**1** A fan with four equally spaced blades is running at 100 revolutions per second clockwise. A movie camera films this fan, shooting 48 frames per second. When the film is played (at the rate of 48 frames per second), what will be the apparent speed of the fan?

2 During a 3-minute time interval, several people observed a worm crawling from east to west in a straight line. Each observer watched the worm for exactly one minute, and the worm was always watched by at least one person. It turns out that each observer saw the worm move forward exactly one foot to the west. To the nearest inch, what is the greatest distance that the worm could have traveled during the 3 minutes?

3 Let $z(n)$ denote the number of zeros at the end of $n!$. For example, $z(6) = 1$ and $z(11) = 2$. Call a non-negative integer k "wranglish" if there is an n such that $z(n) = k$. How many of the integers from 1 to $z(2015)$, inclusive, are *not* wranglish?

4 Consider the $11 \times 11 \times 11$ Rubik's cube below. Each face is painted with a different color, and it is possible to turn any layer, as you can with smaller Rubik's cubes. Let A denote the move that turns the shaded layer shown clockwise by 90 degrees, about the axis labeled X. When move A is performed, the only layer that moves is the shaded layer. Likewise, define move B to be a clockwise 90-degree turn about the axis labeled Y, of just the shaded layer shown. Let M denote the move "perform A, then perform B."
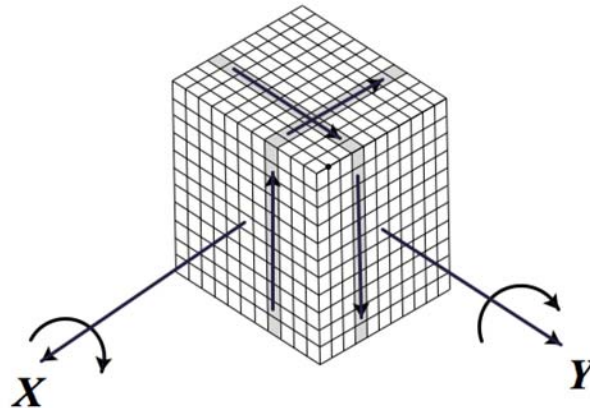
Imagine that the cube starts out in "solved" form (so each face has just one color), and we start doing move M repeatedly. What is the least number of repeats of M in order for the cube to be restored to its original colors?

5 A bug is crawling on the coordinate plane from $(1,3)$ to $(-4,-2)$. The bug travels at constant speed one unit per second everywhere but in the interior of quadrant II (negative x- and positive y-coordinates), where it travels at 0.7 units per second. What is the minimal time needed to complete the journey?

6 A number is a palindrome when it is the same written forward and backwards. Examples are 101, 2112, and 44. A four digit palindrome consists of the digits $\{0,1,2,3,4,5,6,7,8,9\}$ and is a 4 digit string (possibly with leading zero(s)) that is a palindrome. What is the sum of all 4 digit palindromes?

7 Find $\lfloor S \rfloor$, where

$$S = \sum_{n=2}^{100} \frac{1}{\sqrt{n}}.$$

8 A small spider is located at $(1,0)$ on the xy-plane. The bug receives a 10 digit binary number which it interprets digit by digit as follows with the spider returning to a coordinate of the form $(n,0)$ after each digit. If the next digit is a zero then the spider travels once around a circle centered at $(0,0)$ of radius n. If the next digit is a 1 then the spider travels in a straight line from $(n,0)$ to $(n+1,0)$. What 10 digit binary number makes the spider travel the farthest in all 10 steps and how far does the spider go in this case?