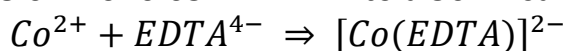


Answer on Question #66937, Chemistry - General Chemistry

EDTA⁴⁻ binds metal ions to form complexes, thus can be used to determine concentrations of metal ions. Calculate the concentration of [Co²⁺] in solution after the addition of 48.0mL of 0.05M EDTA⁴⁻ to a 50mL sample of 0.048M [Co²⁺].



$$K_f = 2.04 \times 10^{16}$$

Solution:

$$1. c(Co^{2+}) = [Co^{2+}] + [[Co(EDTA)]^{2-}] = \frac{50 \times 0.048}{98} = 2.45 \times 10^{-2} \text{ M}$$

$$2. c(EDTA^{4-}) = [EDTA^{4-}] + [[Co(EDTA)]^{2-}] = \frac{48 \times 0.05}{98} = 2.45 \times 10^{-2} \text{ M}$$

$$3. [[Co(EDTA)]^{2-}] = c(Co^{2+}) - [Co^{2+}]$$

$$4. [EDTA^{4-}] = c(EDTA^{4-}) - [[Co(EDTA)]^{2-}] = c(EDTA^{4-}) - c(Co^{2+}) + [Co^{2+}] = 2.45 \times 10^{-2} - 2.45 \times 10^{-2} + [Co^{2+}] = [Co^{2+}]$$

$$5. K_f = \frac{[[Co(EDTA)]^{2-}]}{[Co^{2+}] * [EDTA^{4-}]}$$
$$2.04 \times 10^{16} = \frac{[[Co(EDTA)]^{2-}]}{[Co^{2+}] * [EDTA^{4-}]} = \frac{2.45 \times 10^{-2} - [Co^{2+}]}{[Co^{2+}] * [Co^{2+}]}$$

$$2.04 \times 10^{16} = \frac{2.45 \times 10^{-2}}{[Co^{2+}] * [Co^{2+}]} = \frac{2.45 \times 10^{-2}}{[Co^{2+}]^2} \Rightarrow [Co^{2+}]^2$$
$$= \frac{2.45 \times 10^{-2}}{2.04 \times 10^{16}}$$

$$[Co^{2+}]^2 = 1.2 \times 10^{-18}$$

$$[Co^{2+}] = 1.1 \times 10^{-9} \text{ M}$$

Answer: the concentration of [Co²⁺] in solution is 1.1*10⁻⁹ M.