COLLEGE of CHARLESTON

MATH MEET 2018

Snowflake Symmetries All-Day Sprint

The background for this all-day sprint is given in another document.

Write your team's answers on the copy of this sprint that's on colored paper and show's your team's school code. Turn in only that page at the submission box on the front porch of the Maybank building by 2:00.

First, let's practice simplifying compositions of the operations r and s. Simplify these to the form i, s, r^n, or $r^n s$:

$rsrs =$ i

$r^3 sr =$ $r^2 s$

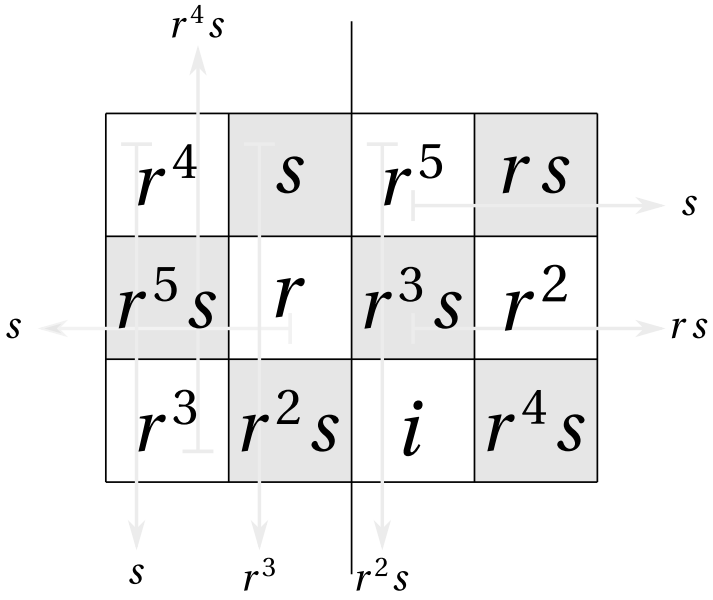
$s^2 r^2 s r^3 s =$ r^5

$r r^{-2} s r^{-3} =$ $r^2 s$

On the back of this page, you'll find several grid puzzles, kind of like a ken-ken. Your job is to put one of the twelve symmetries of a snowflake in each box in the grid. Use the simplified forms i, s, r^n, or $r^n s$.

- In each grid of twelve boxes, each symmetry appears once.
- The symmetries r^n and $r^n s$ never appear in the same row or column. Likewise for $i = r^0$ and $s = r^0 s$.
- The symmetries r^n and $r^n s$ never appear in the same half of the grid, left or right. Likewise for $i = r^0$ and $s = r^0 s$.
- Exactly two symmetries in each row have an s.
- The symmetry that goes in a box with a gray background must include an s. Symmetries in white boxes are unconstrained, and may or may not include an s.
- An arrow through some boxes gives the value of the composition of the symmetries in those boxes.

Easy Grid



To get started, let's label the squares of the grid as follows:

A	D	G	J
B	E	H	K
C	F	I	L

The exclusion rules mean that s and $r^2 s$ must appear on the left half of the grid, and that neither B, E, H, J, nor L can be $r^2 s$. We're given that $K = r^2$. The arrow through H and K labeled rs means that $HK = rs$. Since H is gray, it must include an s, so suppose $H = r^h s$. That means we need to solve $r^h s r^2 = rs$. We can push the s to the right because $sr^2 = r^4 s$, which takes us to $r^{h+4} s = rs$. That means $h = 3$, so $H = r^3 s$. Write that in square H on the grid and keep going!

Difficult Grid