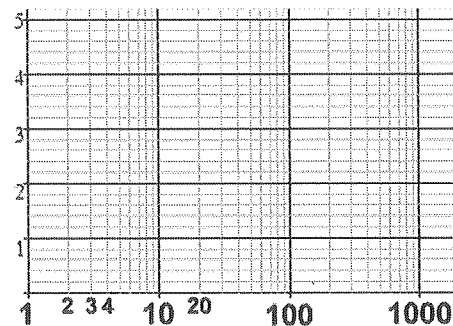
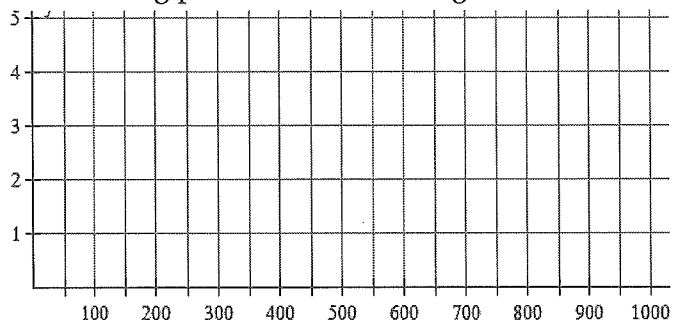


Day 9: 6.5/7.5 - Applications in Physical Sciences

Warm Up - Plot the following points on both of the grids below:

10	1
50	1.7
100	2
300	2.5
1000	3



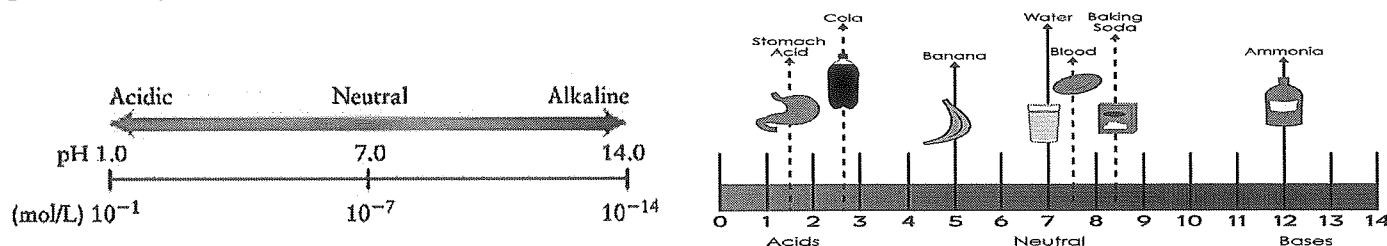
Logarithmic scales are non-linear scales that are used to compare values that have a very large range of values

Acids and Bases: the pH scale

The pH scale measures the acidity or alkalinity of a chemical solution, and is defined as:

$$pH = -\log[H^+] \quad \text{where } H^+ \text{ is the concentration of hydronium ions in moles per litre}$$

pH values typically range from 1 to 14, with pH 7 representing a neutral solution.



EX 1 -

- a) Tomato juice has a hydronium ion concentration of approximately 0.0001 mol/L. What is its pH? $pH = -\log [H^+]$

$$\begin{aligned} &= -\log(0.0001) \\ &= -(-4) = 4 \end{aligned}$$

- b) Orange juice has a pH of approximately 3. What is the concentration of hydronium ions, in orange juice?

$$\begin{aligned} 3 &= -\log [H^+] \\ \therefore -3 &= \log [H^+] \end{aligned}$$

$$H^+ = 10^{-3} = 0.001 \text{ mol/L}$$

- c) Which has a greater concentration of hydronium ions, orange juice or tomato juice, and by how much?

Orange juice has a higher concentration of H^+

$$\frac{0.001}{0.0001} = 10 \Rightarrow 10 \text{ times higher.}$$

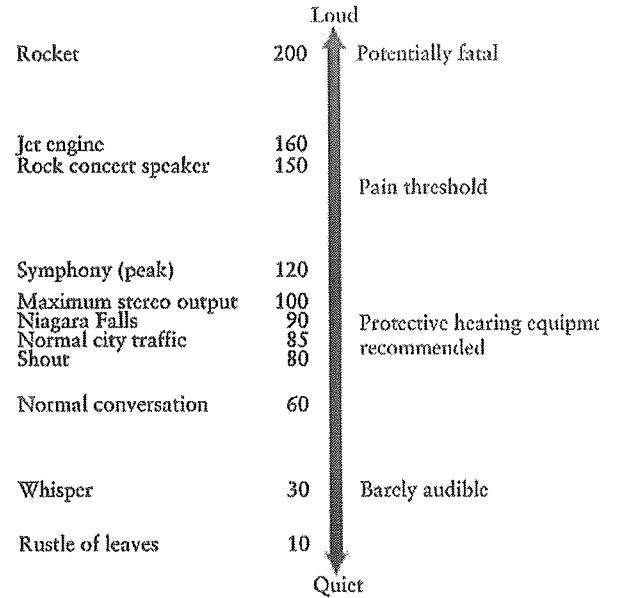
Sound Intensity: the decibel scale

Sound intensity is measured in watts per square metre (W/m^2)

The difference between two sound levels ($\beta_2 - \beta_1$) is measured in decibels (dB), and is defined as:

$$\beta_2 - \beta_1 = 10 \log \left(\frac{I_2}{I_1} \right)$$

where $\frac{I_2}{I_1}$ is the ratio of the intensities of the two sounds in W/m^2 .



EX 2 -

- a) How many times as intense as a whisper is the sound of a normal conversation?

whisper: $\beta_1 = 30$ Normal conv: $\beta_2 = 60$

$$60 - 30 = 10 \log(I)$$

$$30 = 10 \log(I)$$

$$3 = \log I$$

$$I = 10^3 \approx 1000 \text{ } \approx 1000 \text{ times as more intense.}$$

- b) The sound level in normal city traffic is approximately 85 dB. The sound level while riding a snowmobile is about 10 times as intense. What is the sound level while riding a snowmobile, in decibels?

$$\beta_2 - 85 = 10 [\log 10]$$

$$\beta_2 - 85 = 10$$

$$\beta_2 = 95 \text{ dB.}$$

∴ Sound level for snowmobile is 95 dB.

Earthquake Power: the Richter scale

- Earthquakes can vary greatly in intensity from relatively mild to highly destructive.
- The Richter scale using a number called the magnitude, M , to represent the intensity of a given earthquake, I , in comparison to that of a standard low level earthquake, I_0
- The magnitude of an earthquake is defined as:

$$M = \log\left(\frac{I}{I_0}\right)$$

EX 3 -

- a) How many times as intense as a standard low-level (magnitude zero) earthquake is an earthquake measuring 4 on the Richter scale?

$$4 = \log\left(\frac{I}{I_0}\right)$$

$$10^4 = I/I_0$$

\therefore Earthquake measuring 4 on the Richter scale is 10000 times more intense.

- b) What is the magnitude of an earthquake 1000 times as intense as a standard low-level (magnitude zero) earthquake?

$$\begin{aligned} M &= \log(1000) \\ &= 3 \end{aligned}$$

