## Exercise 10.5

The concentration of $Cu^{2+}$ in a sample is determined by reacting it with the ligand cuprizone and measuring its absorbance at 606 nm in a 1.00-cm cell. When a 5.00-mL sample is treated with cuprizone and diluted to 10.00 mL, the resulting solution has an absorbance of 0.118. A second 5.00-mL sample is mixed with 1.00 mL of a 20.00 mg/L standard of $Cu^{2+}$, treated with cuprizone and diluted to 10.00 mL, giving an absorbance of 0.163. Report the mg $Cu^{2+}$/L in the sample.

## Solution

For this standard addition we write equations that relate absorbance to the concentration of $Cu^{2+}$ in the original sample, $C_{Cu}$, before the standard addition

$$0.118 = \epsilon b \left[ C_{Cu} \times \frac{5.00 \text{ mL}}{10.00 \text{ mL}} \right]$$

and after the standard addition

$$0.162 = \epsilon b \left[ C_{Cu} \times \frac{5.00 \text{ mL}}{10.00 \text{ mL}} + \frac{20.00 \text{ mg Cu}}{\text{L}} \times \frac{1.00 \text{ mL}}{10.00 \text{ mL}} \right]$$

in each case accounting for the dilution of the original sample and the standard. The value of $\epsilon b$ is the same in both equations. Solving each equation for $\epsilon b$ and equating

$$\frac{0.162}{\left[ C_{Cu} \times \frac{5.00 \text{ mL}}{10.00 \text{ mL}} + \frac{20.00 \text{ mg Cu}}{\text{L}} \times \frac{1.00 \text{ mL}}{10.00 \text{ mL}} \right]} = \frac{0.118}{\left[ C_{Cu} \times \frac{5.00 \text{ mL}}{10.00 \text{ mL}} \right]}$$

leaves us with an equation in which $Cu^{2+}$ is the only variable. Solving for $Cu^{2+}$ gives its value as

$$\frac{0.162}{0.500 \times C_{Cu} + 2.00} = \frac{0.118}{0.500 \times C_{Cu}}$$

$$0.0810 C_{Cu} = 0.0590 C_{Cu} + 0.236$$

$$0.236 = 0.0220 C_{Cu}$$

$$C_{Cu} = 10.7 \text{ mg Cu/L}$$