Name:_____

Introduction to Cryptography
Modular Arithmetic Properties

Answer the following questions.

(1) Without using a calculator, find the remainder whenever the following quantities are divided by 2, 4, 9, and 11.
   (a) 840971832313256
   (b) $1486 \cdot 2365 \cdot 63704 \cdot 186474$
   (c) $1486 + 2365 + 63704 + 186474$

(2) Find the value of the missing digit k so that the number $4052830k9582$ is divisible by 9.

(3) A number is called a palindrome the digits read forward are the same as the digits read backwards. For example. 14641 and 2332 are both palindromes. Show that all 4 digit palindromes $ABBA$ are divisible by 11.

(4) Without using a calculator, find the last digit of 123^{456}.

(5) Let A be some integer, and let B be an integer obtained by permuting the digits of A in some unknown way. Find X, where X is the last digit of $A - B = 314159X$. (Hint: A and B have the same digits, so what is their remainder when divided by 9?)