Applications of Logarithms

Name: _____

1) The **Richter scale** is commonly used to measure the intensity of an earthquake. If E, measured in joules, is the energy released during an earthquake, then the magnitude of the earthquake is given by, $M = \frac{2}{3}\log\left(\frac{E}{E_0}\right)$ where E_0 is $10^{4.4}$ joules.

a) If 8×10^{14} joules of energy are released during an earthquake, what is the magnitude of the earthquake?

b) How much energy is released in an earthquake with a magnitude of 5.9?

2) **Sound intensities**, I, are often compared with the threshold of human hearing, I_0, which is about 10^{-12} watts per meter squared. The relative intensity, R, of a sound in decibels is given by the equation $R = 10\log\left(\frac{I}{I_0}\right)$.

a) The intensity of a whisper is about 300 times as loud as the threshold of human hearing. Find the relative intensity, R, of a whisper in decibels.

b) Suppose a burglar alarm has a rating of 120 decibels. Compare this intensity to the threshold of human hearing.

3) The **pH level** of a solution describes its acidity: the lower the pH, the more acidic a solution. Apple juice for example, has a pH of about 3, while ammonia has a pH of about 11. The pH of a substance is defined by the equation $pH = -\log(H^+)$ where H^+ is the hydrogen ion concentration in moles per liter.

a) The pH of carbonated soda is 3.

What is H^+?

b) There are 0.003 moles of hydrogen ions in one liter of an unidentified solution. What is the solution's pH?

4) **Desalination** is the process of producing fresh water from salt water. The equation for converting salt water to fresh water is given by $y = 18.27 + 31.03 \ln(t)$ where y represents the amount of fresh water that is produced in cubic yards and t is time measured in hours.

a) How much fresh water can be produced after 10 hours?

b) How long will it take produce 200 cubic yards of fresh water?

5) One type of investment involves **interest compounded continuously**; that is, the money earned on the principal is added instantaneously, rather than quarterly or monthly. The equation that describes this is $A = Pe^{rt}$. If \$5,000 is put into an account that has an interest rate of 3.5%, how long will it take the account to double?