# MATHEMATICS PROBLEM 141

a. What are the last four digits of $3^{123456789}$?

b. What are the last four digits of $4^{123456789}$?

Show all work done "by hand" without computer. (You may use calculator for multiplication only.)

Each midshipman submitting a correct solution with a correct explanation to Problem 141 by 1700 Friday 15 October 2004 will be recognized as a solver on the next problem. (Deadline for problem submission has been extended because of e-mail problems.) Submit solutions to Prof. Wardlaw at mathprob@usna.edu (please no attachments!) or via his Math Dept mailbox in Preble Hall, second deck.

Midshipmen Gabriel H. Campion, Daniel C. Ryan, and Stephen S. McMath submitted correct solutions to Math Problem 139.

A solution to Math Problem 140 is on the back of this page and is posted on the Math Dept bulletin board on the second floor of Preble Hall across from the stairs. Midshipmen Gabriel H. Campion, Jason R.Crane, Ryan B. Forsmo, Lee C. Haney, Jordan Kehrer, Stephen S. McMath, James A. Miller, and Benjamin L. Scripture submitted correct solutions to Math Problem 140. Midshipman Stephen S. McMath and Professor Mark E. Kidwell pointed out that in four dimensions one can obtain (at least) eleven triangles with 12 matchsticks.

## MATHEMATICS PROBLEM 140

a. What is the largest number of equilateral triangles with sides of unit length that can be formed from 12 matchsticks, each of unit length?

b. What is the largest number of squares with sides of unit length that can be formed from 12 matchsticks, each of unit length?

**SOLUTION.**

a. Ten equilateral triangles can be formed with 12 matchsticks as follows:

(1) Use six matchsticks to form a tetrahedron, which has 4 triangular faces.

(2) On one of the triangular faces of the above tetrahedron, use three matchsticks to erect a new tetrahedron, thus obtaining 3 new triangular faces.

(3) Repeat (2) on another face, thus obtaining 3 more triangular faces for a total of 10.

b. Six squares is the largest number of squares; these can be obtained as the faces of a cube formed with the 12 matchsticks as edges.