84601

February 26, 1965

Mathematics Magazine
Los Angeles City College
855 North Vermont Avenue
Los Angeles 29, California
Attention: Robert E. Horton, Editor

Dear Dr. Horton:

I wish to submit the enclosed problem and answer for your consideration to be published in the "Problems and Solutions" section of Mathematics Magazine.

Thank you very much for your consideration.

Very truly yours,

H. Tracy Hall

H. Tracy Hall
Director of Research
Room 224 ELB

HTH/lw
Enclosures

PROBLEM:

Given a flexible, thin walled cylinder, such as a soda straw, of diameter D, what is the edge length L of the largest regular tetrahedron that can be pushed through the straw?

H. Tracy Hall, Feb 26, 1965

H. Tracy Hall
Director of Research
Brigham Young University
Provo, Utah

ANSWER:

$$L = \frac{\pi D}{2}$$

The regular tetrahedron is pushed through the soda straw edgeways with an axis through the mid points of two opposite edges of the tetrahedron coinciding with the cylinder axis. The straw is squeezed flat at one end for initial entry of the tetrahedron's leading ege. As the tetrahedron passes through the straw, the straw "flows" over the tetrahedron "skin tight" conforming completely to the tetrahedron's shape. The property of the tetrahedron that makes this possible is the constant perimeter (πD in this case) of any section made by a plane passing through the tetrahedron perpendicular to two opposite edges. This section varies continuously in shape from a line to a rectangle to a square to a rectangle and back to a line as the plane is moved from one edge to the opposite edge of the tetrahedron.

The above relationship was discovered while contemplating how to construct an electrical resistance heater-container for a tetrahedrally shaped sample for the author's Tetrahedral Press high pressure/temperature apparatus.[1] A skin tight, electrically heated metal "soda straw" which surrounded the tetrahedron and was pinched flat where it extended beyond the two opposite edges of the tetrahedron proved to be an excellent heater-container for the sample. In practice a "straw" is not used but, rather, a strip of metal (the equivalent of a longitudinally slit straw) is wrapped around the tetrahedral sample to give the same end result.

(1) H. T. Hall, Rev. Sci. Instr., 29, 267-275 (1958).

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