Cryptography: Homework 1

(Deadline: 10am, 2021/10/15)

1. (20 points) Suppose that the following ciphertext c is generated using the Vigenère cipher.

   ```
   KCCPKBGUFDPHQTYAVINRRTMVGRKDNBVFDETDGILTXRGUDDKOTFMBPVGEGLTGCKQRACQCWDNAWCRXIZ
   AKFTLEWRPTYCQKYVXCHKFTPONCQQRHJVAJUWETMCMSPKQDYHJVDAHCTRLSVSKCGCZQQDZXGSFRLSWC
   WSJTBHAFSIASPRJAHKJRJUMVGKMITZHFPDISPZLVLGWTFPLKKEBDPGCEBSHCTJRWXBAFSPEZQNRWXC
   VYCGAONWDDKACKAWBBIKFTIOVKCGGHJVLNHIFFSQESVYCLACNVRWBBIREPBBVFEXOSCDYGZWPFDTKF
   QIYCWHJVLNHIQIBTKHJVNPIST
   ```

   Determine the plaintext m and the secret key k. Show your programs.

2. (30 points) Let Π denote the Vigenère cipher where the message space consists of all 3-character strings (over the English alphabet), and the key is generated by first choosing the period t uniformly from $\{1, 2, 3\}$ and then letting the key be a uniform string of length t.

   (a) Define $\mathcal{A}$ as follows: $\mathcal{A}$ outputs $m_0 = \mathsf{aab}$ and $m_1 = \mathsf{abb}$. When given a ciphertext c, it outputs 0 if the first character of c is the same as the second character of c, and outputs 1 otherwise. Compute $\Pr[\mathsf{PrivK}^{\mathsf{eav}}_{\mathcal{A},\Pi} = 1]$.

   (b) Construct and analyze an adversary $\mathcal{A}'$ for which $\Pr[\mathsf{PrivK}^{\mathsf{eav}}_{\mathcal{A}',\Pi} = 1]$ is greater than your answer from part (a).