

How to

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Write Half Reactions



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Writing Half Equations

A half equation is a chemical equation that shows how one species - either the oxidising agent or the reducing agent - behaves in a redox reaction. If you add two half equations together, you get a redox equation.

Step 1: Determine the oxidation states on each side of the equation.

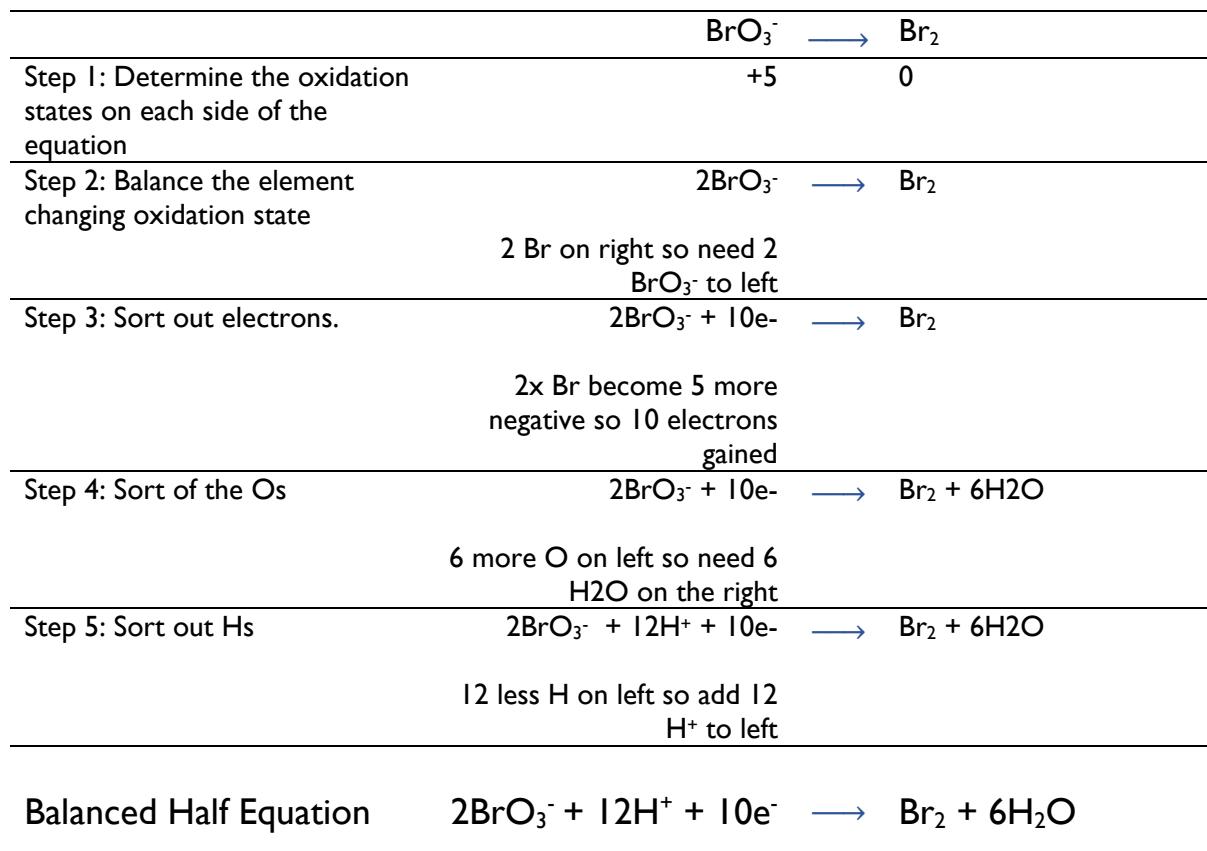
Step 2: Balance the element changing oxidation state.

Step 3: Sort out electrons. If the oxidation state becomes more negative, then it gains electrons. If the oxidation state becomes more positive, then electrons are lost.

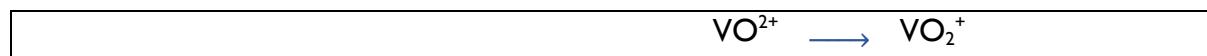
Step 4: Sort out Os. For every O gained/lost, add/remove one H₂O molecule.

Step 5: Sort out Hs. For every H gained/lost, add/remove one H⁺ ion.

Example 1: BrO₃⁻ → Br₂



Example 2: VO²⁺ → VO₂⁺



Step 1: Determine the oxidation states on each side of the equation	+4	+5
Step 2: Balance the element changing oxidation state	VO^{2+}	$\longrightarrow \text{VO}_2^+$
	V becomes 1 more positive so 1 electron lost	
Step 3: Sort out electrons.	VO^{2+}	$\longrightarrow \text{VO}_2^+ + \text{e}^-$
	V becomes 1 more positive so 1 electron	
Step 4: Sort of the Os	$\text{VO}^{2+} + \text{H}_2\text{O}$	$\longrightarrow \text{VO}_2^+ + \text{e}^-$
	1 less O on left so add 1 H_2O on the left	
Step 5: Sort out Hs	$\text{VO}^{2+} + \text{H}_2\text{O}$	$\longrightarrow \text{VO}_2^+ + 2\text{H}^+ + \text{e}^-$
	2 less H on right so add 2 H^+ to right	
Balanced Half Equation	$\text{VO}^{2+} + \text{H}_2\text{O}$	$\longrightarrow \text{VO}_2^+ + 2\text{H}^+ + \text{e}^-$



Practice Problems

- a) $\text{Na} \rightarrow \text{Na}^+$
- b) $\text{Pb}^{4+} \rightarrow \text{Pb}^{2+}$
- c) $\text{H}_2 \rightarrow \text{H}^+$
- d) $\text{Br}^- \rightarrow \text{Br}_2$
- e) $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$
- f) $\text{SO}_4^{2-} \rightarrow \text{S}$
- g) $\text{SO}_4^{2-} \rightarrow \text{H}_2\text{S}$
- h) $\text{SO}_4^{2-} \rightarrow \text{SO}_2$
- i) $\text{N}_2 \rightarrow \text{NO}_3^-$
- j) $\text{IO}_3^- \rightarrow \text{I}_2$
- k) $\text{Hg}^{2+} \rightarrow \text{Hg}_2^{2+}$
- l) $\text{S}_2\text{O}_3^{2-} \rightarrow \text{S}$
- m) $\text{NO}_3^- \rightarrow \text{NO}_2^-$

Answers are given on the next page

**Practice Problem Answers**

- a) $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$
- b) $\text{Pb}^{4+} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$
- c) $\text{H}_2 \rightarrow \text{H}^+ + 2\text{e}^-$
- d) $\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$
- e) $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2 \text{Cr}^{3+} + 7\text{H}_2\text{O}$
- f) $\text{SO}_4^{2-} + 6\text{e}^- + 8\text{H}^+ \rightarrow \text{S} + 4\text{H}_2\text{O}$
- g) $\text{SO}_4^{2-} + 8\text{e}^- + 10\text{H}^+ \rightarrow \text{H}_2\text{S} + 4\text{H}_2\text{O}$
- h) $\text{SO}_4^{2-} + 2\text{e}^- + 4\text{H}^+ \rightarrow \text{SO}_2 + 2\text{H}_2\text{O}$
- i) $\text{N}_2 + 6\text{H}_2\text{O} \rightarrow 2\text{NO}_3^- + 12\text{H}^+ + 10\text{e}^-$
- j) $2\text{IO}_3^- + 10 \text{e}^- + 12\text{H}^+ \rightarrow \text{I}_2 + 6\text{H}_2\text{O}$
- k) $2\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg}_2^{2+} + 7\text{H}_2\text{O}$
- l) $\text{S}_2\text{O}_3^{2-} + 6\text{H}^+ + 4 \text{e}^- \rightarrow 2\text{S} + 3 \text{H}_2\text{O}$
- m) $\text{NO}_3^- + 2\text{e}^- + 2 \text{H}^+ \rightarrow \text{NO}_2^- + \text{H}_2\text{O}$