**Mixing Two Model Rain Samples**

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A classroom model compares two unbuffered rain samples. Use the supplied hydrogen ion concentrations. In this model the hydrogen ion amounts add when the samples mix and the total volume is the sum of the sample volumes.

| Sample | Volume (L) | Hydrogen ion concentration (mol/L) | pH |
|---|---|---|---|
| P | 0.50 | $1.0 \times 10^{-5}$ | 5.0 |
| Q | 0.50 | $1.0 \times 10^{-6}$ | 6.0 |

**1** Before mixing, which sample contains more hydrogen ions and by what factor?

(1) P by a factor of 2

(2) P by a factor of 10

(3) Q by a factor of 2

(4) Q by a factor of 10

**2** Calculate the hydrogen ion concentration after the two full samples are mixed. Show how both samples enter the calculation. [1]

Answer and work

The class uses $pH = -\log_{10}[H^+]$ in the model. It calculates that a solution with pH 5.5 has a hydrogen ion concentration of about $3.2 \times 10^{-6}$ mol/L.

**3** A student averages 5.0 and 6.0 and reports a mixture pH of 5.5. Use the concentrations to decide whether the mixture pH should be above or below 5.5. [1]

Answer and work

**4** If a third equal volume of sample Q is added to the mixture, explain why the hydrogen ion concentration moves toward Q’s value. [1]

Answer and work