OXIDATION NUMBERS → the charge an atom would have in a compound if all the electrons were completely transferred
→ may be fictional (can be fractions)

-sign convention: IONIC CHARGE # +/- Ca^{2+}
OX # +/- # N_2O_4

RULES

Al_2O_3 Ox #
Al = +3
O: -2
+6 -6

$CaCr_2O_7$
Ca = +2
Cr = +6
O = -2
+2 +12 -14

$KMnO_4$ K = +1, Mn = +7, O = -2

CH_4 C = -4, H = +1

CO_2 C = +4, O = -2

NaN_3

NaCl
N = -1/3

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

OXIDATION

REDUCTION

Ox

RED

"OILRIG"

III. REDOX → e⁻ transfer reactions

$Al + O_2 \rightarrow Al_2O_3$

$4(Al \rightarrow Al^{3+} + 3e^-)$ Ox

$3(4e^- + O_2 \rightarrow 2O^{2-})$ RED

$4Al + 3O_2 \rightarrow 4Al^{3+} + 6O^{2-}$
(Al_2O_3)

OXIDATION NUMBERS → the charge an atom would have in a compound if all the electrons were completely transferred
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-sign convention: IONIC CHARGE # +/- Ca^{2+}
OX # +/- # +4 -2 N_2O_4

RULES

+3 -2 OX #
Al_2O_3 Al = +3
+6 -6 O = -2

+2 +6 -2
$CaCr_2O_7$ Ca = +2
+2 +12 -14 Cr = +6
O = -2

$KMnO_4$ K = +1
Mn = +7
O = -2

CH_4 C = -4
H = +1

CO_2 C = +4
O = -2

NaN_3
NaN$_3$ I
N = -1/3

-4 +1 0 +4 -2 +1 -2
$CH_4 + O_2 \longrightarrow CO_2 + H_2O$
OXIDATION
REDUCTION

+2 +1 0 -1 -2
Ox
RED
"OILRIG"

III. REDOX → e⁻ transfer reactions

0 0 +3 -2
$Al + O_2 \longrightarrow Al_2O_3$

$4\left(Al^{0} \longrightarrow Al^{+3} + 3e^-\right)$ OX

$3\left(4e^- + O_2^{0} \longrightarrow 2O^{-2}\right)$ RED

$4Al + 3O_2 \longrightarrow 4Al^{3+} + 6O^{2-}$
(Al_2O_3)

REDOX REACTIONS VARIETIES

(A) COMBINATION (SYNTHESIS)

$A + B \longrightarrow AB$

$4Al + 3O_2 \longrightarrow 2Al_2O_3$

$\overset{0}{2H_2} + \overset{0}{O_2} \longrightarrow 2\overset{+1\ -2}{H_2O}$

(B) DECOMPOSITION (ANALYSIS)

$AB \longrightarrow A + B$

$\overset{+3\ -2}{Fe_2O_3} \xrightarrow{\Delta} \overset{0}{Fe} + \overset{0}{O_2}$

if A, B or both are free elements these are REDOX reactions

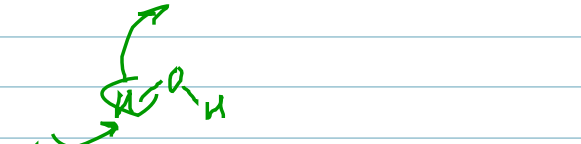
(C) SINGLE DISPLACEMENT

$A + BC \longrightarrow B + AC$

1) H displacement
2) M displacement
3) halogen displacement

1) H displacement

a) 1A, Ca, Sr, Ba



$M + H_2O \longrightarrow MOH + H_2$

b) most metals:

$M + HK \longrightarrow MK + H_2$

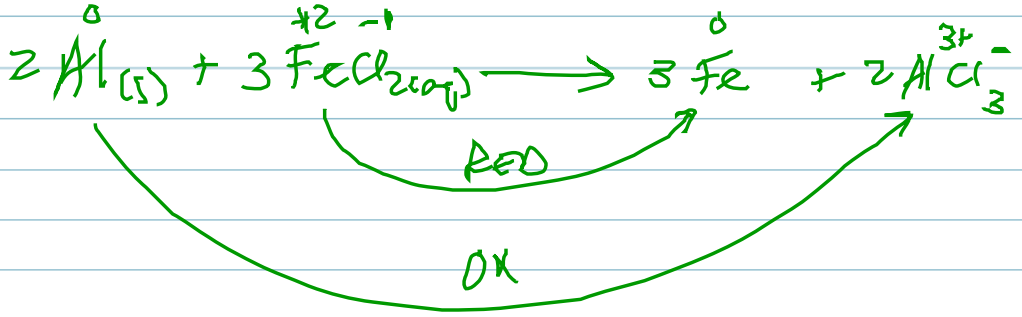
acid

except: Cu, Ag, Au, Pt, Hg

2) metal displacement

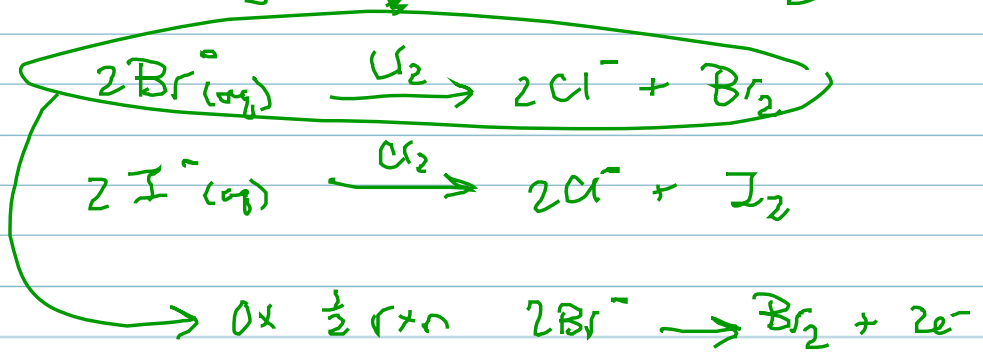
$A + BX \longrightarrow B + AX$ A,B = metals

→ more active metal (more (-) E^0) replaces the less active metal ion



3) HALOGEN DISPLACEMENT

activity $F_2 > Cl_2 > Br_2 > I_2$



DISPROPORTIONATION REACTION

one element in a single ox state is both oxidized AND reduced