A Review of pH and its Relationship to [H^+] SOLUTIONS[i]

Bio390

"The equilibrium states of chemical reactions in which H^+ is involved are determined by the effective concentrations of the reacting substances, so that [H^+] is what we must think about and deal with if we wish to analyze quantitatively and understand systems of such reactions. From this viewpoint, pH is a very **strange** and **confusing doubly nonlinear transformation** of [H^+]."
The above quote is from, P.A. Stewart, How to Understand Acid-Base. 1981. Elsevier, New York.

a. The concentration of [H^+] in arterial plasma is 40 nano molar (nM)
(= to $\frac{40 \times 10^{-9} \text{ mols}}{\text{liter}}$). Estimate pH of arterial plasma.

$$pH = -\log [H^+] = -\log(40 * 10^{-9} \text{ nM}) \approx \mathbf{7.4}$$

b. Estimate the pH of arterial plasma if [H^+] doubled in arterial plasma.

Now the concentration of H^+ is 80 nM:

$$pH = -\log [H^+] = -\log(80 * 10^{-9} \text{ nM}) \approx \mathbf{7.1}$$

c. In humans, arterial plasma has a pH of 7.40 while that of venous plasma is 7.36. Which plasma is more acidic? How many times more acidic?

Obviously, venous is more acidic.

We can find the concentration of H^+ from the *p*H by rearrangement of the *p*H equation:

$$[H^+] = 10^{-pH}$$

and so the ratio of H^+ ions at *p*H 7.36 vs 7.40 would be:
ratio = $10^{-7.36} / 10^{-7.40} = (4.365 * 10^{-8}) / (3.98 * 10^{-8}) = 1.0965$ X -- roughly a 10% increase for a 0.04 unit change!

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