

# MAKO Puzzles

## A Shadow Puzzle

A straight rod is embedded in a solid rectangular block made of translucent plastic. Label three of the faces that meet at a corner  $A$ ,  $B$ , and  $C$ . When the sun is directly overhead, face  $A$  of the block is placed on level ground. The length of the shadow of the rod is 5 units. When face  $B$  is placed on the ground the shadow's length is 6 units and when the face  $C$  is placed on the ground, the shadow's length is 7 units.

How long is the rod?

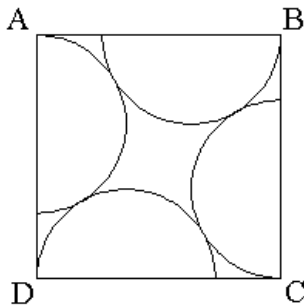
## Ones and Twos

Without using a computer, find the smallest multiple of 9 whose decimal digits consist only of 1's and 2's.

What if we replace "9" by "99" in the previous question?

## A Square with Four Semicircles

In the figure below,  $ABCD$  is a square. The four semicircles are congruent and each is tangent to two of its neighbors. Each side of the square contains the diameter of one of the semicircles and is tangent to another.



What is the ratio of the diameter of one of the semicircles to the side-length of the square?

## A Digital Dilemma

If you were to write down the numbers from 1 to 1000000 in order,

- how many digits would you use?
- how many 0's would you use?
- what would the millionth digit you wrote down be?

For example if you wrote down the numbers from 1 to 20 in order, you'd have

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20.

You would have used 31 digits, 2 zeroes, and the twentieth digit would be 1 (appearing in the 15).

**The answers will be posted at <https://math.missouristate.edu/MAKO2017.htm>.**

**Rules for playing KENKEN®**

- 1) Choose a grid size.
- 2) Fill in the numbers from 1 to grid size.
- 3) Do not repeat a number in any row or column.
- 4) The numbers in each heavily outlined set of squares, called cages, must combine (in any order) to produce the target number in the top corner using the mathematical operation indicated.
- 5) Cages with just one square should be filled in with the target number in the top corner.
- 6) A number can be repeated within a cage as long as it is not in the same row or column.

<b>2 ÷</b>		<b>12 ×</b>	
<b>5 +</b>	<b>2 -</b>		<b>3 -</b>
		<b>7 +</b>	
<b>3 -</b>			

<b>60 ×</b>	<b>3 -</b>		<b>18 +</b>	<b>3 ÷</b>	
					<b>1</b>
<b>1 -</b>	<b>5 +</b>	<b>6 ×</b>	<b>2 -</b>		<b>24 ×</b>
			<b>2 ÷</b>		
<b>12 ×</b>		<b>8 +</b>			<b>300 ×</b>
	<b>7 +</b>				

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