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A **disproportionation reaction** is a type of redox (reduction-oxidation) reaction in which a single substance undergoes both oxidation and reduction simultaneously, forming two different products. In other words, the same element in the reactant gets both oxidized and reduced in the products.

Example of a Disproportionation Reaction:

The decomposition of hydrogen peroxide ($\mathrm{H_2O_2}$) is a classic example:

$$2\mathrm{H_2O_2}(aq) \rightarrow 2\mathrm{H_2O}(l) + \mathrm{O_2}(g)$$

In this reaction, oxygen in hydrogen peroxide is in the -1 oxidation state. It is simultaneously reduced to water (where oxygen is in the -2 oxidation state) and oxidized to oxygen gas (where oxygen is in the 0 oxidation state).

Problems Based on Disproportionation Reaction:

1. **Problem 1**: Write a balanced equation for the disproportionation of chlorine gas in an alkaline medium.
2. **Problem 2**: Balance the disproportionation reaction of phosphorus from $\mathrm{P_4}$ to $\mathrm{H_3PO_4}$ and $\mathrm{PH_3}$.
3. **Problem 3**: In the reaction where iron(III) is converted to iron(II) and iron(0), write the balanced disproportionation reaction.
4. **Problem 4**: Identify and balance the disproportionation reaction for the transformation of sodium hypochlorite (NaOCl) in water.
5. **Problem 5**: Balance the disproportionation reaction of bromine in an acidic medium.
6. **Problem 6**: Determine the products and write the balanced disproportionation reaction for the decomposition of potassium manganate ($\mathrm{K_2MnO_4}$) in a neutral medium.

Key for the Problems (next page):

- For Problem 1, chlorine gas in alkali ($\mathrm{Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O}$).
- For Problem 2, phosphorus undergoes disproportionation as: $\mathrm{P_4 + 4OH^- + 8H_2O \rightarrow 4H_3PO_4 + 4PH_3}$.
- For Problem 3, iron disproportionates: $\mathrm{2Fe^{3+} \rightarrow Fe^{2+} + Fe^0}$.
- For Problem 4, sodium hypochlorite disproportionates: $\mathrm{NaOCl \rightarrow NaCl + O_2}$.
- For Problem 5, bromine disproportionates: $\mathrm{Br_2 \rightarrow Br^- + BrO_3^-}$.
- For Problem 6, potassium manganate disproportionates: $\mathrm{K_2MnO_4 \rightarrow MnO_2 + O_2}$.

These problems and answers focus on recognizing and balancing disproportionation reactions, essential in understanding redox chemistry.