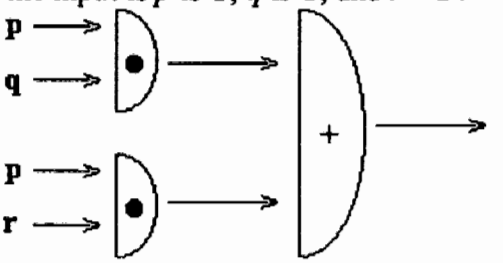
14. Three children were playing baseball. Ttheir names were 10, 20, and 30. One of them hit a home run and broke your expensive plate glass window, and you went out to question the children. Each child made two statements.

10: "30 didn't do it. 20 did it."
20: "I didn't do it. 30 did it."
30: "I didn't do it. 10 did it."

If you know that one of them always tells the truth, one always lies, and the other tells the truth half the time, which one of the children is the guilty party?

15. An engineer designs a circuit using  for "and",  for "or", and  for "not" gates.

What will be the output if the input is p is T, q is T, and r = F?

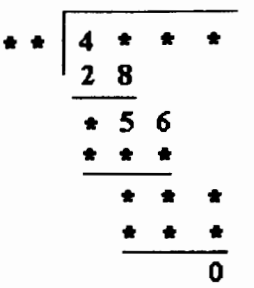


Give your answer as 1 = T and 0 = F.

16. Supply a digit for each letter so that the problem is correct. A given letter always represents the same digit. A digit can be represented by only one letter. Write your answer as ABCDE.

A B C D E
x 4
E D C B A

17. Due to a mistake in the printing of a manuscript of a math textbook, some numbers have become illegible. The printer is under pressure and does not have time to check with the author. Find the quotient.



18. One of the question writers for this Mu Alpha Theta convention has two daughters who were born on Sept. 5 and Oct. 9 of two different years so that the two ages have a difference of 8 for most of the year. She realized that 1998 will be a special birthday year for her daughters. After the birthday of the older girl in September and before the birthday of the younger girl, this will be the second time in their lives when both of them will have ages that are perfect square numbers. What will be the sum of their ages as of Sept. 5, 1998?

19. Find the truth value when p is T, q is F and r is F. $\sim (r \wedge q) \wedge (p \vee \sim q)$. Give your answer as 1 if the value is T and 0 if it is F.

20. Determine the value of $(p \vee q) \rightarrow (\sim q \rightarrow p)$ using the truth table.

p	q	Answer
T	T	Digit in the thousands place
T	F	Digit in the hundreds place
F	T	Digit in the tens place
F	F	Digit in the ones place

Write your answer using 1 for T and 0 for F.