Math 433

## Quiz 5 Applied Algebra

Summer 2009

Instructions Please write your name in the upper right-hand corner of the page. Use complete sentences, along with any necessary supporting calculations, to answer the following questions.

1. Find the order of 22 modulo 23 , that is, find the smallest positive integer $k$ such that $22^{k} \equiv 1 \bmod 23$.
2. You receive a message that was encoded by the RSA system using public key $(55,3)$, where 55 is the modulus $n$ and 3 is the exponent $a$. The coded message, in two blocks, is 2011 . Decode the message and convert the result into alphabetic form via the correspondence $A \leftrightarrow 1$, $B \leftrightarrow 2$, etc.
[Hints: Notice that $\phi(55)=40$. Also, the easy way to do computations $\bmod 55$ is to compute both $\bmod 5$ and $\bmod 11$ and then use the Chinese remainder theorem.]
