First name _____

LARSON—MATH 556—CLASSROOM WORKSHEET 19 The Birkhoff von Neumann Theorem

1. What is a *doubly stochastic matrix*?

2. What is a bipartite graph that can be used to model which entries of a non-negative matrix have positive entries?

3. What is a *permutation matrix*?

4. What is a *convex combination* (of vectors, or matrices, etc)?

5. What is the Birkhoff von Neumann Theorem?

6. What is an example of the Birkhoff von Neumann Theorem?

7. What is *Birkhoff's Algorithm* (applied to a matrix with constant row and column sums)?

8. (Claim:) Let A be a square nonnegative matrix with constant row and column sums. A finite number of iterations of Birkhoff's algorithm will yield a 0 matrix.

9. How can the last fact be used to prove the Birkhoff von Neumann Theorem?