Homework Assignment 2

(Due Thursday January 31, 2008 in class)

Numbers in brackets are given for the problems from the textbook

(1) (1.1) A spherical water drop loses volume by evaporation at a rate proportional to its surface area. Express its radius at time t in terms of the constant of proportionality and its radius r_0 at $t = 0$.

(2) (1.2) The rate of increase of bacteria in a culture is proportional to the number present. The population multiplies by the factor n in the time interval T. Find the number of bacteria at time t when the initial population is p_0.

(3) (1.3) In Exercise 1.2 the population is found to increase by 2455 bacteria from t=2 to t=3 and by 4314 bacteria from t=4 to t=5. Show that $p_0 = 4291$ approximately and that, when T=3, n is about 2.33.

(4) (1.15) According to Newtons law of cooling, the rate of decrease of temperature of a body is proportional to the difference between its temperature and that of its environment. If the temperature of the environment is 20C and the body cools from 80C to 60C in 1 h, show that it will take somewhat over 4 h to cool to 30 C.

(5) (1.16) A body cools in 10 min from 100C to 60C when the environment is at 20C. How long does it take to cool to 25C?

(6) When a plant or animal is alive it continually replenishes the carbon in its system. Some of this carbon is radioactive C^{14}. When it dies the carbon it contains no longer replenishes, hence the C^{14} begins to decay. Suppose, you find a skull in a nearby Native American ancient burial site and with the help of a spectrometer, discover that the skull contains 9% of the C^{14} found in a modern skull. Assuming that the half life of C^{14} is 5730 years, how old is the skull?