

### MATH 180, MINITEST 3

Choose two.

- (1) What are the fixed points for the action of  $A = \begin{pmatrix} 0 & 4 \\ 1 & 0 \end{pmatrix}$  on  $\hat{\mathbb{C}}$ ? Where does it take the unit circle  $C$ ? Sketch  $A.C$ .
- (2) Chicago is almost on a perfect grid except for Milwaukee Ave, which runs diagonally. Most other Avenues run North-South. Let the Chicago Avenue Metric on  $\mathbb{R}^2$  be the one that says the path from  $p$  to  $q$  is to go straight north or south to Milwaukee Ave as quickly as possible from  $p$ , walk along Milwaukee until you can walk out directly north or south to  $q$ . (You're allowed to stop at your destination before reaching Milwaukee Ave at all, if possible.)  
Suppose the equation of Milwaukee Ave is  $y = x$ . Draw a path from  $(0, 2)$  to  $(3, 2)$ . What is its length? What is the isometry group of the Chicago Avenue Metric? (At least name a few isometries.)
- (3) Describe  $C_3(i + 1)$  (the circle of radius 3 centered at  $i + 1$ ) in  $\mathbb{H}$ . You may use the fact that  $d(ai, bi) = \ln(|b/a|)$  and that the action of  $\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$  is an isometry.