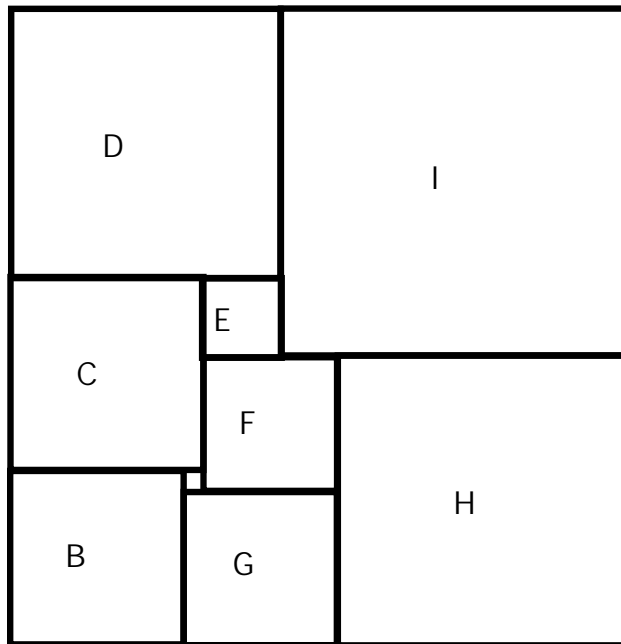


**MATHEMATICS ENRICHMENT CLUB.**  
**Hint Sheet 11, August 5, 2014<sup>1</sup>**

1. If cog 1 rotates clockwise, cog two must rotate counter clockwise, and so cog three must rotate clockwise and so on. All the odd cogs must rotate the same way.



2. We can work out the side lengths for each square. Let the lowercase letter for a square be its side length, then say  $b = 1 + g$ ,  $g = 1 + f$ ,  $c = 1 + b$ ,  $d = c + e$  and so on. The total area is  $(d + c + b) \cdot (b + g + h) = (d + i) \cdot (i + h)$ . With a bit of work we can determine that the total area is 1056.
3. The probability of a coin flip coming up heads is  $1=2$ .  
 To get a big loop of string it doesn't matter how the tops are tied. There are 6 ends at the bottom, so the total number of ways of tying them into pairs is  $\frac{6}{2}$ , how many of these result in one big loop? Take one end, it can be tied to 5 other ends, one of which results in two pieces of string becoming its own loop (the piece of string it's tied to at the top). So tie it to one of the other 4. After this, there are 4 remaining ends

<sup>1</sup>Some problems from UNSW's publication Parabola others from [www.brilliant.org](http://www.brilliant.org)

{ choose one, then it can be tied to 3 other ends, but one of those either results in a loop with 2 pieces of string, or a loop with 4 pieces of string, so tie it to one of the other two. Thus there are  $4 \times 2 = 8$  ways of making one big loop once the tops are tied. Meaning the probability of you winning this game is  $\frac{1}{8} = \frac{1}{8} < \frac{1}{2}$ .

Thus you're more likely to win the coin game.

4. The ant should walk in straight lines to walk the shortest distance. The shortest path from A to the line BX