TAOCO has invented a new zero calorie candy is made by heating a complex mixture of proprietary ingredients to a fluid state at 250 oF, so that it can be formed into a spherical shape (radius = 2 cm). Since the candy is somewhat fluid after molding, it is important to cool the candy to at least 71 oF before further processing/packaging. This is done by blowing ambient air on the candy.

Unfortunately, data on the physical and thermal properties of this candy are not available, so temperature measurements have taken to determine the cooling rate (see below).





1. **Create a numerical model** for the temperature of the candy (oF) vs. time (min). **Clearly explain/justify your choice** of numerical model and **provide an appropriate plot of your model**, including the data points for comparison. **Calculate the time** needed to cool the candy to 71 oF.
2. The marketing folks want to different sizes of the candy. For example, they want to make a larger version of this candy, with a radius of 4 cm. Using your model (part a) to d**etermine the time needed to cool this larger candy to 71o F**. The candy physical properties are unchanged, on the size is increased.

Assumptions:

The heat conduction inside the candy is much faster than the rate of heat transfer to the outside air (i.e. the candy temperature is uniform), so the temperature of the candy can be modeled using an energy balance as:

Cp\* V\* dT/dt = -h\*A\*(T – Tair)

Where :

Cp = candy heat capacity

 = candy density

V – candy volume

A – candy area

h = convective heat transfer coefficient in air

Tair = ambient air temperature = 70 oF (assumed constant)

To = initial candy temperature = 250 oF

T = candy temperature

t = time