FREE NOTES · NCERT + JEE/NEET LEVEL

Redox Reactions

Oxidation aur reduction ki classical aur electronic definitions, oxidation number ke rules, redox reactions ke types, oxidation number aur half-reaction method se balancing, redox titrations aur electrode processes ki shuruaat.

01 Classical definitions
02 Electron transfer ka nazariya
03 Oxidation number (ON)
04 Redox reactions ke types
05 Balancing: oxidation number method
06 Balancing
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01 Classical definitions

Oxidation	Reduction
Oxygen / electronegative element judna	Oxygen / electronegative element hatna
Hydrogen / electropositive element hatna	Hydrogen / electropositive element judna

$2Mg + O_2 \rightarrow 2MgO$ (Mg oxidise). $CuO + H_2 \rightarrow Cu + H_2O$ (CuO reduce, H_2 oxidise). Dono saath hote ⇒ **redox**.

02 Electron transfer ka nazariya

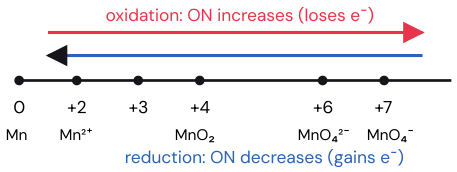
OIL RIG

Oxidation **I**s **L**oss of electrons; **R**eduction **I**s **G**ain. Jo oxidise hota wo **reducing agent**; jo reduce hota wo **oxidising agent**.

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$: Zn $2e^-$ khota (oxidise, reducing agent); Cu^{2+} $2e^-$ leta (reduce, oxidising agent). Zn Cu ko hatata kyunki Zn aasani se electrons deta (electrochemical series).

03 Oxidation number (ON)

1. Free element: 0 (O_2, Na, P_4, S_8).
2. Monoatomic ion: uska charge (Na^+ +1, Cl^- −1).
3. O −2, siwaay peroxides (−1: H_2O_2, Na_2O_2), superoxides (−½: KO_2), OF_2 (+2), O_2F_2 (+1).
4. H +1, siwaay metal hydrides (−1: NaH, CaH_2).
5. F hamesha −1. Baaki halogens −1, siwaay O ya zyada electronegative halogen ke saath.
6. Alkali metals +1, alkaline earth +2.
7. Molecule me ONs ka jod = 0, ion me = charge.



Mn ki oxidation states: upar = oxidation, neeche = reduction

Dhyan do: CrO_5 (butterfly) me Cr +6 (chaar O peroxide, −1). Fe_3O_4 me Fe ka average ON = +8/3. $S_4O_6^{2-}$ me average +2.5 (do S +5, do 0).

04 Redox reactions ke types

Type	Example
Combination	$C + O_2 \rightarrow CO_2$
Decomposition	$2KClO_3 \rightarrow 2KCl + 3O_2$
Metal displacement	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Non-metal displacement	$2Na + 2H_2O \rightarrow 2NaOH + H_2$; $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$
Disproportionation (same element oxidise aur reduce)	$2H_2O_2 \rightarrow 2H_2O + O_2$; $Cl_2 + 2OH^- \rightarrow ClO^- + Cl^- + H_2O$; $P_4 + NaOH \rightarrow PH_3 + NaH_2PO_2$
Comproportionation (ulta)	$Ag^{2+} + Ag \rightarrow 2Ag^+$

F_2 disproportionate nahi ho sakta (sirf reduce; positive ON nahi). ClO_4^- bhi nahi (Cl pehle hi max +7 pe).

05 Balancing: oxidation number method

1. Skeleton equation likho; jinka ON badalta wo atoms dhoondo.
2. Har formula unit me ON ka badhna aur ghatna nikalo.
3. Guna karke total badhna = total ghatna karo.
4. O aur H chhod ke baaki atoms balance karo.
5. O ko H_2O se, phir H ko H^+ (acid) ya H_2O aur OH^- (base) se balance karo. Charge check karo.

Example: MnO_4^- + Fe^{2+} → Mn^{2+} + Fe^{3+} (acid). Mn: +7 → +2 (−5); Fe: +2 → +3 (+1). Fe ko 5 se guna ⇒ $MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$.

06 Balancing: half-reaction (ion-electron) method

1. Oxidation aur reduction half-reactions alag karo.
2. O, H ke alawa atoms balance; phir O ko H_2O se, H ko H^+ se.
3. Charge ko electrons se balance karo.
4. Basic medium me dono taraf OH^- jod ke H^+ khatam karo.
5. Halves ko guna karke electrons cancel; jod do.

Example: $Cr_2O_7^{2-}$ + Fe^{2+} (acid). Reduction: $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$. Oxidation: $Fe^{2+} \rightarrow Fe^{3+} + e^-$ (× 6). Jod: $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$.

07 Redox titrations

Titrant	Indicator
$KMnO_4$ (acid)	Khud indicator: pehla tikau gulabi rang
$K_2Cr_2O_7$	Diphenylamine (neela end point)
I_2 / $Na_2S_2O_3$ (iodometry)	Starch (neela rang gayab)

Iodometry: $2Cu^{2+} + 4I^- \rightarrow Cu_2I_2 + I_2$, phir $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$.

08 Redox aur electrode processes

Zn aur $CuSO_4$ alag beakers me rakho, taar aur salt bridge se jodo, to wahi redox reaction current chalata: ye **galvanic cell** hai (Daniell cell). Har half ek **redox couple** (Zn^{2+}/Zn, Cu^{2+}/Cu). Standard electrode potential E° reduce hone ki tendency naapta; zyada positive E° ⇒ zyada strong oxidising agent. (Poora detail Class 12 Electrochemistry me.)

09 JEE Extra + Tricks

JEE LEVEL

- Oxidation number tricks: peroxides me O = -1 (H_2O_2, Na_2O_2), superoxides -½ (KO_2), OF_2 me O = +2; CrO_5 aur H_2SO_5 me structure dekho (peroxide bonds).
- $Na_2S_4O_6$ me S ka average O.N. = +2.5 (asal me 0 aur +5); Fe_3O_4 me Fe = +8/3.
- Redox me n-factor = O.N. ka badlav × per molecule atoms; oxidant ke equivalents = reductant ke equivalents.
- $KMnO_4$ n-factor: acidic 5 (→ Mn^{2+}), neutral 3 (→ MnO_2), tez basic 1 (→ MnO_4^{2-}). $K_2Cr_2O_7$ (acidic): 6.
- Disproportionation: ek hi element oxidise aur reduce (NaOH me Cl_2, $H_2O_2 \rightarrow H_2O + O_2$).

10 Solved questions

Q1. H_2SO_4 me S, $K_2Cr_2O_7$ me Cr, H_3PO_2 me P ka ON.

S: 2 + x − 8 = 0 ⇒ **+6**. Cr: 2 + 2x − 14 = 0 ⇒ **+6**. P: 3 + x − 4 = 0 ⇒ **+1**.

Q2. Oxidising aur reducing agents batao: $H_2S + Cl_2 \rightarrow 2HCl + S$.

S: -2 → 0 (oxidise) ⇒ H_2S reducing agent. Cl: 0 → -1 ⇒ Cl_2 oxidising agent.

Q3. Basic medium me balance karo: $MnO_4^- + I^- \rightarrow MnO_2 + I_2$.

$$2MnO_4^- + 6I^- + 4H_2O \rightarrow 2MnO_2 + 3I_2 + 8OH^-.$$

11 Mistakes & practice

- Oxidise hone wale ko oxidising agent kehna.
- H_2O_2 ya KO_2 me O ko -2 lena.
- Basic medium me H^+ ko OH^- me na badalna.
- Sochna ki ON hamesha poora number (average fraction ho sakta).

1. OF_2 me O ka ON?
2. Kya $2NO_2 \rightarrow N_2O_4$ redox hai?
3. $3HNO_2 \rightarrow HNO_3 + 2NO + H_2O$ me disproportionation batao.
4. $KMnO_4$ titration me indicator?

ANSWERS

1) +2 · 2) Nahi, N +4 hi rehta · 3) N: +3 → +5 aur +2 · 4) $KMnO_4$ khud

12 Quick revision: exam se 5 minute pehle

BASICS

- OIL RIG.
- Oxidise hone wala = reducing agent.
- ON ↑ oxidation, ↓ reduction.

ON RULES

- O −2 (peroxide −1, OF_2 +2).
- H +1 (hydride −1).
- F hamesha −1.

TYPES

- Combination, decomposition, displacement.
- Disproportionation: same element upar aur neeche.

BALANCING

- ON change barabar karo.
- O ke liye H_2O, H ke liye H^+.
- Basic: OH^- jodo.

Koi doubt? padhaiadda.netlify.app pe AI Doubt Solver se poocho, ya is chapter ka mock test do.