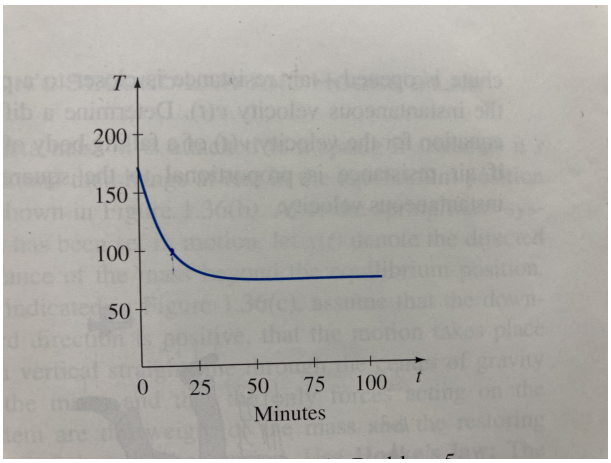
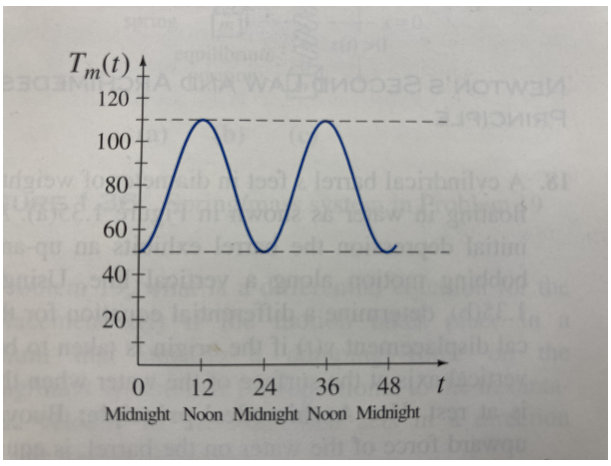
Questions:

1. A cup of coffee cools according to Newton's law of cooling. Use the data from the graph of $T(t)$ to estimate T_m, T_0, and k for:

$$\frac{dT}{dt} = k(T - T_m), T(0) = T_0$$



2. The ambient temperature T_m could be a function of time t. Suppose that in an artificially controlled environment, $T_m(t)$ is periodic with a 24-hour period, as in the graph below. Create a mathematical model for the temperature $T(t)$ of a body within this space.



3. Suppose that a large mixing tank initially holds 300 gallons of water in which 50 pounds of salt have been dissolved. Pure water is pumped into the tank at a rate of $3\frac{gal}{min}$, and when the solution is well stirred, it is them pumped out at the same rate. Determine a differential equation for the amount of salt $A(t)$ in the tank at a time t. What is $A(0)$?

4. Suppose that a large mixing tank initially holds 300 gallons of water in which 50 pounds of salt have been dissolved. Another brine solution is pumped into the tank at a rate of $3\frac{gal}{min}$, and when the solution is well stirred, it is them pumped out at a rate of $2\frac{gal}{min}$. If the solution entering has a concentration of $2\frac{lbs}{gal}$, determine a differential equation for the amount of salt $A(t)$ in the tank at a time t.?

5. What is a generalized solution to a brine tank with initial volume N_0, input and output rates of r_{in}, r_{out} respectively, c_{in} as the concentration of input brine, $c(t)$ the concentration of salt in the tank/outflow with $A(t)$ as the amount of salt in the tank at a time t?