How to .....

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 H_2O molecule.

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

Example 1: $BrO_3^- \rightarrow Br_2$

	BrO_3^- ⟶ Br_2
Step 1: Determine the oxidation states on each side of the equation	+5 ⟶ 0
Step 2: Balance the element changing oxidation state	$2BrO_3^-$ ⟶ Br_2 2 Br on right so need 2 BrO_3^- to left
Step 3: Sort out electrons.	$2BrO_3^- + 10e^-$ ⟶ Br_2 2x Br become 5 more negative so 10 electrons gained
Step 4: Sort of the Os	$2BrO_3^- + 10e^-$ ⟶ $Br_2 + 6H2O$ 6 more O on left so need 6 H2O on the right
Step 5: Sort out Hs	$2BrO_3^- + 12H^+ + 10e^-$ ⟶ $Br_2 + 6H2O$ 12 less H on left so add 12 H^+ to left
Balanced Half Equation	$2BrO_3^- + 12H^+ + 10e^-$ ⟶ $Br_2 + 6H_2O$

Example 2: $VO^{2+} \rightarrow VO_2^+$

	VO^{2+} ⟶ VO_2^+

Step 1: Determine the oxidation states on each side of the equation	+4		+5
Step 2: Balance the element changing oxidation state	VO^{2+}	$\longrightarrow$	VO_2^+
	V becomes 1 more positive so 1 electron lost		
Step 3: Sort out electrons.	VO^{2+}	$\longrightarrow$	$VO_2^+ + e^-$
	V becomes 1 more positive so 1 electron		
Step 4: Sort of the Os	$VO^{2+} + H_2O$	$\longrightarrow$	$VO_2^+ + e^-$
	1 less O on left so add 1 H2O on the left		
Step 5: Sort out Hs	$VO^{2+} + H_2O$	$\longrightarrow$	$VO_2^+ + 2H^+ + e^-$
	2 less H on right so add 2 H^+ to right		
Balanced Half Equation	$VO^{2+} + H_2O$	$\longrightarrow$	$VO_2^+ + 2H^+ + e^-$

Practice Problems

a) $Na \rightarrow Na^+$

b) $Pb^{4+} \rightarrow Pb^{2+}$

c) $H_2 \rightarrow H^+$

d) $Br^- \rightarrow Br_2$

e) $Cr_2O_7^{2-} \rightarrow Cr^{3+}$

f) $SO_4^{2-} \rightarrow S$

g) $SO_4^{2-} \rightarrow H_2S$

h) $SO_4^{2-} \rightarrow SO_2$

i) $N_2 \rightarrow NO_3^-$

j) $IO_3^- \rightarrow I_2$

k) $Hg^{2+} \rightarrow Hg_2^{2+}$

l) $S_2O_3^{2-} \rightarrow S$

m) $NO_3^- \rightarrow NO_2^-$

Answers are given on the next page

Practice Problem Answers

a) $Na \rightarrow Na^{+} + e^{-}$

b) $Pb^{4+} \rightarrow Pb^{2+} + 2e^{-}$

c) $H_2 \rightarrow H^{+} + 2e^{-}$

d) $Br^{-} \rightarrow Br_2 + 2e^{-}$

e) $Cr_2O_7^{2-} + 14H^{+} + 6e^{-} \rightarrow 2\ Cr^{3+} + 7H_2O$

f) $SO_4^{2-} + 6e^{-} + 8H^{+} \rightarrow S + 4H_2O$

g) $SO_4^{2-} + 8e^{-} + 10H^{+} \rightarrow H_2S + 4H_2O$

h) $SO_4^{2-} + 2e^{-} + 4H^{+} \rightarrow SO_2 + 2H_2O$

i) $N_2 + 6H_2O \rightarrow 2NO_3^{-} + 12H^{+} + 10e^{-}$

j) $2IO_3^{-} + 10\ e^{-} + 12H^{+} \rightarrow I_2 + 6H_2O$

k) $2Hg^{2+} + 2e^{-} \rightarrow Hg_2^{2+} + 7H_2O$

l) $S_2O_3^{2-} + 6H^{+} + 4\ e^{-} \rightarrow 2S + 3\ H_2O$

m) $NO_3^{-} + 2e^{-} + 2\ H^{+} \rightarrow NO_2^{-} + H_2O$