Common Logarithmic and Exponential Formulas

Compound Interest Formula

If P dollars are deposited in an account earning interest at an annual rate r, compounded k times each year, the amount A in the account after t years is given by

$$A = P\left(1 + \frac{r}{k}\right)^{kt}.$$

Continuous Compound Interest Formula

If P dollars are deposited in an account earning interest at an annual rate r, compounded continuously, the amount A after t years is given by

$$A = Pe^{rt}.$$

Malthusian Model of Population Growth

If b is the annual birth rate, d is the annual death rate, t is the time in years, P_0 is the initial population at $t = 0$, and P is the current population, then

$$P = P_0 e^{kt},$$

where $k = b - d$ is the annual growth rate.

Decibel Voltage Gain

If E_O is the output voltage of a device and E_I is the input voltage, the decibel voltage gain is

$$\text{dB Gain} = 20 \log\left(\frac{E_O}{E_I}\right).$$

Richter Scale

If R is the intensity of an earthquake, A is the amplitude (in micrometers), and P is the period (in seconds), then

$$R = \log\left(\frac{A}{P}\right).$$

Charging Batteries

If M is the theoretical maximum charge that a battery can hold and k is a positive constant depending on the battery and charger, the time (in minutes) required to charge the battery to a level C is

$$t = -\frac{1}{k} \ln\left(1 - \frac{C}{M}\right).$$

Isothermal Expansion

If the temperature T is constant, the energy E required to increase the volume of 1 mole of gas from initial volume V_i to final volume V_f is

$$E = RT \ln\left(\frac{V_f}{V_i}\right),$$

where E is measured in joules, T in kelvins, and $R = 8.314$ J/(mol·K) is the universal gas constant.

Radioactive Decay Formula

The amount A of radioactive material present at time t is

$$A = A_0 2^{-t/h},$$

where A_0 is the initial amount and h is the half-life.