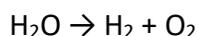


Balancing Molecular, Ionic and Net Ionic Equations

An equation is considered “balanced” if the Law of Conservation of Matter is obeyed. This means that the mass of the reactants (left-hand side) must equal the mass of the products (right-hand side). Put another way, reactant and product sides of a balanced chemical equation **MUST** contain the same elemental type and number of atoms.

Molecular Equation:

1. If the chemical equation is given in “word form”, convert the chemical names to formulas - this must be done accurately, or the equation cannot be balanced.
2. You are only allowed to add coefficients to a chemical formula, NEVER add subscripts. For example, in the following decomposition reaction of water, there are 2 Oxygen atoms on the product side but only 1 Oxygen atom on the reactant side:



✗ Incorrect: $\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$

✓ Correct: $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$

The ✗ incorrect answer is a balanced equation, but, adding the “2” as a subscript makes the reactant hydrogen peroxide (not water). So, only the ✓ correct answer is the balanced equation for the decomposition of water.

3. If an element appears in just one reactant and one product, add coefficient(s) to balance that element first.
4. Next, balance elements other than Hydrogen and Oxygen.
5. Then, balance the Hydrogen and Oxygen atoms.
6. Finally, make sure all coefficients are in the lowest possible whole number ratio – at least one of the coefficients must be a prime number.

Ionic Equation:

1. Write the molecular equation (see above)
2. Break apart into ions any strong acid, strong base or soluble salt that has an (aq) after its formula.
3. Place the coefficient (from the balanced equation) TIMES the ion's subscript in front of the ion as its new coefficient.

$2 \text{Fe}_2(\text{SO}_4)_3(\text{aq})$ (molecular equation) is written as $4\text{Fe}^{3+}(\text{aq}) + 6\text{SO}_4^{2-}(\text{aq})$ (ionic equation)

4. Do Not break apart any reactant or product that
 - i. has (s) or (l) or (g)
 - ii. has (aq) and is a weak acid or base
 - iii. has (aq) and is a non-electrolyte (i.e. ethanol, $\text{CH}_3\text{CH}_2\text{OH}_{(aq)}$, or sucrose)
5. Make sure to include the charge and state for the ions and compounds - all compounds have a charge of zero.
6. Check that the ionic equation is balanced.
7. As a final check, the total charge on the reactant side must equal the total charge on the product side

Net Ionic Equation:

1. Cancel out any spectator ions (ions that appear on both sides of the equation).
2. Simplify the remaining coefficients to the smallest whole number ratio if necessary.