**Balancing Chemical Equations**

Steps for balancing equations:

1. Balance polyatomic structures, if needed
2. Balance the individual atoms other than O, H or polyatomic structures
3. Select either O or H to balance, choosing the element that appears least often in the total equation. Do not balance O or H that only appear in the already balanced polyatomic structures.
4. When balancing an element, recheck the balance of all elements affected.

EXAMPLES

1. Balance the equation: SOCL2 + C2H6O → C2H5CL + H2SO3

In the above unbalanced equation, notice the following initial list of atoms on both sides of the equation:

Left Side

1S

2CL

2C

6H

2O

Right Side

1S

1CL

2C

2H

3O

This equation is not balanced. To balance this equation, first balance all atoms except O and H. The equation may need to be balanced and rebalanced as follows:

CL needs to be balanced by adding a CL atom to the right side of the equation. It cannot be balanced by adding as a subscript, but by increasing the coefficient of the entire compound.

(i.e. → 2 C2 H5 CL)

 Now there are 4C on the right side and 10 H on the right side.

Look at the left side of the equation and see that two more carbons must be added, giving: SOCL2 + [2C2H6O] → 2C2H5CL + H2SO3

Now review the entire equation, checking all atoms other than O and H and find:

Left Side

1S

4CL

4C

Right Side

1S

4CL

4C

We are now ready to balance the O and H atoms.

Left Side

12H

30

Right Side

12H

30

 Since they are balanced, the final equation format will be as follows:

SOCL2 + 2C2H6O → 2C2H5CL + H2SO3

 Sum total of coefficients of the reagents = 6

1. Balance the equation: C2H6 + O2 → CO2 + H2O

Initial

Left Side

2C

6H

2O

Right Side

1C

2H

3O

Balance the carbons and the equation now has the following balance:

Left Side

2C

6H

2O

Right Side

2C

2H

5O

Balance the H atoms and the equation now has the following balance:

C2H6 + O2 → 2CO2 + 3H2O

Left Side

2C

6H

2O

Right Side

2C

6H

5O

Balance the O atoms.

An even number of O on both sides cannot be obtained. Therefore, utilize the following two step approach.

1. Balance both sides by using a half atom as follows:

C2H6 + 2.5O2 → 2CO2 + 3H2O

1. However, balanced equations can only have whole numbers of atoms in every compound. Therefore, the smallest whole number coefficient for every compound is multiplied by two to get:

2C2H6 + 5O2 → 4CO2 + 6H2O

(Final answer)

PRACTICE PROBLEMS

**Balance these equations:**

1. H2 + O2 → H­2O
2. N2 + H2 → NH­3
3. C2­ H6  + O2 → CO2 + H­2O
4. Pb( NO3 )2 → PbO + N­O2 + O2
5. Mg + HCl → MgCl2 + H­2
6. H3AsO4 → As2O5 + H­2O
7. Fe2O3 + CO → Fe + CO2
8. Al + H2SO4 → Al2(SO4)3 + H­2

**Use the proper coefficients to balance each of the following reactions:**

1. H2 + F2 → HF
2. CaF2 + H2SO4 → CaSO4 + HF
3. NaClO → NaClO3 + NaCl
4. H2SO3 + O2 → H2SO4
5. Li3N + H2O → LiOH + NH3
6. P4 + NO → P4O6  + N2
7. N2O5 → NO2 + O2
8. KHSO4  → K2S2O7 + H2O
9. NH4NO3  → N2O + H2O
10. Ag + H2S + O2 → Ag2S + H2­O

**Answer Key:**

1. 2 H2 + O2 → 2 H­2O
2. N2 + 3 H2 → 2 NH­3
3. 2 C2­ H6 + 7 O2 → 4 CO2 + 6 H­2O
4. 2 Pb(NO3)2 → 2 PbO + 4 N­O2 + O2
5. Mg + 2 HCl → MgCl2 + H­2
6. 2 H3AsO4 → As2O5 + 3 H­2O
7. Fe2O3 + 3 CO → 2 Fe + 3 CO2
8. ­2 Al + 3 H2SO4 → Al2(SO4)3 + 3 H­2
9. H2 + F2 → 2 HF
10. CaF2 + H2SO4 → CaSO4 + 2 HF
11. 3 NaClO → NaClO3 + 2 NaCl
12. 2 H2SO3 + O2 → 2 H2SO4
13. Li3N + 3 H2O →3 LiOH + NH3
14. P4 + 6 NO → P4O6 + 3 N2
15. 2 N2O5 → 4NO2 + O2
16. 2 KHSO4 → K2S2O7 + H2O
17. NH4NO3 → N2O + 2 H2O
18. 4 Ag + 2 H2S + O2 → 2 Ag2S + 2H