## 10. Separation of variables exercise

Work on this problem as preparation for the upcoming test. In particular, work on the exposition—try to make it clear and concise.

(1) Let $L$ be a positive number greater than one. Use separation of variables to solve the following Neumann problem for the Heat Equation:

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, \quad 0 < x < L, \quad t > 0$$
$$\left.\frac{\partial u}{\partial x}\right|_{x=0} = \left.\frac{\partial u}{\partial x}\right|_{x=L} = 0,$$
$$u(x,0) = \begin{cases} 1, & \text{if } 0 < x < 1 \\ 0, & \text{otherwise.} \end{cases}$$

(2) Validate your solution numerically for $L = 5, 10, 20$ and $t = .1$.
(3) What happens to the solution as $L \to \infty$? Write a paragraph summarizing your thoughts.