

**Exercise 2.3.4**

Consider

$$\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2},$$

subject to  $u(0, t) = 0$ ,  $u(L, t) = 0$ , and  $u(x, 0) = f(x)$ .

- (a) What is the total heat energy in the rod as a function of time?
- (b) What is the flow of heat energy out of the rod at  $x = 0$ ? at  $x = L$ ?
- (c) What relationship should exist between parts (a) and (b)?