

## Mayhem Problems

To be eligible for this month's MAYHEM TAUNT, solutions must be post-marked *before April 1, 2003*, and attached to each solution of each problem must be a completed student information sheet.

**M69.** *Proposed by the Mayhem Staff.*

A sequence of digits is formed by writing the digits from the natural numbers in the order that they appear. The sequence starts:

1, 2, 3, 4, 5, 6, 7, 8, 9, 1, 0, 1, 1, 1, 2, . . .

What is the 2002<sup>nd</sup> digit in the sequence?

**M70.** *Proposed by the Mayhem Staff.*

What is the smallest positive multiple of 15 that is made up of only the digits 0, 4 and 7, each appearing the same number of times?

**M71.** *Proposed by Richard Hoshino, Dalhousie University, Halifax, Nova Scotia.*

Let  $x = a + b - c$ ,  $y = a + c - b$  and  $z = b + c - a$ , where  $a$ ,  $b$  and  $c$  are prime numbers. Given that  $x^2 = y$  and  $\sqrt{z} - \sqrt{y}$  is the square of a prime number, determine all possible values for the product  $abc$ .

**M72.** *Proposed by J. Walter Lynch, Athens, GA, USA.*

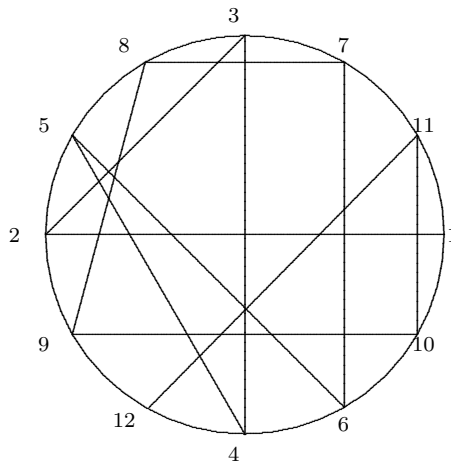
You have a cup of coffee and a cup of tea. The cups are identical and each contains the same amount of liquid as the other. You take a teaspoon full of coffee out of the coffee cup and put it into the teacup. You then take a teaspoon full of the mixture out of the teacup and put it into the coffee cup. Which is greater, the amount of coffee in the teacup, the amount of tea in the coffee cup, or are they the same?

**M73.** *Proposed by J. Walter Lynch, Athens, GA, USA.*

A right circular cylinder with radius  $r$  and height  $h$  contains a liquid to within  $x$  of the top of the cylinder. Find the angle through which the cylinder must be tilted in order for the liquid to start to pour out. (Assume that there is enough liquid in the cylinder so that the surface of the liquid does not intersect the bottom of the cylinder before the liquid starts to pour out.)

**M74.** *Proposed by the Mayhem Staff.*

A circle has 12 equally spaced points placed on its circumference. How many ways can the numbers 1 through 12 be assigned to the points so that if the points 1 through 12 are connected with line segments, in order, the segments do not cross? An example of a **bad** arrangement is illustrated below.



**M75.** *Proposed by the Mayhem Staff.*

The increasing sequence 1, 5, 6, 25, 26, 30, 31, 125, 126, ... consists of positive integers that can be formed by adding distinct powers of 5. What is the 75<sup>th</sup> integer in the sequence?