Logarithms in Practice

Radioactive Decay Model: If P is the initial mass of a radioactive substance with a half life h, then the mass remaining A, at time t is modeled by:

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

where $r = \frac{\ln 2}{h}$.

1. A skeleton of a cat was found in a well and has a ratio of carbon 14 to carbon 12 that is 61% of the corresponding ratio for living things. (Carbon 14 is only make by living things, carbon 14 begins to decay to carbon 12 upon death. The halflife of carbon 14 is 5730 years.) About how long ago did the cat die?

Newton's Law of Cooling: If D is the initial temperature difference between an object and its surroundings, and if its surroundings have a temperature T, then the temperature of the object A and time t is modeled by:

$$A = T + De^{-kt}$$

where k is a positive constant that depends on the type of object.

2. Initially coffee has a temperature of 200°F in a room that is 70°. After ten minutes the temperature is 150°. What will the temperature of the coffee be after an additional ten minutes passes?

pH Scales: Let $[H^+]$ be the concentration of hydrogen ions in solution X measured in moles per liter (denoted M). Then

$$\text{pH level of solution } X = -\log[H^+]$$

3. What is the pH level of human blood if the concentration of hydrogen ions in blood is about $3.16 * 10^{-8}$M?

4. How many times more concentrated is $[H^+]$ of acid rain with a pH value of 3 to ordinary rain with a pH value of 6?