21.10 Quinones
Oxidation of hydroquinone produces \( p \)-benzoquinone.

**Oxidant:** \( \text{Na}_2\text{Cr}_2\text{O}_7, \ (\text{KSO}_3)_2\text{NO} \) — Fremy’s salt (potassium nitrosodisulfonate)

\[
\begin{align*}
\text{OH} & \quad \text{OH} \\
\text{O} & \quad +2e^- \\
\text{OH} & \quad \text{O}
\end{align*}
\]

Hydroquinone \( p \)-Benzoquinone

This reaction is reversible; \( p \)-benzoquinone is easily reduced by mild reducing agents to hydroquinone.

\[
\begin{align*}
\text{SnCl}_2, \text{H}_2\text{O} & \quad \rightarrow \quad \text{SnCl}_2, \text{H}_2\text{O} \\
(\text{KSO}_3)_2\text{NO} & \quad \rightarrow \quad (\text{KSO}_3)_2\text{NO}
\end{align*}
\]
Quinones are an interesting and valuable class of compounds because of their oxidation-reduction, or redox, properties.

The redox properties of quinones are important to the functioning of living cells, where compounds called ubiquinones (\( \square \square \)) act as biochemical oxidizing agents to mediate the electro-transfer processes involved in energy production.

\[
\begin{align*}
\text{Ubiquinones (n=6) (coenzymes Q)} & \quad +2e^- , +2H^+ & \quad \text{Ubiquinols (hydroquinone form)}
\end{align*}
\]
Chapter 21

1,4-Naphthoquinone

Vitamin K₁

The substance first identified as essential for the normal clotting of blood

Alizarin

A red pigment extracted from the roots of the madder plant