Using Logarithms to Solve Applications of Exponential Functions

1. **Population**: In 1986 the population of Springfield, Illinois, was 190,000 and was increasing at an annual rate of 0.2%. Then the population of Springfield t years after 1986 can be described by the function $P(t) = 190{,}000e^{0.002t}$. If this growth rate continues, when will Springfield's population reach 200,000?

2. **Compound Interest**: The amount of money A in an account at the end of n quarters at r% compounded quarterly for a principal P can be found by the function $A = P(1 + r/4)^n$. For a principal of $8000 deposited in an account at 6% interest compounded quarterly, the function becomes $A = 8000(1.015)^n$. How long will it take for the account to be worth $10,000?
How long will it take for the account to double in value?

3. **Learning**: The number of words per minute a student can type will increase with practice and can be approximated by the function $N(t) = 100[1-(0.9)^t]$, where N(t) is the number of words typed per minute after t days of instruction. How many days of instruction will it take for a student to type 60 words per minute?

4. **Spread of disease**: on a college campus of 10,000 students, a single student returned to campus infected by a disease. The spread of the disease through the student body is given by $y = \dfrac{10{,}000}{1 + 9999e^{-0.99t}}$, where y is the total number infected at time t (in days). If the school will shut down if 50% of the students are ill, during what day will it close?

5. **Marketing**: A statistical study shows that the ~~fraction~~ percentage of television sets of a certain brand that are still in service after x years is given by $f(x) = e^{-0.15x}$. What ~~fraction~~ percent are still in service after 5 years?
In how many years will only 5% of the brand be in service?