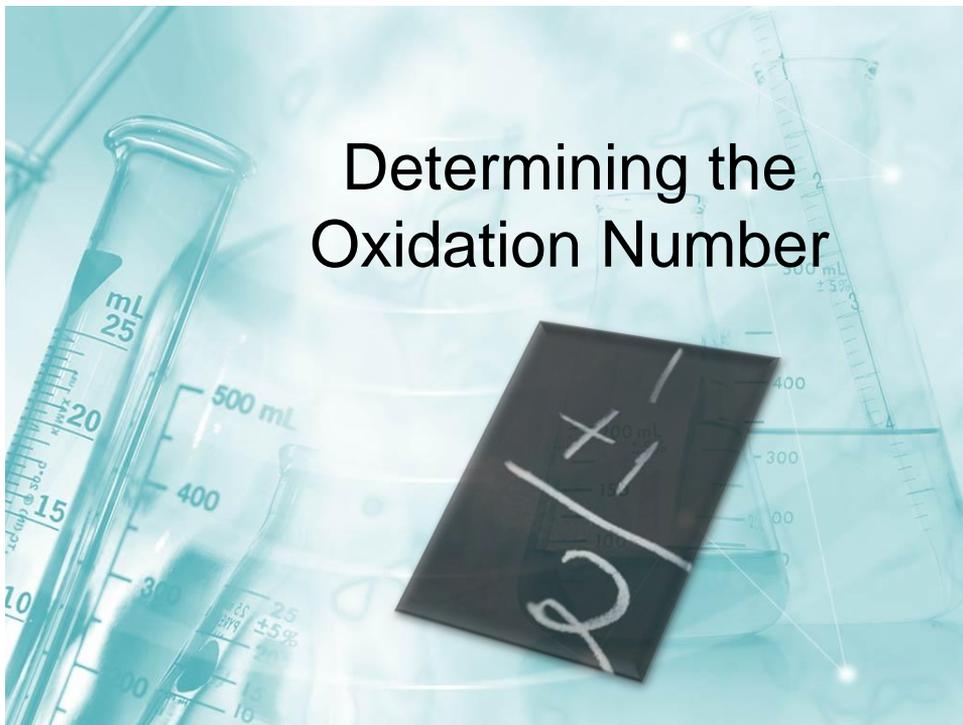# Determining the Oxidation Number

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Rules to remember…

Cation- positive ion

Anion- Negative ion

1. The <u>cation</u> is written first in a formula, followed by the <u>anion</u>.

For example, in NaH, the H is H^{-1}; in HCl, the H is H^{+1}.

Mono- prefix meaning 1

2. The oxidation number of a <u>monatomic</u> ion equals the charge of the ion.

For example, the oxidation number of Na^{+1} is +1; the oxidation number of N^{3-} is -3.

Rules to remember…

3. The <u>oxidation number</u> of hydrogen is +1 in most of its compounds.

Exception: In hydrides, the oxidation number of hydrogen is -1, as in CaH_2.

4. The <u>oxidation number</u> of oxygen in compounds is usually -2.

The oxidation number of most Group 16 elements is -2.

Oxidation # can be written as -2 or 2-

Rules to remember…

Group 1- Alkali Metals

5. The oxidation number of a <u>Group 1 element</u> in a compound is +1.

Group 2- Alkali Earth Metals

6. The oxidation number of a <u>Group 2 element</u> in a compound is +2.

Group 17- Halogen Gases

7. The oxidation number of a <u>Group 17 element</u> in a compound is -1,

except when that element is combined with one having a higher electronegativity.
It is -1 when it is bonded to a metal.

Rules to remember…

8. The <u>sum</u> of the oxidation numbers of all of the atoms in a <u>neutral</u> compound is zero.
Positives = Negatives, for example
$(+2) + (-2) = $ **0**

9. The sum of the oxidation numbers in a polyatomic ion is equal to the charge of the ion.

For example, the sum of the oxidation numbers for SO_4^{2-} is **-2.**

Polyatomic Ion- More than 1 element

The entire ion (SO_4) is -2.

Example 1…

Determine the oxidation number of carbon in $K_2C_2O_4$.

Rule #5

- Na is +1 (Group 1)…but there are two of them **so…(+1)(2) = +2**

Rule #4

- O is -2 (Group 16)…but there are four of them **so…(-2)(4) = -8**

- Do the math...add +2 and -8
  (+2) + (-8) = -6

Remember positives = negatives

- Refer to rule #8…the sum of the oxidation numbers of all atoms in a neutral compound is zero…so (-6) + ? = 0

The oxidation number of S = +6

Example 2…

Determine the oxidation number of the metal in Fe_2O_3.

Rule #4

- O is -2 (Group 16)…but there are three of them
  so…(-2)(3) = -6
- Refer to rule #3…the sum of the oxidation numbers of all atoms in a neutral compound is zero…so (-6) + ? = 0

  ?= +6 <u>BUT</u> there are two atoms of Fe, so…

Divide by 2

  (+6)/2 = +3

  The oxidation number of Fe is **+3.**

Remember to include the + symbol if the oxidation # is positive.

Example 3…

Determine the oxidation number of phosphorus in PO_4^{-3}.

PO_4^{-3} is not a neutral compound

Rule #4

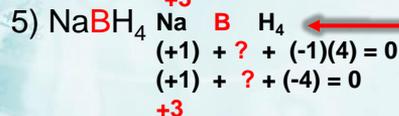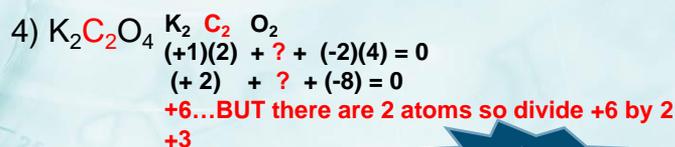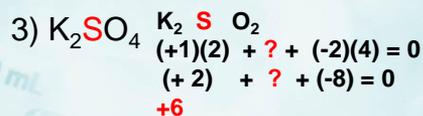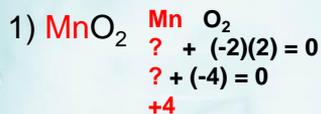- O is -2 (Group 16)…but there are four of them so…(-2)(4) = -8
- Do the math…

  (?) + (-8) = -3

  The oxidation number of P = **+5**

	+5
+	**-8**
=	**-3**

Practice…

Determine the oxidation numbers of the identified ion in each of the following.

1) MnO_2 Mn O_2
? + (-2)(2) = 0
? + (-4) = 0
+4

2) Cu_2O Cu_2 O
? + (-2) = 0
+2…BUT there are 2 atoms so divide +2 by 2
+1

3) K_2SO_4 K_2 S O_2
(+1)(2) + ? + (-2)(4) = 0
(+ 2) + ? + (-8) = 0
+6

4) $K_2C_2O_4$ K_2 C_2 O_2
(+1)(2) + ? + (-2)(4) = 0
(+ 2) + ? + (-8) = 0
+6…BUT there are 2 atoms so divide +6 by 2
+3

5) $NaBH_4$ Na B H_4
(+1) + ? + (-1)(4) = 0
(+1) + ? + (-4) = 0
+3

H is an anion (-1)

Redox Reactions…

- The loss of electrons is Oxidation
  - An element that loses electrons is said to be oxidized.

Oxidized

  - The gain of electrons is Reduction An element that gains electrons is said to be reduced.

Reduced

Homework Tonight…

Determining Oxidation Numbers

(back side of Charting Oxidation Numbers)

Due tomorrow.

HINT

#10…keep (NH_4) together as a polyatomic ion with a +1 charge.