CHEMWHIZ QUICK REFERENCE

TOPIC 07

Redox Reactions & Balancing

Oxidation numbers, identifying redox and agents, disproportionation, and the half-reaction and oxidation-number methods.

01 Assigning oxidation numbers — CORE RULE

Free element = 0. Monatomic ion = its charge. F = −1. H = +1 (but −1 in metal hydrides). O = −2 (−1 in peroxides, +2 in OF_2). Fixed-charge metals: Group 1 = +1, Group 2 = +2, Al = +3. Variable-charge metals (Sn, Pb, Tl, transition metals): use the Roman numeral or solve with the sum rule.

02 Sum rule (solve for an unknown) — CORE RULE

Oxidation numbers sum to 0 (neutral compound) or to the charge (polyatomic ion). Solve algebraically: H_2SO_4 → S = +6; MnO_4^- → Mn = +7.

03 Average oxidation numbers — CORE RULE

A formula-unit average can be fractional and is bookkeeping, not a per-atom state: Fe_3O_4 → Fe = +8/3; $S_2O_3^{2-}$ → S = +2 (avg); $S_4O_6^{2-}$ → S = +2.5 (avg).

04 Redox or not? — CORE RULE

Assign oxidation numbers on both sides. If any element's number changes → redox (name it). If none change → not redox (neutralization, metathesis, hydrolysis).

05 Oxidized / reduced / agents — CORE RULE

Oxidized = number increases (loses e^-). Reduced = number decreases (gains e^-). Oxidizing agent = the whole species reduced; reducing agent = the whole species oxidized. Name the full formula (HNO_3, not N).

06 Disproportionation & comproportionation — CORE RULE

Disproportionation: one element is both oxidized and reduced ($2H_2O_2 \rightarrow 2H_2O + O_2$). Comproportionation: two states of one element converge to one ($NH_4NO_3 \rightarrow N_2O + 2H_2O$).

07 Non-redox traps — WATCH OUT

Looks like redox but isn't (no ox-number change): halide/phosphide hydrolysis ($PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$), peroxide preservation, and acid-base neutralization. Check every element first.

08 Half-reaction method (acidic) — METHOD

Split into two half-reactions; balance non-H/O atoms; balance O with H_2O; balance H with H^+; balance charge with e^- (e^- on right = oxidation, on left = reduction); scale to equal e^-; add and cancel.

09 Half-reaction method (basic) — METHOD

Balance as if acidic, then add one OH^- to both sides for each H^+; combine $H^+ + OH^- \rightarrow H_2O$; cancel duplicate H_2O. The final answer has OH^- and H_2O but no H^+.

10 Match the electrons — CORE RULE

Electrons transferred must be equal in both halves: scale each to the LCM of the two counts (2 & 3 → 6). After summing, electrons must cancel completely; leftover e^- means the multipliers are wrong.

11 Oxidation-number method (non-aqueous) — METHOD

Assign ox numbers; find electrons lost (reducing agent) and gained (oxidizing agent); scale by the LCM so total lost = total gained; balance the rest by inspection; reduce. Best when no $H^+/OH^-/H_2O$ is needed.