
The Chapter Problem—Cryptography Questions

Section 3.2

- CP1.** The coding method described in the Chapter Problem is an example of a function. Why?
- CP2.** What is the domain of this function? Why?
- CP3.** What is the range of this function? Why?
- CP4.** What does it mean to “break the code”?

Section 3.4

- CP5.** Graph the coding function.
- CP6.** How does this graph show that the relation is a function?
- CP7.** Is the inverse relation a function? Why must the inverse relation be a function for any encryption method?
- CP8.** Graph the inverse relation on the same axes in a different colour.
- CP9.** Use the graph of the inverse relation to decode the message.
- CP10.** What features of this coding technique make it easy to decode?

Section 3.6

- CP11.** What is the restriction on the domain of the coding function in the Chapter Problem on page 218? Why?
- CP12.** What is the restriction on the range of the coding function? Why?
- CP13.** What was there about the coding function that guaranteed the range would work out appropriately?
- CP14.** A student suggested this code: instead of multiplying by 17, square the number, divide by 26, and add 1 to the remainder.
- (a) Graph this function.
 - (b) Why would this code not work?
 - (c) What is necessary for any code to work?

Section 3.7

- CP15.** You could write the code in question CP14 in function notation as follows:

$$f(x) = \text{mod}(17x, 26) + 1, x \in \{1, 2, 3, \dots, 26\}$$

where $\text{mod}(a, b)$ is the remainder when a is divided by b . For example, $\text{mod}(17, 5) = 2$ because 17 divided by 5 is 3 with remainder 2.

- (a) Suppose that the equation is $y = 17x + 1$. What is the equation for the inverse function (the decoder)?
- (b) The last operation is “add 1.” What do you know about $f^{-1}(x)$?
- (c) What is the purpose of taking the remainder after dividing by 26?
- (d) Suppose you multiply a certain number by 17 and divide the result by 26. The remainder is 1. What is the number?
- (e) $f^{-1}(x)$ is very much like $f(x)$, but involves the number you found in (d). Determine $f^{-1}(x)$.
- (f) Verify your answer for all possible values of x .
- (g) Use $f^{-1}(x)$ to decode the message in the Chapter Problem on page 218.