

Balancing equations using oxidation numbers

Review: balancing chemical equations

- Balance the following chemical reaction:

$$\text{CuCl}_2 + \text{Al} \rightarrow \text{Cu} + \text{AlCl}_3$$
- In the past (e.g. in grade 11) we balanced equations by "inspection".
- Balancing equations relied on having equal numbers of atoms on each side of the equation
- We can balance equations using oxidation #s.
- This relies on the idea that the number of electrons lost by an element must be equal to the number gained by a different element.
- In other words the total gain in oxidation numbers must be equal to the total lost.

Using Oxidation Numbers

total	+2 -2	0	0	+3 -3
oxidation #	+2 -1	0	0	+3 -1
	$\text{CuCl}_2 + \text{Al}$	\rightarrow	$\text{Cu} +$	AlCl_3

- Notice: Cu has gained $2e^-$ (oxidation # ↓ by 2)
- Notice: Al has lost $3e^-$ (oxidation # ↑ by 3)
- But, number of e^- gained must equal e^- lost
- Multiply Cu by 3, Al by 2: change is 6 for both

		-6		+6	
change					
	+6	0	0	+6	
total	+2 -2	0	0	+3 -3	
oxidation #	+2 -1	0	0	+3 -1	
	$3\text{CuCl}_2 + 2\text{Al}$	\rightarrow	$3\text{Cu} +$	2AlCl_3	

Steps to balancing equations

1. Write the skeleton equation
2. Assign oxidation numbers to all atoms
3. Identify which atoms change oxidation number
4. Make the number of atoms that change oxidation number the same on both sides by inserting temporary coefficients
5. Compute the total change in oxidation number
6. Make the total increase in oxidation number equal the total decrease by multiplication using appropriate factors
7. Balance the remainder by inspection. Do not change what has been balanced. Compounds with elements that have changed in one case but not in another are considered twice.

Example 1

Balance the following equation:

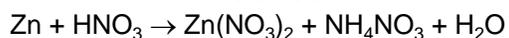
change					
total					
ox. #					
	$\text{H}_2\text{SO}_4 + \text{Al}$	\rightarrow	$\text{Al}_2(\text{SO}_4)_3 +$	$\text{SO}_2 +$	H_2O

Example 1

Balance the following equation:

			-2 x 3 = -6		
		+6			
change	+6	0	+6	+4	
total	+2+6-8	0	+6+18-24	+4-4	+2 -2
ox. #	+1+6-2	0	+3 +6 -2	+4-2	+1 -2
	$3\text{H}_2\text{SO}_4 + 3\text{H}_2\text{SO}_4 + 2\text{Al}$	\rightarrow	$\text{Al}_2(\text{SO}_4)_3 + 3\text{SO}_2 +$	$6\text{H}_2\text{O}$	

Practice



Assignment:

PE 4b (pg. 453) & 12.21 (pg. 484)

