Problem 8.1. To use RSA, we need a way to encode things as numbers. Instead of encoding each letter separately, let’s encode the entire message as a number. We use the following rule:

<table>
<thead>
<tr>
<th>letter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>…</th>
<th>…</th>
<th>W</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>encoding</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>…</td>
<td>…</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
</tbody>
</table>

(We want every letter to be associated to a 2-digit number. Note that the textbook actually does $A \rightarrow 01$, $B \rightarrow 02$, etc., which also works, but is more complicated.)

For example, “HELLO” becomes the single number 1815222225.

(a) Encode: “BYE”
(b) Decode: 231130181929163124

Problem 8.2. Bob tells Alice to send him a message securely via RSA. He tells Alice (and the public) the numbers

\[ n = 30796045883 \quad \text{and} \quad e = 48611. \]

(If you don’t remember what this means, see the lecture notes.)

(a) What is the encryption function?
(b) Alice wants to send the very important message “HELLO.” So as before, we encode it as 1815222225. What number does Alice send to Bob?
(c) What does Bob do to decrypt Alice’s message? Please check that what he does actually does decrypt the message.

Problem 8.3. Bob is using RSA with

\[ n = 956331992007843552652604425031376690367 \quad \text{and} \quad e = 12398737. \]

Eve the Eavesdropper observes that Alice sends him the following encrypted number:

136918035529722837836652077416303475217

What is Alice’s message?