

## Balancing oxidation-reduction equations using the ion-electron method

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### Acidic solution

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- 1) Write the equation in ionic form.
- 2) Write the half-reactions for oxidation and for reduction.
- 3) Balance oxygen atoms adding  $\text{H}_2\text{O}$  molecules.
- 4) Balance hydrogen atoms adding  $\text{H}^+$  ions.
- 5) Balance charge adding electrons  $\text{e}^-$ .
- 6) Multiply each half-reaction by a number that will equalize the number of electrons transferred.
- 7) Add the resulting half-reactions equations to obtain the balanced net ionic equation.
- 8) Add spectator ions to obtain the balanced net molecular equation.

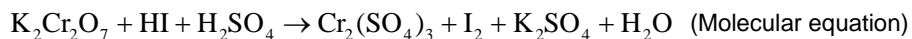
### Basic solution

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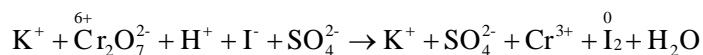
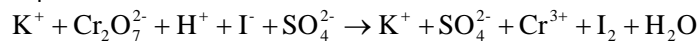
- 1) Write the equation in ionic form.
- 2) Write the half-reactions for oxidation and for reduction.
- 3) Balance oxygen atoms adding  $\text{H}_2\text{O}$  molecules.
- 4) Balance hydrogen atoms adding  $\text{H}^+$  ions.
- 5) Eliminate  $\text{H}^+$  ions adding  $\text{OH}^-$  ions to each side of the half-reaction to obtain  $\text{H}_2\text{O}$  molecules
- 6) Balance charge adding electrons  $\text{e}^-$
- 7) Multiply each half-reaction by a number that will equalize the number of electrons transferred.
- 8) Add the resulting half-reactions equations to obtain the balanced net ionic equation.
- 9) Add spectator ions to obtain the balanced net molecular equation.

### Example 1. Acidic solution

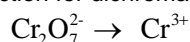
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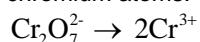
Write the equation in ionic form:



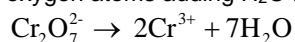
Half-reaction for dichromate reduction:



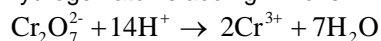
Balance chromium atoms:



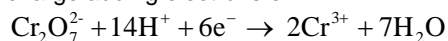
Balance oxygen atoms adding H<sub>2</sub>O molecules:



Balance hydrogen atoms adding H<sup>+</sup> ions:



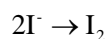
Balance charge adding electrons e<sup>-</sup>:



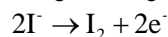
Half-reaction for iodide oxidation:



Balance iodine atoms:

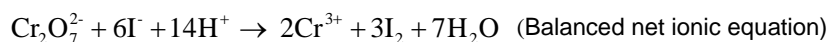
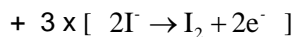
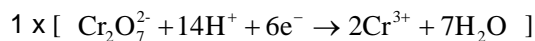


Balance charge adding electrons e<sup>-</sup>:

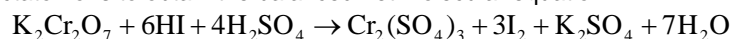


Multiply each half-reaction by a number that will equalize the number of electrons transferred.

Add the resulting half-reactions equations to obtain the balanced net ionic equation:

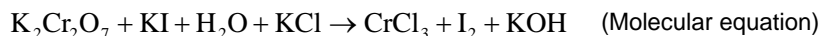


Add spectator ions to obtain the balanced net molecular equation:

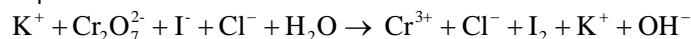


## Example 2. Basic solution

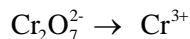
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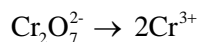
Write the equation in ionic form:



Half-reaction for dichromate reduction:



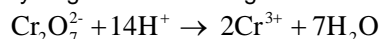
Balance chromium atoms:



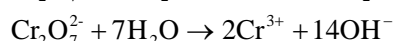
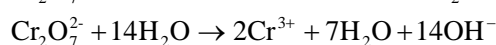
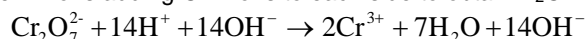
Balance oxygen atoms adding H<sub>2</sub>O molecules:



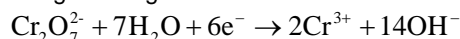
Balance hydrogen atoms adding H<sup>+</sup> ions:



Eliminate H<sup>+</sup> ions adding OH<sup>-</sup> ions to each side to obtain H<sub>2</sub>O molecules:



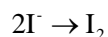
Balance charge adding electrons e<sup>-</sup>:



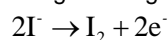
Half-reaction for iodide oxidation:



Balance iodine atoms:

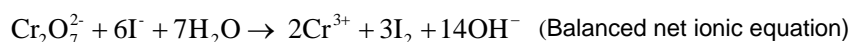
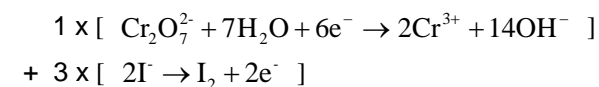


Balance charge adding electrons e<sup>-</sup>:



Multiply each half-reaction by a number that will equalize the number of electrons transferred.

Add the resulting half-reactions equations to obtain the balanced net ionic equation:



Add spectator ions to obtain the balanced net molecular equation:

