

## Oral Exam Questions Jennifer Hom

### Algebraic Topology and Knot Theory (Leidy)

1. Let  $M$  be a oriented 3-manifold with boundary, with  $H_1(M)$  finite. What can you say about the boundary of  $M$ ?
2. Let  $X$  be the wedge of two circles. What is the infinite cyclic cover, infinite abelian cover, and universal cover of  $X$ ? Give an example of a finite sheeted cover of  $X$ . What is its homology, both as a group, and as a module over its deck group?
3. Consider the following three knot invariants: signature, Alexander polynomial and fundamental group of the knot complement. For each possible pair of these invariants, which, if either, is stronger than the other? Proof or counterexample.
4. Sketch the proof that the signature of a slice knot is 0.

### Algebraic Topology (Shaneson)

1. Does every manifold admit an orientation reversing homeomorphism?
2. Compute the homology of  $V_2(\mathbb{R}^n)$ .

### Enumerative Combinatorics (Ward)

1. Define a rise in a binary word on the alphabet  $a, b$  to be an  $a$  followed by a  $b$ . Give a bivariate generating function that counts by the number of rises and by the number of letters in the word.