**5.7 HONORS CLASS WORKSHEET – INTRODUCING OXIDATION NUMBERS**

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| The **oxidation number** (or **oxidation state**) of an atom is the charge that would exist on an atom if the bonding were completely ionic. |

Oxidation numbers are very useful for identifying oxidation and reduction processes in more complex situations.

Fill in the blanks in the tables below:

1. If an atom has a charge, the oxidation number of the atom is just the charge on that atom:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Formula | Ca2+ | Fe3+ | N3- | Na+ | S2- | Br- | MgCl2 | CaO | Na2S | Al2O3 |
| O. N. | +2 |  |  |  |  |  | +2, -1 |  |  |  |

1. In elements and free atoms, all atoms have an oxidation number of zero:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Formula | Na | Cl2 | O2 | Al | S8 |
| O. N. | 0 | 0 |  |  |  |

1. In compounds, the sum of the oxidation numbers on the atoms is always zero, but the most electropositive atom will always have a positive oxidation number and the most electronegative atom will always have a negative oxidation number; a few atoms always have the same oxidation number and this can be used to predict the others:
* Group 1 atoms always have an oxidation number of +1; Group 2 atoms always have an oxidation number of +2; Al always has an oxidation number of +3; F always has an oxidation number of -1
* O usually has an oxidation number of -2
* H usually has an oxidation number of +1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Formula | H2O | CO2 | NH3 | SO2 | SO3 | CH4 | H2S | SiF4 | C2H6 | CO |
| O. N. | +1, -2 |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Formula | CaCO3 | NaOH | H2SO4 | HNO3 | KMnO4 | Na2S2O3 | NaClO | HCN |
| O. N. | +2, +4, -2 |  |  |  |  |  |  |  |

1. In polyatomic ions, the rules are the same as for compounds, except that the sum of the oxidation numbers is equal to the overall charge on the ion:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Formula | CO32- | OH- | CO32- | SO42- | NO3- | PO43- | NH4+ | Cr2O72- |
| O. N. | +4, -2 |  |  |  |  |  |  |  |

1. There are some important exceptions (but not many) to the rules for hydrogen and oxygen:

|  |  |  |
| --- | --- | --- |
| Formula | Oxidation Numbers | Name |
| H2O2 | +1, -1 | hydrogen peroxide |
| Na2O2 |  |  |
| NaH |  |  |
| AlH3 |  |  |
| OF2 |  |  |

1. Identify the following processes as oxidation or reduction:

|  |  |  |
| --- | --- | --- |
| Process | Change in Oxidation Number | Oxidation or Reduction |
| PbO2 to PbO | Pb changes from +4 to +2 | Reduction |
| H2O2 to O2 |  |  |
| ClO- to Cl- |  |  |
| S2O32- to S4O62- |  |  |
| NO3- to NO |  |  |