

OpenCourseWare (2023)

CHEMISTRY II

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EXERCISES OF CORROSION



Exercise 1. A copper bar is immersed in a solution of hydrochloric acid. If the amount of oxygen available in the cathode is negligible, write the balanced oxidation and reduction half-reactions and the global reaction.

Data: $E^0(\text{Cu}^{2+}/\text{Cu}) = +0.34 \text{ V}$.

Exercise 2. Explain electrochemically the formation of the solid $\text{Fe}(\text{OH})_3$ commonly known as rust in an electrolytic corrosion cell.

Data: $E^0(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$.

Exercise 3. A piece of corroded metal alloy plate was found in a submerged ocean vessel. It was estimated that the original area of the plate was 800 cm^2 and that approximately 7.6 kg had corroded away during the submersion. Assuming a corrosion penetration rate of 4 mm/yr for this alloy in seawater, estimate the time of submersion in years. The density of the alloy is 4.5 g/cm^3 .

Exercise 4. A sample of magnesium corrodes uniformly with a current density of $1.8 \times 10^{-5} \text{ A/cm}^2$ in an aqueous solution. What is the corrosion rate of magnesium in $\text{mol/m}^2 \text{ s}$?

Exercise 5. Why does chromium in stainless steels make them more corrosion resistant in many environments than plain carbon steels?

Exercise 6. Several types of metallic coatings are used to protect steel, including zinc, lead, tin, aluminium, and nickel. In which of these cases will the coating provide protection even when the coating is locally disrupted? Justify your answer.

Data: $E^0(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$; $E^0(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$; $E^0(\text{Pb}^{2+}/\text{Pb}) = -0.13 \text{ V}$; $E^0(\text{Sn}^{2+}/\text{Sn}) = -0.14 \text{ V}$; $E^0(\text{Al}^{3+}/\text{Al}) = -1.66 \text{ V}$; $E^0(\text{Ni}^{2+}/\text{Ni}) = -0.25 \text{ V}$.

Exercise 7. A steel nut is securely tightened onto a bolt in an industrial environment. After several months, the nut is found to contain numerous cracks. Explain why cracking might have occurred. Could this be avoided by using inhibitors? And coatings?