



Study the rules for assigning oxidation numbers and examine the sample problem below. Then determine the unknown oxidation state in each example.

RULES FOR ASSIGNING OXIDATION NUMBERS

- Oxidation numbers for atoms that are free elements are always zero
- The oxidation numbers of ions are the same as the charge on the ion
- Some elements have only one oxidation state
 - group 1 metals always form 1+ ions and always have a +1 oxidation state
 - group 2 metals always form 2+ ions and always have a +2 oxidation state
- Some elements usually have a particular oxidation state
 - oxygen has a -2 oxidation state except in peroxides where it is -1 and in compounds with fluorine (OF_2) where it is +2
 - hydrogen has a +1 oxidation state except in hydrides with group 1 and group 2 metals
- the sum of the oxidation numbers
 - in a compound it is always zero
 - in a polyatomic ion it is equal to the charge on the ion

Sample Problem

Find the oxidation state of the elements in $\text{K}_2\text{Cr}_2\text{O}_7$.

Element	K	Cr	O	TOTAL
Subscript	2	2	7	
Oxidation state	+1	?	-2	
Sum of oxidation states	+2	??	-14	0

- [a] potassium is a group one metal; its oxidation state is always +1
- [b] oxygen usually has an oxidation state of -2
- [c] the sum of oxidation states of each element is the product of the subscript and the oxidation state
- [d] find the sum of the oxidation states of chromium (??) by setting the sum of all the oxidation states to zero
- $$(+2) + ?? + (-14) = 0$$
- $$?? = +12$$
- [f] find the oxidation state of chromium (?) by dividing the sum (+12) by the subscript (2)
- $$+12 \div 2 = +6$$

- Chlorine in KClO_4 1. +7
 $(\text{ClO}_4)^- \quad -8 + 7 = -1$
- Nitrogen in $\text{Ba(NO}_3)_2$ 2. +5
 $(\text{NO}_3)^- \quad -6 + 5 = -1$
- Phosphorus in $\text{Ca}_3(\text{PO}_4)_2$ 3. +5
 $(\text{PO}_4)^{-3} \quad -8 + 5 = -3$
- Manganese in LiMnO_4 4. +7
 $(\text{MnO}_4)^- \quad -8 + 7 = -1$
- Sulfur in Na_2SO_3 5. +4
 $(\text{SO}_3)^{-2} \quad -6 + 4 = -2$
- Chromium in CaCrO_4 6. +6
 $(\text{CrO}_4)^{-2} \quad -8 + 6 = -2$
- Sulfur in MgS_2O_3 7. +2
 $(\text{S}_2\text{O}_3)^{-2} \quad -6 + 4 = -2$
- Nitrogen in $\text{Zn(NO}_2)_2$ 8. +3
 $(\text{NO}_2)^- \quad -4 + 3 = -1$
- Chlorine in HClO_3 9. +5
 $(\text{ClO}_3)^- \quad -6 + 5 = -1$
- Carbon in CaC_2O_4 10. +3
 $(\text{C}_2\text{O}_4)^{-2} \quad -8 + 6 = -2$
- Sulfur in KHSO_4 11. +6
 $(\text{HSO}_4)^- \quad -8 + 1 + 6 = -1$