

EXPONENTIAL MODELS- Proposed problems

1. The radium in a piece of lead decays at a rate which is proportional to the amount present. If 10 percent of the radium decomposes in 200 years, what percent of the original amount of radium will be present in a piece of lead after 1000 years? What is the half-life of this radioactive decay? [T-P p.5]

2. In the 1950 excavation at Nippur, a city in Babylonia, charcoal from a roof beam gave a count of 4.09 disintegrations per minute per gram. Living wood gave 6.68 disintegrations. Assuming the charcoal was formed during the city's existence, estimate the age of Nippur. (Half-life of carbon-14: 5568 years)[Braun p.19]

3. A tank initially contains 200 l of fresh water. Salt solution of unknown concentration is poured into the tank at a rate of 10 l/min, and the mixture flows out at the same rate. At the end of 120 min, the concentration of salt in the outgoing solution is found to be 1.2 kg/l. Find the concentration of the entering solution.

4. The CO_2 content of air in a $9000 m^3$ room is 0.3 percent (in volume). Fresh air containing 0.1 percent CO_2 is pumped into the room at the rate of $1000 m^3$ /min. When will the CO_2 content of the air in the room be 0.2 percent? [TP p.129]

5. The temperature in a room is 21 degrees Celsius. A thermometer which has been kept in it is placed outside. After 5 min the thermometer reading is 16 Celsius. Five minutes later, it is 13 Celsius. Find the outside temperature. [TP p. 130]

6. By natural increase (births minus deaths), a city whose present population is 40,000 would double in 50 years. There is also a net addition of 400 persons per year, because of people leaving and moving into the city. Estimate its population in 10 years. (Assume an exponential model, which is reasonable over short periods.) [TP p.133]

7. The rate of loss of volume (per unit time) of a spherical object (such as a ball of ice) through evaporation is proportional to its surface area. Express the radius of the ball as a function of time. If the radius is 10cm initially and 5cm after 10 min, how long will it take for the ball to evaporate completely?[TP, p. 133]