Dr. Katiraie MA115A Section 3.3 Quiz 3 Form A Name: Solutions

1. Suppose that in January there is a magnitude 3.5 earthquake hitting the east coast of the United States. Six months later, a magnitude 5.5 earthquake hits the west coast. How many times more intense was the west coast quake compared to the east coast quake?

$5.5 - 3.5 = 2.00$

$\text{Relative Intensity} = 10^{\wedge \text{magnitude}} = 10^2 = 100$

The west coast quake was 100 times more intense than the east coast quake.

2. How many times more intense is a 4.0 magnitude earthquake compared to a 1.0 magnitude earthquake?

$4 - 1.00 = 3.00$

$\text{Relative Intensity} = 10^3 = 1000 \text{ times}$

3. A speaker is playing music at 80 decibels. A second speaker playing the same music at the same decibel reading is placed beside the first. What is the decibel reading of the pair of speakers?

$\text{Relative Intensity of one speaker} = 1.26^{\wedge 80}$

$\text{Relative Intensity of a pair of speakers} = 2 * 1.26^{\wedge 80}$

$\text{Decibels} = 10 \log(\text{Relative Intensity}) = 10 \log(2 * 1.26^{180}) \cong 83.31$

4. If the per capita growth rate of the world population continues to be what it was in the year 2000, the world population t years after July 1, 2000, will be 6.085×1.0121^t billion. According to this formula, when will the world population reach 12 billion?

$12 = 6.085 \times 1.0121^t \Rightarrow \frac{12}{6.085} = 1.0121^t \Rightarrow t = \frac{\log\left(\frac{12}{6.085}\right)}{\log(1.0121)} = 56.4$ years

After July 1, 2000

5. The acidity of a solution is determined by the concentration H of hydrogen ions. The formula is $pH = -\log H$. The accompanying exponential formula is $H = 0.1^{pH}$. Lower pH values indicate a more acidic solution. Normal rain has a pH of 5.7. Suppose acid rain has a pH of 3.3. How many times as acidic as normal rain is this?

$H = 0.1^{5.7}$

$H = 0.1^{3.3}$

$\Rightarrow \frac{0.1^{\wedge 3.3}}{0.1^{5.7}} \cong 251.2 \text{ times}$

6. What is the solution to $3.5 = 1.05^t$?

$t = \log_{1.05} 3.5 = \frac{\log 3.5}{\log 1.05} \cong 25.68 \approx 25.7$

7. You have $1000 and wish to buy a computer. You find an investment that increases by 5% each month, and you put your $1000 into the account. When will the amount enable you to purchase a computer costing $2000?

$2000 = 1000(1+0.05)^t \Rightarrow 2 = 1.05^t$

$\Rightarrow t = \log_{1.05} 2 = \frac{\log 2}{\log 1.05} \cong 14.21$ months

8. Suppose that a certain jet engine up close produces sound at 165 decibels. What is the decibel reading of a pair of nearby jet engines?

Relative Intensity of one jet enjine $= 1.26^{\wedge}165$

Relative Intensity of a pair of jet enjines $= 2*1.26^{\wedge}165$

Decibels $= 10 \log$ (Relative Intensity) $=$

$= 10 \log(2*1.26^{\wedge}165) \cong 168.62$

9. From 1929 to the early 1930s, the prices of consumer goods actually decreased. Economists call this phenomenon *deflation*. The rate of deflation during this period was around 7% per year. Suppose this rate of deflation persisted over a period of 10 years. What would be the cost after 10 years of an item that costs $2000 initially?

$2000(1-0.07)^{10} = 2000(0.93)^{10} \cong \$967.96$

10. The energy released by an earthquake is related to the magnitude by an exponential function: Energy = $25{,}000 \times 31.6^{\text{Magnitude}}$. The unit of energy in the above equation is a *joule*. One joule is approximately the energy expressed in lifting ¾ of a pound 1 foot. The earthquake that devastated a certain country on January 12, 2010 had a magnitude of 6.0 and killed hundreds of thousands of people. How much energy was released by this earthquake?

Energy $= 25000 \times 31.6^{\wedge}6.0 = 2.489 \times 10^{\wedge}13$ Joules