Exercise 303

The concentration of hydrogen ions in a substance is denoted by $[H^+]$, measured in moles per liter. The pH of a substance is defined by the logarithmic function $\text{pH} = -\log[H^+]$. This function is used to measure the acidity of a substance. The pH of water is 7. A substance with a pH less than 7 is an acid, whereas one that has a pH of more than 7 is a base.

a. Find the pH of the following substances. Round answers to one digit.

b. Determine whether the substance is an acid or a base.

   i. Eggs: $[H^+] = 1.6 \times 10^{-8}$ mol/L

   ii. Beer: $[H^+] = 3.16 \times 10^{-3}$ mol/L

   iii. Tomato Juice: $[H^+] = 7.94 \times 10^{-5}$ mol/L

Solution

Use a calculator.

$$\text{Eggs:} \quad [H^+] = 1.6 \times 10^{-8} \ \frac{\text{mol}}{\text{L}} \quad \rightarrow \quad \text{pH} = -\log(1.6 \times 10^{-8}) \approx 7.8 \approx 8 \qquad \text{(Base)}$$

$$\text{Beer:} \quad [H^+] = 3.16 \times 10^{-3} \ \frac{\text{mol}}{\text{L}} \quad \rightarrow \quad \text{pH} = -\log(3.16 \times 10^{-3}) \approx 2.50 \approx 3 \quad \text{(Acid)}$$

$$\text{Tomato Juice:} \quad [H^+] = 7.94 \times 10^{-5} \ \frac{\text{mol}}{\text{L}} \quad \rightarrow \quad \text{pH} = -\log(7.94 \times 10^{-5}) \approx 4.10 \approx 4 \quad \text{(Acid)}$$