Ch 2. Review questions

1. What physical law is involved in the derivation of the heat equation?
2. What is the method of separation of variables? Explain the steps.
3. What is the (mathematical) purpose of the steady state solution in the solution procedure for heat problems?
4. What is the superposition principle? Does it apply to nonlinear equations? Does it apply to non-homogeneous linear equations? When do we use it?
5. In the solution process, where do we use the homogeneity of the partial differential equation and boundary conditions?
6. What is an eigenvalue problem? Give several examples.
7. Where do we use the Fourier series in the solution of a heat problem?
8. What is the characteristic of heat problems that require the use of the Fourier integral instead of Fourier series?
9. What condition has to be added to the usual specifications for a problem on an unbounded interval (infinite or semi-infinite)?

Imagine the rod mentioned in Section 2-1.

1. What partial differential equation would describe the temperature $u(x,t)$ under each of these conditions?

    a. The cylindrical surface is insulated, and the rod is carrying an electric current.
    b. The cylindrical surface is not insulated but is exposed to circulating water at temperature T.
    c. The cylindrical surface is insulated, and there is no heat "generation" of any kind inside the rod.

2. Express mathematically the boundary condition that corresponds to each of these physical conditions.
    a. The left end is insulated.
    b. The left end is held against a block of ice.
    c. The left end is in contact with an electric heater that "produces" heat at a constant rate; the heater and the left end are enclosed in insulation.
    d. The right end is exposed to condensing steam.
    e. The right end is exposed to circulating water at temperature T.