**Homework Assignment #1  
Due: Tuesday, March 20 by 5:00 p.m.  
(Follow homework submission requirements posted on myCourses)**

**Problem:** Ball bearings are hardened through a process of heating and then rapid cooling (known as “quenching”) by submersion in an oil or water bath. During the quenching process, the temperature of the ball bearings as a function of time, *T(t)* in the bath may be estimated by the equation below:

*t* is the time in seconds in the oil bath;   
*Ti* is the initial ball temperature;  
*T∞* is the oil bath temperature; and  
*τ*  is a time constant (in seconds) which depends on the ball material, bath properties, etc.

Create a spreadsheet that contains

1. Your name, PSWC section number, and assignment title in the first row
2. A well-formatted problem statement, including the governing equation above
3. *Ti*, *T∞*, and *τ* as the input variables arranged in a table
4. A table of results which calculates the ball temperature vs. time for times from 0 to 200 seconds at 2-second intervals. Use a time constant *τ*= 60 s and an initial ball temperature (*Ti* ) of 900 °C.
5. A graph showing ball temperature vs. time for different bath temperatures (*T∞*) of 100, 200, 400 & 600 °C. The graph should be well defined with descriptive title, axes, legend, units etc.

Create a Word document that contains

1. Your name, PSWC section number, and the assignment title,
2. The problem statement, including the governing equation and given values,
3. The graph of ball temperature vs. time from your spreadsheet,
4. The answers to the questions below.

**Questions** to answer in addition to making your spreadsheet and plots:

1. Does the solution make sense? Why?
2. How long does it take for the ball bearing to cool to a temperature of less than 450 °C in the case when T∞ = 200 °C? How long does it take in the case when T∞ = 400 °C?

**Suggestions/Hints:** To solve the above problem, make a table in Excel with time varying from 0 to 200 seconds and calculate the corresponding ball temperature for different values of *T∞* for fixed values of *Ti*, and *τ*. Make sure you do this by using $ symbols and/or named cells appropriately in your formula to be able to copy the formula across the entire table to get full credit.