Example 4: During the exponential phase, a population of bacteria in a culture increases at a rate proportional to the current population. If the growth rate is 5% per hour, and the current population is 500, what will be the population in 6.4 hours?

$P = 500 \cdot e^{0.05 \times 6.4} \simeq$ **689 bacteria**

⚠ $P \neq 500 \times 1.05^{6.4}$ because the percentage is compounded continuously.

Example 6: During the exponential phase, a population of bacteria in a culture increases at a rate proportional to the current population. If the population doubles in 20 days, and the current population is 1000, when will the population be 3000?

$3000 = 1000 \times 2^{t/20}$

$3 = 2^{t/20}$

$\frac{t}{20} \ln 2 = \ln 3$

$t = \frac{20 \ln 3}{\ln 2}$

$t \simeq 31.7$ days

Example 7: A savings account balance is compounded continuously. If the interest rate is 2.8% per year and the current balance is \$2400.00, in how many years will the balance reach \$3000?

$3000 = 2400 \times e^{0.028t}$

$\frac{5}{4} = e^{0.028t}$

$t = \frac{\ln(5/4)}{0.028}$

$t \simeq 8$ years

Example 8: A radioactive substance decays at a rate proportional to the amount present. If the decay rate is 5% per year, and the current mass is 100mg, what will be the mass in 10 years?

$M = 100 \times e^{-0.05 \times 10}$

$M \simeq 60.653$ mg