

Balancing Redox Equations

SUMMARY**Procedure for Balancing Redox Equations Using Oxidation Numbers**

- Step 1** Assign oxidation numbers and identify the atoms/ions whose oxidation numbers change.
- Step 2** Using the change in oxidation numbers, write the number of electrons transferred per atom.
- Step 3** Using the chemical formulas, determine the number of electrons transferred per reactant. (Use the formula subscripts to do this.)
- Step 4** Calculate the simplest whole number coefficients for the reactants that will balance the total number of electrons transferred. Balance the reactants and products.
- Step 5** Balance the O atoms using $\text{H}_2\text{O}_{(l)}$, and then balance the H atoms using $\text{H}_{(aq)}^+$.
- For basic solutions only,*
- Step 6** Add $\text{OH}_{(aq)}^-$ to both sides equal in number to the number of $\text{H}_{(aq)}^+$ present.
- Step 7** Combine $\text{H}_{(aq)}^+$ and $\text{OH}_{(aq)}^-$ on the same side to form $\text{H}_2\text{O}_{(l)}$, and cancel the same number of $\text{H}_2\text{O}_{(l)}$ on both sides.

Check the balancing of the final equation. Make sure that both symbols and charge are balanced.

SUMMARY**Writing Half-Reaction Equations**

- Step 1** Write the chemical formulas for the reactants and products.
- Step 2** Balance all atoms, other than O and H.
- Step 3** Balance O by adding $\text{H}_2\text{O}_{(l)}$.
- Step 4** Balance H by adding $\text{H}_{(aq)}^+$.
- Step 5** Balance the charge on each side by adding e^- and cancel anything that is the same on both sides.
- For basic solutions only,*
- Step 6** Add $\text{OH}_{(aq)}^-$ to both sides to equal the number of $\text{H}_{(aq)}^+$ present.
- Step 7** Combine $\text{H}_{(aq)}^+$ and $\text{OH}_{(aq)}^-$ on the same side to form $\text{H}_2\text{O}_{(l)}$. Cancel equal amounts of $\text{H}_2\text{O}_{(l)}$ from both sides.

(continued)

SUMMARY***Balancing Redox Equations
Using Half-Reaction Equations***

- Step 1** Separate the skeleton equation into the start of two half-reaction equations.
- Step 2** Balance each half-reaction equation.
- Step 3** Multiply each half-reaction equation by simple whole numbers to balance the electrons lost and gained.
- Step 4** Add the two half-reaction equations, cancelling the electrons and anything else that is exactly the same on both sides of the equation.

For basic solutions only,

- Step 5** Add $\text{OH}^-_{(\text{aq})}$ to both sides equal in number to the number of $\text{H}^+_{(\text{aq})}$ present.
- Step 6** Combine $\text{H}^+_{(\text{aq})}$ and $\text{OH}^-_{(\text{aq})}$ on the same side to form $\text{H}_2\text{O}_{(\text{l})}$, and cancel the same number of $\text{H}_2\text{O}_{(\text{l})}$ on both sides.