GROWTH, DECAY and NEWTON'S LAW OF COOLING

1.The initial population 5000 of a town is increased by 20% in first 10 years. What will be the population after 20 years? The rate of growth of population is proportional to the population at that instant. Ans: 7200

2. Number of bacteria in a certain culture doubles in 6 hours and becomes 1000 in 8 hours. If the rate of growth of bacteria is proportional to the number present at that instant, find the initial number of bacteria Ans: $1000\,(0.5)^{\frac{4}{3}}$.

3. Initially 10 grams of a Radioactive substance disintegrates to 8 grams in 10 years. The rate of decay of the substance is proportional to the amount present at time t. What is the half-life of the substance? What amount of substance will be left after 20 years? Ans: $10\left(\frac{\ln 2}{\ln 5-\ln 4}\right)$,/6.4 grams.

4. A cake is put in a preheated oven at temperature 120^0 C reaches 40^0 C in 5 seconds and to 50^0 C in 10 seconds. What was the initial temperature of the cake? Ans: 29^0 C.

5. A coin is put in a boiling water, whose temperature is recorded after 2 minutes and 4 minutes to be 40^0 C and 50^0 C respectively. What was the initial temperature of the coin? Ans: 28^0 C.

6. A thermometer with reading 20^0 C is taken outside of a room, which after 1 minute reads 25^0 C and after 2 minutes reads 28^0 C. What is the temperature outside? Ans: 32.5^0 C.

7. The population of a town grows by 5% in 10 years and it becomes 10000 in 15 years. If the rate of growth of population is proportional to the population at that instant, what is the initial population? Ans: $1000(1.1)^{-\frac{3}{2}}$. (Hint: Assume intial population is P_0, then at $t = 10$, $P = P + \frac{P_0}{20} = \frac{21P_0}{20} = (1.05)P_0$)