

Last name \_\_\_\_\_

First name \_\_\_\_\_

### LARSON—MATH 353—HOMEWORK WORKSHEET 04

**Suggestions:** Write out lots of examples. Collect evidence. Doodle. You won't sit down knowing the right idea. But it **will** come if you start early, wrestle with the problem, read, sleep on it, and come back to it.

1. What is the definition for Euler's  $\phi$  function?
2. Use this definition to find  $\phi(12)$ .
3. What is  $12\mathbb{Z}$ ?
4. What is  $\mathbb{Z}/12\mathbb{Z}$ ? List the elements (using Stein's notation).
5. Make an addition table for  $\mathbb{Z}/12\mathbb{Z}$ .
6. Make an multiplication table for  $\mathbb{Z}/12\mathbb{Z}$ .
7. Find the *units* in  $\mathbb{Z}/12\mathbb{Z}$ .
8. Make a multiplication table for the units in  $\mathbb{Z}/12\mathbb{Z}$ . The elements in your table should themselves be units (that is, the units are closed with respect to multiplication).
9. For each unit in  $\mathbb{Z}/12\mathbb{Z}$ , find the *order* of that unit. Explain.
10. What commands can you give to check your last answers in Sage/CoCalc?