DIAGNOSTIC 4 MODELING AND SIMULATION

- Download copper_script.m from wb/modsim/code/. It contains a solution to the copper block problem, written in a style we recommend. Some features of this style are:
 - 1. It uses MATLAB to perform computations you are probably used to doing by hand, including unit conversions.
 - 2. The variable names are chosen carefully to make the computation demonstrably correct.
 - 3. For every assignment statement, the units of the result are shown in the comments.

Run this script and check whether the result it computes for dQ/dt is the same as what you computed.

• The computed value of *dQ/dt* is the *instantaneous* rate of temperature change when the block is at 30 °C. As the temperature of the block cools, this rate of change will slow. However, if you pretend that this rate is sustained, you can estimate the temperature of the block over relatively short time scales.

Use dQ/dt to estimate the change in the temperature of the block after 24 hours. Does the result sound believable?

- Convert copper_script.m into copper_func.m, which should define a function that takes time in seconds, t, and the temperature of the block in °C, Q, as input variables, and returns dQ/dt as an output variable¹. Call this function from the command window with arguments t = 0 and Q = 30 and confirm that you get the same result.
- Read about Euler's method in the cat book and/or the Wikipedia, and then write a script called copper_euler that uses Euler's method to make a better estimate of the temperature of the block after 24 hours. It should call the function in copper_func.m at each time step. Run your program with smaller time steps until the result converges to 4 significant digits.
- Write a script called copper_ode45.m that uses ode45 and the function in copper_func.m to estimate the temperature of the block after 24 hours. In an ideal world, the result should agree, to 4 significant digits, with the result from copper_euler.



Figure 1: Pink cube.

¹ There is no reason, yet, for this function to take time as an input variable. But soon we will want to use this function with ode45, which requires the input variables to follow this convention.