Oxidation Number Exercise

Do not hand in this work sheet. When you are ready, you will be given an examination over this material. Complete the examination by yourself and hand it in to receive credit.

Purpose: This exercise is designed to teach the student how to assign oxidation numbers. Oxidation numbers are very important and are used for 1) naming compounds, 2) balancing oxidation-reduction reactions, 3) calculations in electrochemistry and other areas of chemistry.

Rule 0 The following rules are in the form of a hierarchy; that is, the first stated rule takes precedence over subsequent rules if a conflict arises.

Rule 1 The oxidation numbers for all the atoms in a neutral molecule must add up to 0. Similarly, the oxidation numbers for all the atoms of an ion must add up to the charge of the ion. (You are expected to recognize polyions. For the common polyions, know their charges and their names. A summary of the common polyions appears on page xiv. The first step is, always, to determine what polyions are present.)

Rule 1a The oxidation number of elements in the elemental form is 0. (Note - this rule is a direct consequence of rule 1. How so?)

Rule 1b The oxidation number of any monatomic ion is the same as its charge. (See comment in 1a.)

Exercises - Give the oxidation number for the following atoms:

O_2	O = _____	F_2	F = _____
S_8	S = _____	Cl_2	Cl = _____
N_2	N = _____	Al	Al = _____
Co^{2+}	Co = _____	Mn^{2+}	Mn = _____
Cl^-	Cl = _____	Cr^{3+}	Cr = _____
I_3^-	I = _____	Hg_2^{2+}	Hg = _____

Rule 2 Fluorine has an oxidation number of -1.

Exercises - Give the oxidation number for the following atoms:

NaF	Na = _____	IF_3	I = _____	ClF_2^-	Cl = _____
SF_4	S = _____	PF_3	P = _____	SF_6^{2-}	S = _____
PF_5	P = _____	PF_6^{3-}	P = _____	$W_2F_9^{3-}$	W = _____
OF_2	O = _____	NF_3	N = _____	F_2	F = _____

Rule 3 The metals of group 1 (old CAS IA) have an oxidation number of +1
The metals of group 2 (old CAS IIA) have an oxidation number of +2
Sc, Y and Al have an oxidation number of +3.

Exercises - Give the oxidation number for the following atoms:

Na_2O	Na = _____	Na_2O_2	O = _____	KO_2	O = _____
NaOH	Na = _____	ScH_3	H = _____	LiH	H = _____
CaC_2	C = _____	$CaMgO_2$	O = _____	MgH_2	H = _____
MgF_2	Mg = _____	RbO_2	O = _____	$MgSF_6$	S = _____
$NaPF_6$	P = _____	$LiBF_4$	B = _____		

Rule 4 Hydrogen has an oxidation number of +1 when combined with elements on the right side of the periodic chart (non-metals) and a -1 when combined with elements on the left side of the periodic chart (metals).

Exercises - Give the oxidation number for the following atoms:

HCl	Cl = _____	HF	F = _____(why)	NaOH	O = _____
HI	I = _____	UH_3	U = _____	NH_4^+	N = _____
PH_3	P = _____	H_2SF_6	S = _____	NH_3	N = _____
AsH_3	As = _____	ScH_3	Sc = _____	HPF_4	P = _____
H_3O^+	O = _____	OH^-	O = _____		

Rule 5 Oxygen has an oxidation number of -2. (Note: Your knowledge of the polyions is now needed. The polyions you are responsible for knowing are on xiv. **Turn to xiv now and become familiar with this chart.** Notice that for the polyions on xiv, the oxidation number for oxygen is -2)
Cautionary Note: Review Rule 0.

Exercises - Give the oxidation number for the following atoms:

$Co(ClO)_2$	Co = _____	Cl = _____	Na_2O_2	Na = _____	O = _____
$CoCrO_4$	Cr = _____	Co = _____	$AgNO_3$	Ag = _____	N = _____
$Mg(OH)_2$	Mg = _____	O = _____	H_2SO_4	S = _____	
RbO_2	Rb = _____	O = _____	ClO_4^-	Cl = _____	
$KMnO_4$	Mn = _____	K = _____	NH_4OH	N = _____	
OF_2	F = _____	O = _____	IO_3^-	I = _____	
KO_2	K = _____	O = _____	$K_2Cr_2O_7$	Cr = _____	
IO_2^-	I = _____		BrO_2^-	Br = _____	
$Zn(NO_2)_2$	Zn = _____	O = _____			

Cautionary Note: Review Rule 0 again

Rule 6 Group 1**7** (old CAS VIIA) atoms have an oxidation number of -1.
Rule 7 Group 1**6** (old CAS VIA) atoms have an oxidation number of -2.
Rule 8 Group 1**5** (old CAS VA) atoms have an oxidation number of -3.

Exercises - Give the oxidation number for the following atoms:

PH_3	P = _____	CH_3NH_2	C = _____	CN^-	C = _____
BF_3NH_3	B = _____	$MnCl_4$	Mn = _____	$W_2Cl_9^{3-}$	W = _____
Co_3N_2	Co = _____	NCl_3	N = _____	KSCN	C = _____
HCN	C = _____	$POCl_3$	P = _____	V_3N_4	V = _____

Additional (Optional) Exercises:

NH_3	N = _____	As_2O_5	As = _____	SiF_4	Si = _____
HNO_3	N = _____	N_2H_4	N = _____	PCl_6^-	P = _____
MnO_2	Mn = _____	$CrCl_3$	Cr = _____	$Cr_2O_7^{2-}$	Cr = _____
$AgCH_3COO$	Ag = _____	N_2O	N = _____	N_2O_5	N = _____
Au_2O	Au = _____	AuO	Au = _____	$CuSO_4$	Cu = _____
Os_2O_5	Os = _____	Fe_3O_4	Fe = _____	Fe_2O_3	Fe = _____
FeO	Fe = _____	$FePO_4$	Fe = _____	SiO_2	Si = _____
H_2S	S = _____	FeS	S = _____	$NaHCO_3$	C = _____
$AuHCO_3$	Au = _____	$ScAsO_4$	As = _____	NH_4OH	N = _____
SO_3	S = _____	H_2CrO_4	Cr = _____	$H_4P_2O_7$	P = _____
Cl_2	Cl = _____	$S_2O_3^{2-}$	S = _____	MgC_2	C = _____
S_2Cl_2	S = _____	$Cr_2(CO_3)_3$	Cr = _____	K_3FeO_4	Fe = _____
S_8	S = _____	BO_2^-	B = _____	Al_2O_3	Al = _____
Ag_2CrO_4	Ag = _____	RbO_2	O = _____	I_3^-	I = _____
RbH	H = _____	Th_4H_{11}	Th = _____	$NaHSO_4$	S = _____
Na_2HPO_4	P = _____	$Eu_3(PO_3)_2$	P = _____	$B_4O_7^{2-}$	B = _____
P_4O_6	P = _____	BeF_2	Be = _____	P_4O_{10}	P = _____

OF_2 F = _____ O = _____

$Ce(ClO_3)_2$ Ce = _____ Cl = _____

$Fe(MnO_4)_2$ Mn = _____ Fe = _____

NaSCN S = _____ C = _____ N = _____