Chapter 1

1. A transducer is a device that converts information contained in a chemical or physical domain into an electrical signal, or the reverse. The most common input transducers convert chemical or physical information to current, voltage or charge, and the most common output transducers convert electrical signals into some numerical form.

6. Analog domains consist of electrical signals that are continuous in both magnitude and time. Information is encoded as the magnitude of electrical quantities such as voltage, current, charge and power.

10. Let $\text{[Cu}^{2+}\text{]}_{\text{std}} = \text{molar concentration in standard} = 0.0287 \text{ M}$

$\text{[Cu}^{2+}\text{]}_{\text{unk}} = \text{molar concentration in unknown}$

$V_{\text{std}} = \text{volume of standard} = 0.500 \text{ mL}$

$V_{\text{unk}} = \text{volume of unknown} = 25.0 \text{ mL}$

$S_{\text{unk}} = \text{signal for unknown} = 23.6$

$S_{\text{unk+std}} = \text{signal for unknown plus standard} = 37.9$

Assuming that the signal is proportional to concentration,

$S_{\text{unk}} = k [\text{Cu}^{2+}]_{\text{unk}}$  and  $k = \frac{S_{\text{unk}}}{[\text{Cu}^{2+}]_{\text{unk}}}$

and after addition of the standard

$S_{\text{unk+std}} = k \left( \frac{V_{\text{unk}}[\text{Cu}^{2+}]_{\text{unk}} + V_{\text{std}}[\text{Cu}^{2+}]_{\text{std}}}{V_{\text{unk}} + V_{\text{std}}} \right)$

Substituting for $k$ and rearranging gives

$[\text{Cu}^{2+}]_{\text{unk}} = \frac{S_{\text{unk}}V_{\text{std}}[\text{Cu}^{2+}]_{\text{std}}}{S_{\text{unk+std}}(V_{\text{unk}} + V_{\text{std}}) - S_{\text{unk}}V_{\text{unk}}} = \frac{(23.6)(0.500 \text{ mL})(0.0287 \text{ M})}{37.9(0.500 \text{ mL} + 25.0 \text{ mL}) - 23.6(25.0 \text{ mL})} = 9.00 \times 10^{-4} \text{ M}$