

BALANCING REDOX REACTIONS

Oxidation Number Method

OXIDATION NUMBER METHOD

Redox reactions can be balanced using:

a) Half Reactions

b) Oxidation numbers

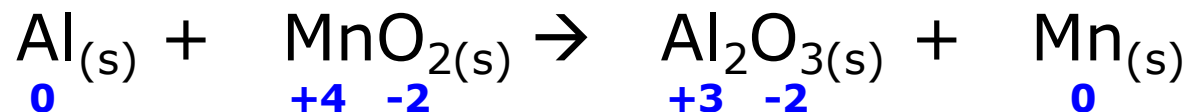
Goal: **To balance the electrons that are gained and lost**

NOTE: When half-reactions are not provided, and a reaction does not occur in either acidic or basic solution, then the oxidation number method can be used to balance a redox reaction

OXIDATION NUMBER METHOD

Example #1

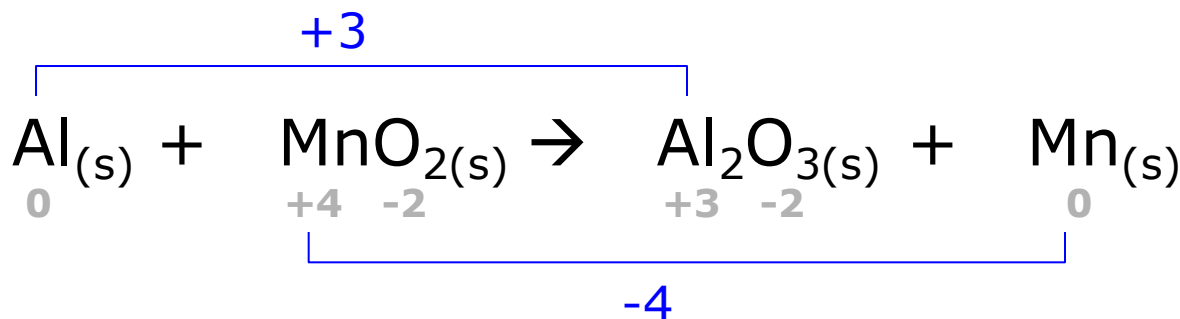
1. Assign oxidation numbers to each element.
2. Identify the increase and decrease in oxidation numbers.
3. Determine the smallest whole-number ratio of the oxidized and reduced elements so that the total increase in oxidation numbers equals the total decrease in oxidation numbers.
4. Use the determined ratio from step 3 to balance the oxidized and reduced reactants.
5. Balance the other elements/compounds by inspection.
6. Add H_2O , H^+ , and OH^- as needed to balance reactions in acidic or basic solution (recall the half-reaction method rules)



OXIDATION NUMBER METHOD

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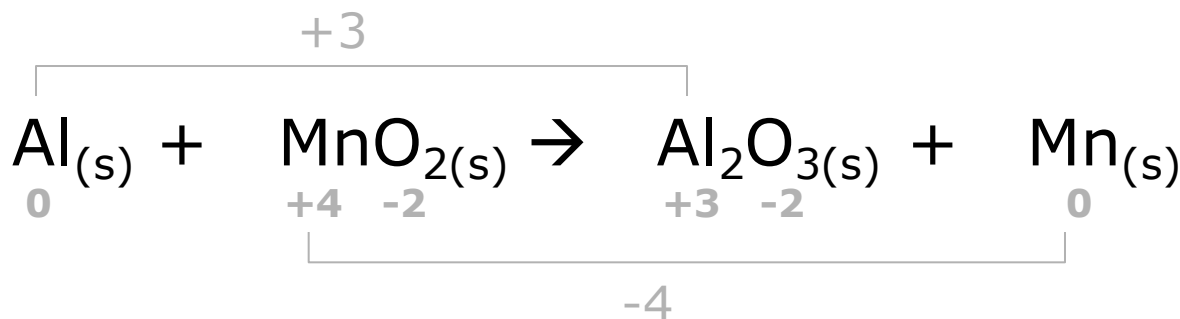
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Ratio = 4:3

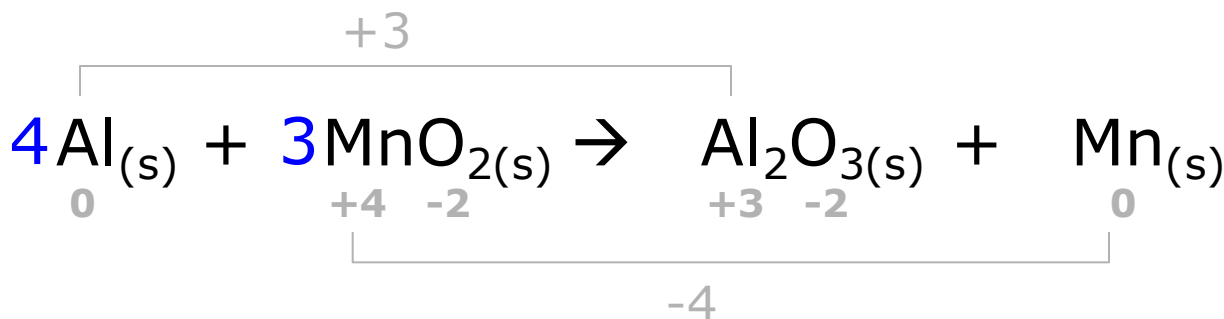
Each Al atom loses 3, \therefore 4 Al loses 12

Each Mn atom gains 4, \therefore 3 Mn gains 12

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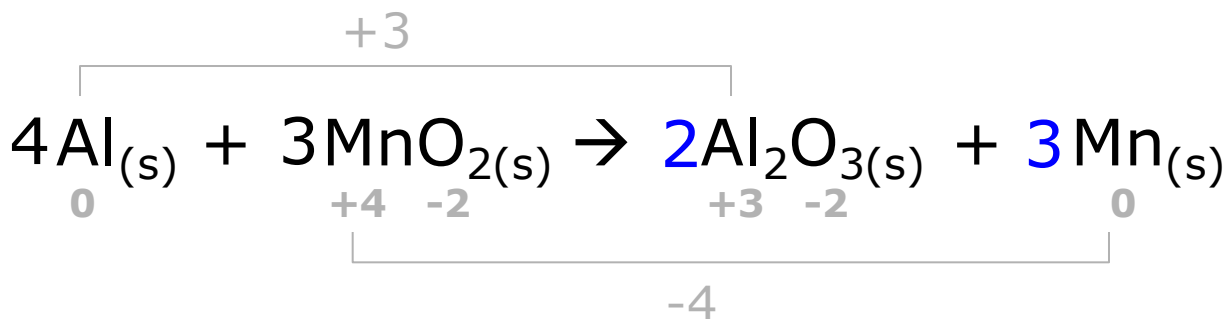


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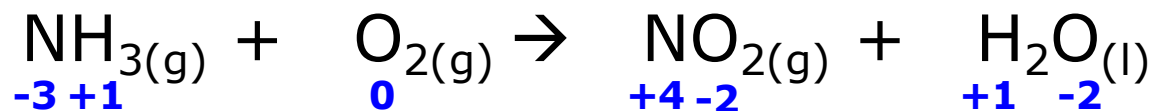
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OXIDATION NUMBER METHOD

Example #2

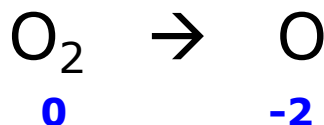
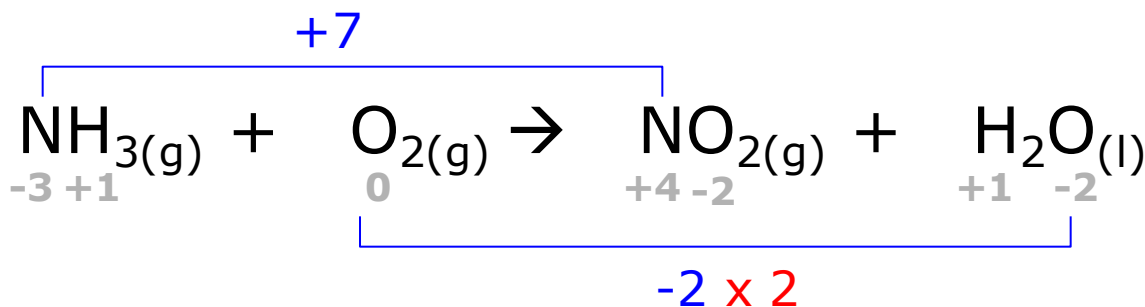
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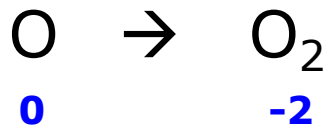
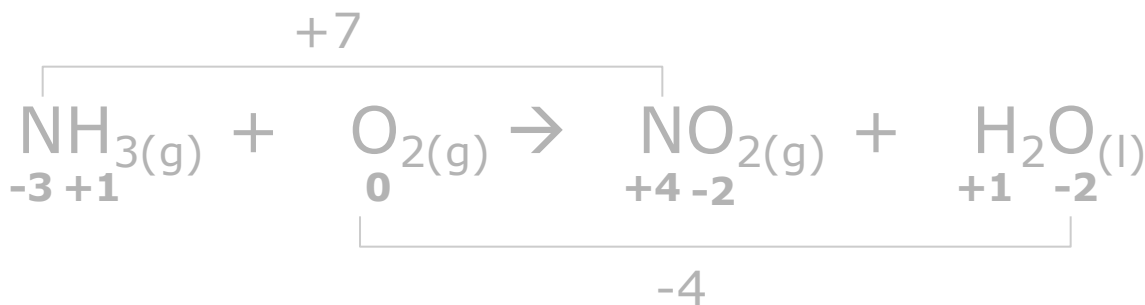


Each O gains 2 electrons, for a total of 4 electrons

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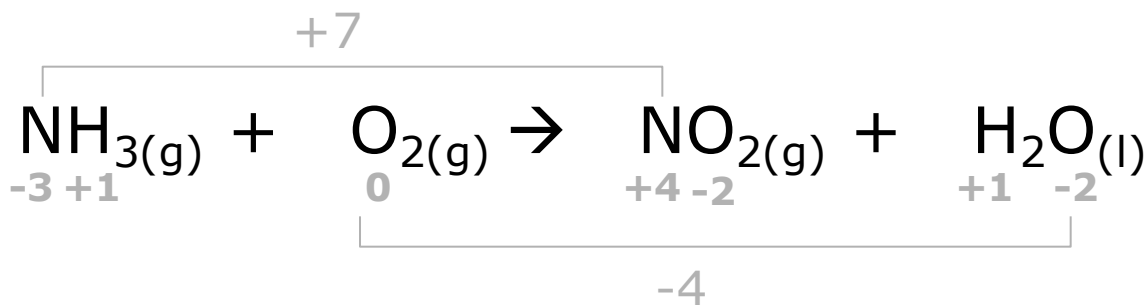


If it was the other way around, though, then you don't need to multiply the change in electrons by 2

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Ratio = 4:7

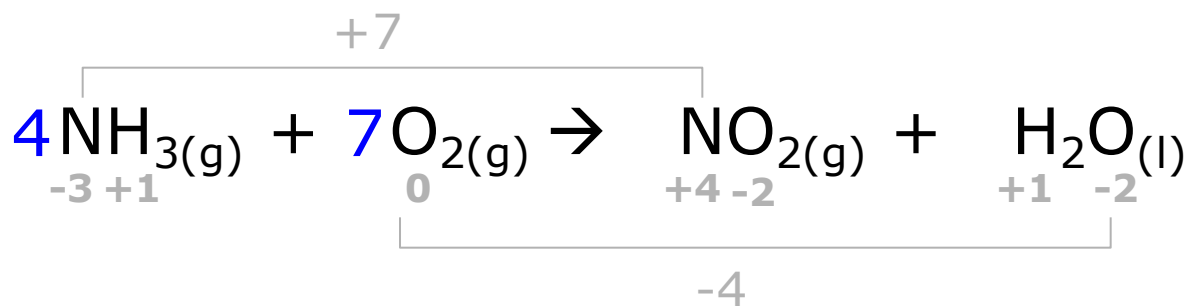
Each N atom loses 7, \therefore 4 N loses 28

Each O atom gains 2 \rightarrow each O_2 gains 4, \therefore 7 O_2 gains 28

OXIDATION NUMBER METHOD

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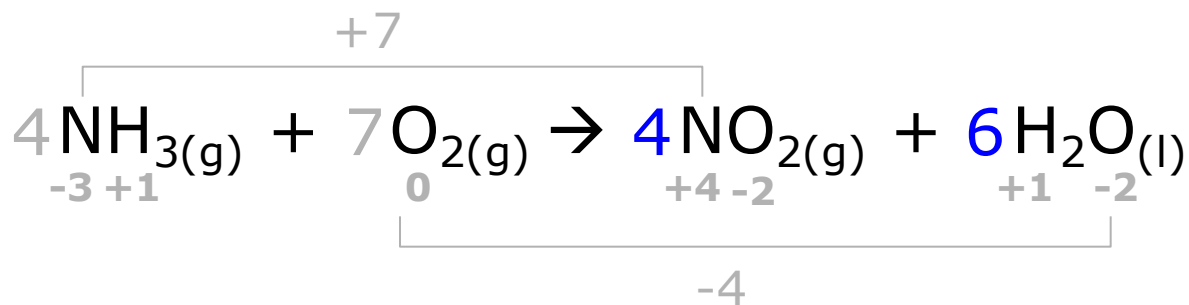
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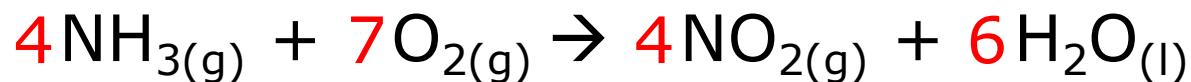
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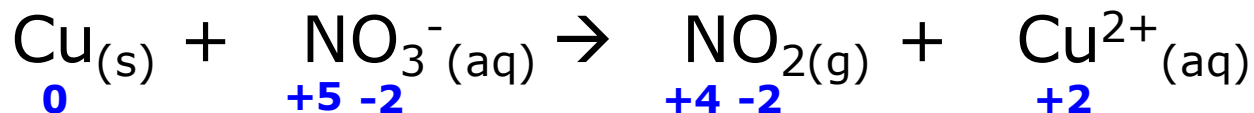
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Example #3: In **acidic** solution

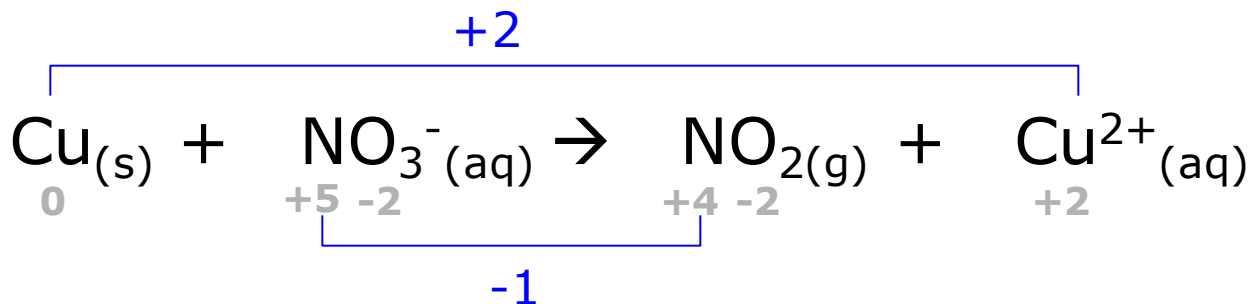
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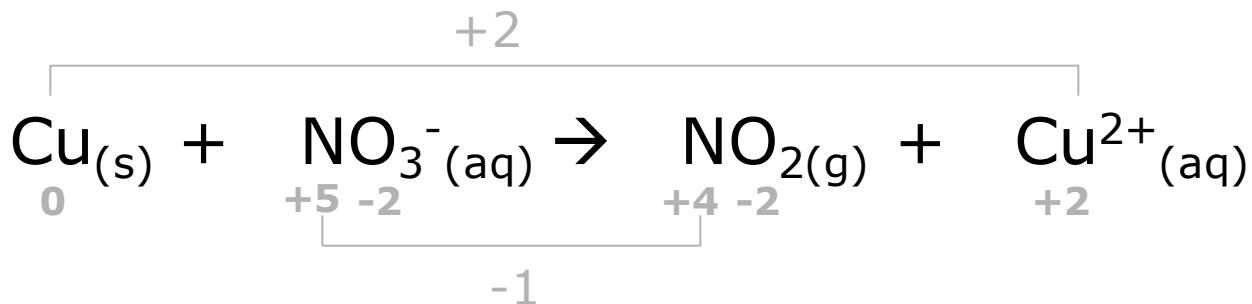
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Ratio = 1:2

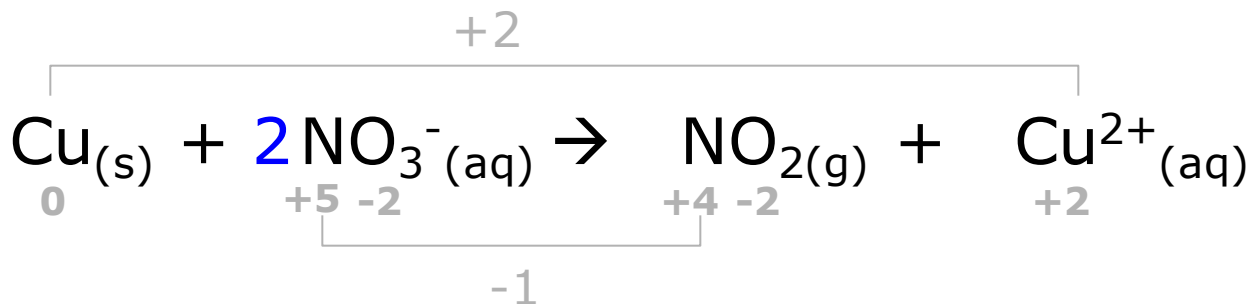
Each Cu atom gains 2, \therefore **1** Cu gains 2

Each N atom loses 1, \therefore **2** N loses 2

OXIDATION NUMBER METHOD

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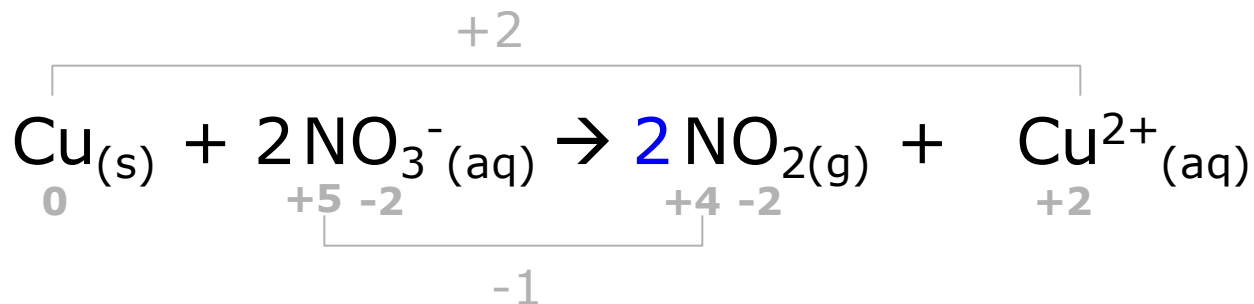
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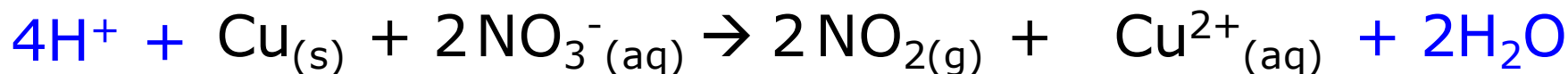
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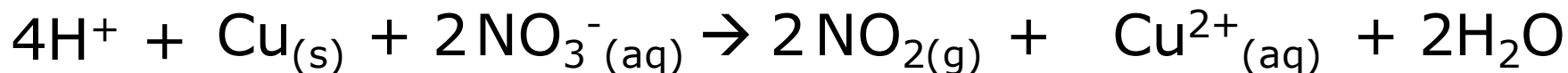


- 1) If ions are present, balance the charge by adding H^+ for acid solutions or OH^- for basic solutions.
 - 2) Finish balancing the equation by adding H_2O .

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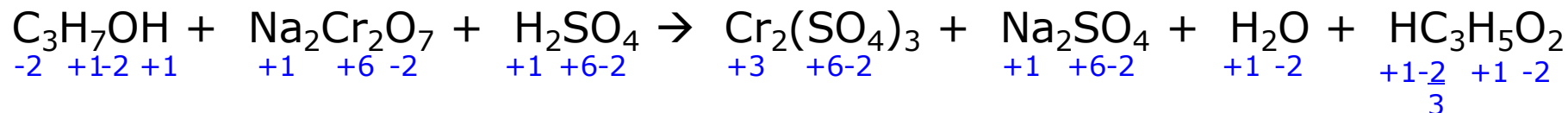
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Example #4: Fractions

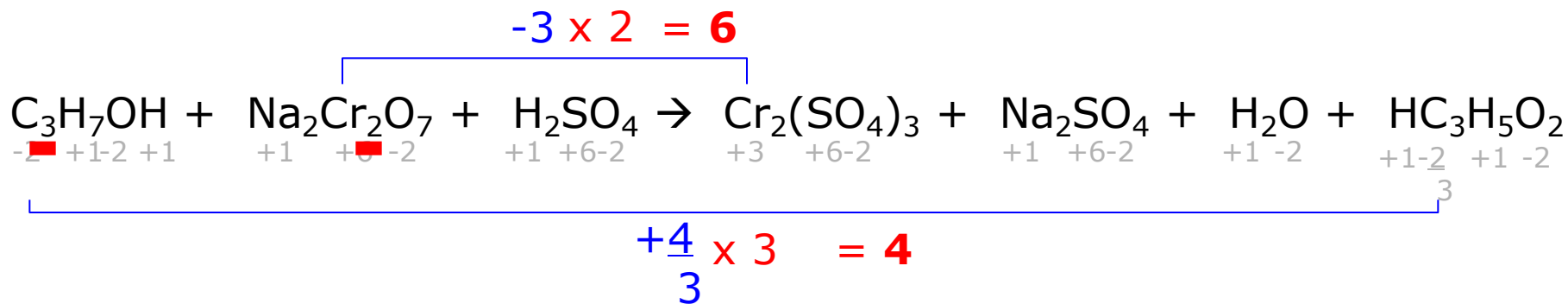
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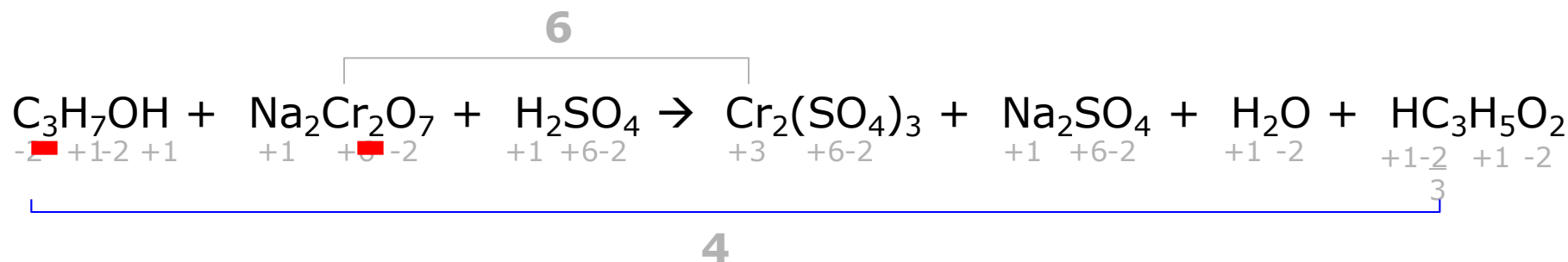


$$\frac{-2}{3} - (-2) = +\frac{4}{3}$$

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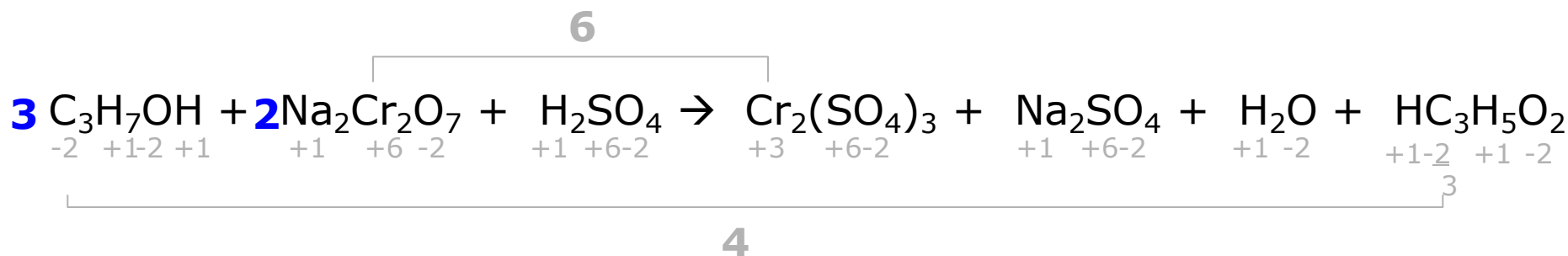


$$\begin{aligned} \text{Ratio} &= 6:4 \\ &= \mathbf{3:2} \end{aligned}$$

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- $$\begin{array}{ccccccc}
 & & & & & & 6 \\
 & & & & & & \updownarrow \\
 \text{3 C}_3\text{H}_7\text{OH} & + & \text{2 Na}_2\text{Cr}_2\text{O}_7 & + & \text{8 H}_2\text{SO}_4 & \rightarrow & \text{2 Cr}_2(\text{SO}_4)_3 + \text{2 Na}_2\text{SO}_4 + \text{11 H}_2\text{O} + \text{3 HC}_3\text{H}_5\text{O}_2 \\
 \begin{array}{cccccccc}
 -2 & +1 & -2 & +1 & +1 & -6 & -2 & +3 & -6 & -2 & +1 & -2 & +1 & -2 & +1 & -2
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