4.7: Exponential Growth and Decay

Supplementary Notes

Many natural phenomena follow the *exponential law*, that is, that a certain amount A changes in time t according to

$$A(t) = A_0 e^{kt}. \qquad (k \neq 0)$$

This is also known as the *law of unihibited growth* $(k > 0)$ or *law of uninhibited decay* $(k < 0)$.

Exercises

1. The size, P, of a certain insect population at time t (in days) obeys the function $P(t) = 450e^{0.03t}$. After how many days will the population reach 750?

2. The population, N (in millions), of a country may be approximated by the formula $N(t) = N_0 e^{kt}$. If the population is 40 million initially and 50 million after 1 year, what will be the population after 3 years?

3. The voltage of a certain conductor decreases over time according to the law of uninhibited decay $V(t) = V_0 e^{kt}$, $k < 0$. If the initial voltage is 140 volts and 4 seconds later, it is 20 volts, then what is the voltage after 6 seconds?

4. Iodine I-31 is a radioactive material that decays according to $A(t) = A_0 e^{-0.091t}$, where A_0 is the initial amount present and $A(t)$ is the amount present at time t (in days). What is the half-life of iodine I-31?

5. The population of a city follows the exponential law. If the population decreased from 1.2 million in 2010 to 1 million in 2012, what will the population be (in millions) in 2025?

6. Yeast grows according to the exponential law. If the original amount doubles in one hour, in how many hours will it triple?

7. A certain radioactive material is known to decay according to the exponential law. If initially there is 100 milligrams of the material present and after three hours it is observed that the material has lost 10 percent of its original mass, find the time at which the material has decayed to one half its initial mass.