Weird Chemist

DPP-4 Solutions — Part 1 (Q1–Q22)

Redox Reactions

Chapter: Redox Reactions

Master Formulae — Redox Reactions

1. OIL RIG Rule (Sabse important!):

Oxidation (OIL)	Reduction (RIG)
Oxidation Is Loss (of e^-)	Reduction Is Gain (of e^-)
ON increases	ON decreases
Reducing agent (khud oxidize hota)	Oxidizing agent (khud reduce hota)

2. Oxidation Number Rules:

- Free element (O_2, Cl_2, Na, Fe etc.) = 0
- Monoatomic ion = charge of ion ($Na^+ = +1$, $Cl^- = -1$)
- O = -2 (except in OF_2 it's $+2$; in peroxides H_2O_2, BaO_2 it's -1; in O_2^- it's $-\frac{1}{2}$)
- H = $+1$ (except in metal hydrides: NaH, CaH_2 etc., where H = -1)
- F = always -1 (most electronegative, no positive state!)
- Sum of ON in neutral compound = 0; in ion = charge of ion

3. Disproportionation vs Comproportionation:

- **Disproportionation (auto-redox):** Same element, same initial ON $\rightarrow$ two DIFFERENT final ON (ek element khud hi oxidize + reduce hota hai)
- **Comproportionation:** Same element, two DIFFERENT initial ON $\rightarrow$ same final ON (opposite of disproportionation)

4. Types of Redox:

- **Intermolecular:** Redox between two different molecules (Na + H_2O)
- **Intramolecular:** Redox within same molecule ($KClO_3 \rightarrow KCl + O_2$)

5. Identifying Redox — Quick Check:
Agar kisi bhi element ka ON change nahi hua $\Rightarrow$ NOT a redox reaction.
Agar ON change hua AND ek badhaa + ek ghata $\Rightarrow$ REDOX reaction.

Quick Answer Key — DPP-4 All 43 Questions

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	(3)	10	(2)	19	(1)	28	(3)	37	(2)
2	(2)	11	(2)	20	(1)	29	(4)	38	(4)
3	(3)	12	(4)	21	(4)	30	(2)	39	(2)
4	(3)	13	(3)	22	(4)	31	(1)	40	(2)
5	(4)	14	(3)	23	(3)	32	(3)	41	(1)
6	(3)	15	(1)	24	(1)	33	(2)	42	(1)
7	(2)	16	(1)	25	(4)	34	(1)	43	(1)
8	(4)	17	(3)	26	(3)	35	(3)		
9	(4)	18	(1)	27	(1)	36	(3)		

TYPE-1 — Definitions of Oxidation and Reduction

Q1. Oxidation is defined as?

Explanation

OIL = Oxidation Is Loss (of electrons).
Oxidation ke definitions:

- Electrons ka **loss** $\Rightarrow$ **Correct!**
- Addition of electronegative element (O, F, Cl etc.) $\Rightarrow$ Also correct (alternative definition)
- Removal of electropositive element
- **Increase** in oxidation number (ON) (not decrease)

Option (3): Loss of electrons $\Rightarrow$ **Correct definition of oxidation.**

Approach

OIL RIG yaad karo: OIL = Oxidation Is Loss. Loss = electrons ka jaana. Option (3).

Common Mistake

Students option (4) "Addition of electropositive element" sochte hain. Yeh bhi technically ek DEFINITION hai (ek electropositive element add hone se substance oxidized hota hai dusri cheez ko), lekin primary definition "loss of electrons" hi hai. Aur decrease in positive valency oxidation ka OPPOSITE (reduction) hai!

Answer

Option (3): Loss of electrons

Q2. Reduction is defined as?

Explanation

RIG = Reduction Is Gain (of electrons).

- Gain of electrons $\Rightarrow$ **Correct!**
- Decrease in ON (oxidation number ghata = reduction)

Option (2): Gain of electrons $\Rightarrow$ **Correct definition of reduction.**

Approach

RIG = Reduction Is Gain. Simple! Option (2).

Answer

Option (2): Gain of electrons

TYPE-2 — Identify Oxidised / Reduced Species or Agent

Q3 & Q4. $MnO_4^- + SO_3^{2-} + H^+ \longrightarrow SO_4^{2-} + Mn^{2+} + H_2O$. Which is oxidized/reduced?

Explanation (Step-by-Step)

ON track karo har element ka:
Mn: MnO_4^-: $Mn + 4(-2) = -1 \Rightarrow Mn = +7$
Mn^{2+}: $Mn = +2$
$+7 \rightarrow +2$ (ON **decreased**) $\Rightarrow$ **Mn is REDUCED.** MnO_4^- = oxidizing agent.

S: SO_3^{2-}: $S + 3(-2) = -2 \Rightarrow S = +4$
SO_4^{2-}: $S + 4(-2) = -2 \Rightarrow S = +6$
$+4 \rightarrow +6$ (ON **increased**) $\Rightarrow$ **S is OXIDIZED.** SO_3^{2-} = reducing agent.

H: $+1$ throughout. **No change.**

Approach

Start karo: Har element ka ON reactants aur products mein calculate karo.
End: Mn: +7→+2 (reduced); S: +4→+6 (oxidized). MnO_4^- reduced, SO_3^{2-} oxidized.

Common Mistake

H^+ ko dekh ke students sochte hain H bhi change hua. But H stays +1 throughout — it just balances the charge and forms H_2O. **H^+ yahan sirf acid medium provide karta hai, koi redox nahi hota iske saath!**

Answer

Option (3): MnO_4^- is reduced and SO_3^{2-} is oxidised (Same for both Q3 and Q4)

Q5. $4Fe + 3O_2 \rightarrow 4Fe^{3+} + 6O^{2-}$. Which statement is INCORRECT?

Explanation

Oxidation states:

- Fe: $0 \rightarrow +3$ (ON **increased = oxidized**). Fe is REDUCING AGENT (khud oxidize hua).
- O: $0 \rightarrow -2$ (ON **decreased = reduced**). O_2 is OXIDIZING AGENT.

Check each statement:

- (1) "Redox reaction" — TRUE (Fe oxidized, O reduced).
- (2) "Metallic iron is reducing agent" — TRUE (Fe gives electrons to O).
- (3) "Fe^{3+} is oxidizing agent" — This is debatable. In THIS reaction, Fe^{3+} is the PRODUCT of Fe's oxidation. The actual oxidizing agent IS O_2. Fe^{3+} can act as OA in OTHER contexts, but here it's just the oxidized product. Still, this statement can be considered true in general... So this is borderline.
- (4) "Metallic iron is reduced to Fe^{3+}" — **FALSE!** Fe goes from 0 to +3 = OXIDIZED, NOT REDUCED! Yeh INCORRECT statement hai.

Common Mistake — Biggest Exam Trap!

"Fe REDUCED to Fe^{3+}" — BILKUL GALAT!
Fe ka ON 0 se +3 badhta hai = **OXIDATION**. "Reduced" ka matlab ON GHATA hona chahiye. Students confuse "metallic iron is converted to Fe^{3+}" with reduction. Conversion $\neq$ reduction!

Approach

Start: Fe: 0→+3 (oxidized). O: 0→-2 (reduced).
End: Option (4) says Fe is "reduced" — yeh INCORRECT statement hai.

Answer

Option (4): "Metallic iron is reduced to Fe^{3+}" is INCORRECT (Fe is actually OXIDIZED, not reduced)

Q6. $Cl_2 + OH^- \longrightarrow Cl^- + ClO_4^- + H_2O$. Chlorine is?

Explanation

Cl ka ON track karo:

- Cl_2: Cl = **0** (free element)
- Cl^-: Cl = -1 (decreased $\Rightarrow$ **reduced**)
- ClO_4^-: Cl + 4(-2) = $-1 \Rightarrow$ Cl = $+7$ (increased $\Rightarrow$ **oxidized**)

Cl (0) $\rightarrow$ Cl (-1) **AND** Cl (0) $\rightarrow$ Cl ($+7$).
Same element, same initial ON, going to TWO different final ON values = **Disproportionation!**
$\Rightarrow$ Chlorine is both **oxidised as well as reduced.**

Approach

Start: Cl ka ON reactant aur dono products mein check karo.
End: Cl: 0→-1 (reduced) AND 0→+7 (oxidized) $\Rightarrow$ Both! Option (3).

Answer

Option (3): Oxidised as well as reduced (Disproportionation of Cl)

Q7. $6Li + N_2 \rightarrow 2Li_3N$. What happens to Li?

Explanation

ON track karo:

- Li: $0 \rightarrow +1$ in Li_3N: (3)(+1) + N = 0 $\Rightarrow$ N = -3. Li = $+1$.
  Li: $0 \rightarrow +1$ (ON **increased**) $\Rightarrow$ **Oxidized!**
- N: $0 \rightarrow -3$ (ON decreased) $\Rightarrow$ Reduced.

Li undergoes OXIDATION (electron deta hai N ko).
Li = reducing agent (oxidized hota hai).
N = oxidizing agent (reduced hota hai).

Approach

Li: $0 \rightarrow +1$ = oxidation. **N:** $0 \rightarrow -3$ = reduction. Option (2).

Answer

Option (2): Li undergoes oxidation

Q8. $I_2 + KI \longrightarrow KI_3$. What happens in this reaction?

Explanation

KI3 ka structure samjho: KI_3 actually $K^+[I_3]^-$ hai, jahan I_2 iodide ion (I^-) ke saath **coordinate bond** banata hai.

$$I_2 + I^- \longrightarrow I_3^- \quad \text{(Lewis acid-base reaction)}$$

- I_2: I = 0 (Lewis acid)
- KI ka I: -1 (Lewis base, electron donor)
- I_3^- mein: Average ON = $-1/3$ formally, but yeh sirf COMPLEX FORMATION hai, actual electron transfer NAHI hota!

Key: I_2 ek dative/coordinate bond banata hai I^- ke saath. Koi actual electron transfer nahi hota. $\Rightarrow$ **Neither oxidation nor reduction!**

Common Mistake

Students sochte hain: "ON change hua (0 to -1/3 and -1 to -1/3), toh redox hai!" Lekin yeh COORDINATE BOND formation hai, real electron transfer nahi. **I_2 sirf I^- ke lone pair se coordinate bond accept karta hai** — yeh Lewis acid-base reaction hai, redox nahi!

Approach

Key: $KI_3 = K^+[I_3]^-$ = complex ion. Coordinate bond = no real redox. Option (4).

Answer

Option (4): Neither oxidation nor reduction (Coordinate complex formation, Lewis acid-base)

Q9. Which reaction represents OXIDISING behaviour of H_2SO_4?

Explanation

H_2SO_4 oxidizing agent tab kaam karta hai jab S ka ON (+6) **decrease** kare (S reduce ho).
Check karo S in H_2SO_4 aur products:

- (1) SO_2Cl_2: S ka ON = +6 (same). No redox. NOT oxidizing behaviour.
- (2) Na_2SO_4: Acid-base. S = +6 throughout. NOT oxidizing.
- (3) $NaHSO_4$: Double displacement. NOT oxidizing.
- (4) $_2HI + H_2SO_4 \longrightarrow I_2 + SO_2 + {}_2H_2O$:
  - S: $+6$ (in H_2SO_4) $\rightarrow +4$ (in SO_2) $\Rightarrow$ **S reduced!** H_2SO_4 is oxidizing agent.
  - I: -1 (in HI) $\rightarrow 0$ (in I_2) $\Rightarrow$ I oxidized.

Approach

Start: H_2SO_4 as OA $\Rightarrow$ S must go from +6 to lower state (S reduced).
End: Only option (4): S: +6$\rightarrow$+4 in SO_2. H_2SO_4 oxidizes HI!

Answer

Option (4): $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$ (S: +6$\rightarrow$+4, H_2SO_4 acts as oxidizing agent)

Q10. $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$. Zn undergoes?

Explanation

- Zn: $0 \rightarrow +2$ (in $ZnSO_4$) $\Rightarrow$ ON **increased = OXIDIZED**
- H: $+1$ (in H_2SO_4) $\rightarrow 0$ (in H_2) $\Rightarrow$ H reduced

Zn electrons donate karta hai H^+ ko $\Rightarrow$ Zn is reducing agent, Zn is OXIDIZED.

Approach

Zn: 0$\rightarrow$+2 = oxidation. Direct! Option (2).

Answer

Option (2): Oxidation (Zn: 0$\rightarrow$+2)

Q11. Which involves REDUCTION of copper?

Explanation

Reduction of copper = Cu ka ON decrease hona.

- (1) $Cu(s) + \frac{1}{2}O_2(g) \longrightarrow CuO(s)$: Cu: $0 \rightarrow +2$ (ON **increased**) $\Rightarrow$ **OXIDIZED.** Not reduction!
- (2) $Cu^{2}\equiv(aq) + {}_2I^{-} \longrightarrow {}_2CuI$: Cu: $+2 \rightarrow +1$ (ON **decreased**) $\Rightarrow$ **REDUCED!**
- (3) $CuCl_2 + {}_2F^{-} \longrightarrow CuF_2 + Cl_2$: Cu: $+2 \rightarrow +2$ (no change). Not Cu reduction.

Approach

Start: Cu ka ON reactant aur product mein compare karo.
End: Option (2): Cu: +2→+1 (decreased = reduced).

Common Mistake

Option (3) mein F^- ki wajah se students Cu ka ON recalculate nahi karte. $CuCl_2$: Cu = +2; CuF_2: Cu = +2. Cu ka ON same hai! Sirf Cl^- oxidized hua (Cl: $-1 \rightarrow 0$ in Cl_2). Cu ka reduction nahi hua!

Answer

Option (2): Cu^{2+} + $2I^-$ → 2CuI (Cu: +2→+1, reduced)

Q12. $2H_2O_2 \rightarrow 2H_2O + O_2$. What happens to oxygen?

Explanation

O ka ON track karo:

- O in H_2O_2: H = +1, so $2(+1) + 2x = 0 \Rightarrow x = -1$. O = -1
- O in H_2O: O = -2 (decreased from -1) $\Rightarrow$ **Reduced!**
- O in O_2: O = **0** (increased from -1) $\Rightarrow$ **Oxidized!**

Same element (O), same initial ON (-1), going to TWO different values (-2 and 0).
$\Rightarrow$ **Disproportionation!** Oxygen is BOTH oxidised and reduced.

Approach

Start: H_2O_2 mein O ka ON = -1 (peroxide! not -2).
End: O: $-1 \rightarrow -2$ (reduced) AND $-1 \rightarrow 0$ (oxidized). Both! Option (4).

Common Mistake — Peroxide Trap!

H_2O_2 mein O ka ON = -2 NAHI hai! H_2O_2 = Hydrogen peroxide = O is in PEROXIDE state = -1. Yeh bahut common galti hai. H_2O mein O = -2, H_2O_2 mein O = -1. Dono alag hain!

Answer

Option (4): Oxygen is both oxidised and reduced (Disproportionation: O_2H_2: O at $-1 \rightarrow -2$ and 0)

TYPE-3 — Classify Reactions: Redox or Not?

Q13. **Which does NOT involve oxidation-reduction?**

Explanation

Har reaction mein **sab elements ka ON check karo**. Agar koi bhi change nahi = NOT REDOX.

- (1) $_2Rb + {}_2H_2O \longrightarrow {}_2RbOH + H_2$: Rb: $0 \to +1$ (oxidized); H: $+1 \to 0$ (reduced). **REDOX.**
- (2) $_2CuI_2 \longrightarrow {}_2CuI + I_2$: Cu: $+2 \to +1$ (reduced); I: $-1 \to 0$ in I_2 (oxidized). **REDOX.**
- (3) $NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$:
  - N in NH_4Cl: $-3 \to$ N in NH_3: -3 (no change!)
  - H, Na, Cl, O: all no change

  $\Rightarrow$ **Double displacement (acid-base). NOT REDOX!**
- (4) $_3Mg + N_2 \longrightarrow Mg_3N_2$: Mg: $0 \to +2$; N: $0 \to -3$. **REDOX.**

Approach

Start: Har option mein ek element ka ON reactant vs. product compare karo.
Short-cut: Acid-base + double displacement reactions usually NOT redox.
End: Option (3): $NH_4Cl + NaOH$ is pure neutralization. NOT REDOX.

Answer

Option (3): NH_4Cl + NaOH $\to$ NaCl + NH_3 + H_2O (NOT a redox reaction)

Q14. **Which is NOT a redox reaction?**

Explanation

- (1) $MnO_4^- \longrightarrow MnO_2 + O_2$: Mn: $+7 \to +4$; O: $-2 \to 0$. **REDOX.**
- (2) $Cl_2 + H_2O \longrightarrow HCl + HClO$: Cl: $0 \to -1$ and $0 \to +1$. **REDOX (disproportionation).**
- (3) $_2CrO_4^{2-} + {}_2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$:
  - Cr in CrO_4^{2-}: $+6 \to$ Cr in $Cr_2O_7^{2-}$: Let $2x + 7(-2) = -2 \Rightarrow 2x = 12 \Rightarrow x = +6$
  - Cr stays $+6$! O stays -2. H stays $+1$.
  - **Just condensation (dehydration), NOT REDOX!**
- (4) $MnO_4^- + {}_8H^+ + {}_5Ag \longrightarrow Mn^{2+} + {}_4H_2O + {}_5Ag^+$: Mn: $+7 \to +2$; Ag: $0 \to +1$. **REDOX.**

Common Mistake

$CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$ reaction mein Cr ka ON $+6$ se $+6$ hi rehta hai! Students sochte hain "chromate convert to dichromate hua, toh redox hoga." GALAT! It's just two CrO_4^{2-} ions joining (with water leaving). **No electron transfer!**

Approach

Key check: Cr: +6→+6 in option (3). No change = NOT REDOX.

Answer

Option (3): $\mathbf{{}_2CrO_4^{2-} + {}_2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O}$ (Cr stays +6, NOT a redox reaction)

Q15. Choose the REDOX reaction.

Explanation

- (1) $Cu + {}_2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + {}_2H_2O$: Cu: $0 \to +2$ (oxidized); S: $+6 \to +4$ in SO_2 (reduced). **REDOX!**
- (2) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + {}_2HCl$: All ON unchanged. Double displacement. NOT REDOX.
- (3) ${}_2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + {}_2H_2O$: Neutralization. NOT REDOX.
- (4) $KNO_3 + H_2SO_4 \longrightarrow HNO_3 + K_2SO_4$: K: +1; N: +5; S: +6; all unchanged. NOT REDOX.

Approach

Short-cut: Option (1) mein metal Cu + acid hai, aur SO_2 banta hai (concentrated acid). Yeh clearly redox hai (Cu khud oxidize hota, H_2SO_4 ka S reduce hota).

Answer

Option (1): $\mathbf{Cu + 2H_2SO_4 \to CuSO_4 + SO_2 + 2H_2O}$ (Cu oxidized, S reduced)

Q16. Which one is a redox reaction?

Explanation

- (1) $H_2 + Br_2 \longrightarrow {}_2HBr$: H: $0 \to +1$ (oxidized); Br: $0 \to -1$ (reduced). **REDOX!**
- (2) ${}_2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + {}_2HCl$: All ON unchanged. NOT REDOX.
- (3) $HCl + AgNO_3 \longrightarrow AgCl + HNO_3$: Precipitation. NOT REDOX.
- (4) $NaOH + HCl \longrightarrow NaCl + H_2O$: Neutralization. NOT REDOX.

Approach

Pattern: Jab bhi ek element free state (ON=0) mein react karta hai aur compound banata hai (or vice versa), **it's REDOX**. $H_2 + Br_2 \to HBr$: dono elements free state se compound banate hain.

Answer

Option (1): $\mathbf{H_2 + Br_2 \to 2HBr}$ (H: $0 \to +1$; Br: $0 \to -1$)

Q17. Which is NOT a redox change?

Explanation

- (1) $_2H_2S + SO_2 \longrightarrow {}_2H_2O + {}_3S$: S in H_2S: -2; S in SO_2: $+4$; S in elemental S: 0. So S: $-2 \to 0$ (oxidized) and $+4 \to 0$ (reduced). **REDOX (comproportionation).**
- (2) $_2BaO + O_2 \longrightarrow {}_2BaO_2$: O in BaO: -2; O in O_2: 0; O in BaO_2: -1. O: $0 \to -1$ (reduced) and $-2 \to -1$ (oxidized). **REDOX.**
- (3) $BaO_2 + H_2SO_4 \longrightarrow BaSO_4 + H_2O_2$: O in BaO_2: -1; O in H_2O_2: -1 (no change!). Ba: $+2 \to +2$; S: $+6 \to +6$. **NOT REDOX!**
- (4) $_2KClO_3 \longrightarrow {}_2KCl + {}_3O_2$: Cl: $+5 \to -1$ (reduced); O: $-2 \to 0$ (oxidized). **REDOX.**

Approach

Key insight for option (3): BaO_2 (peroxide: O = -1) + $H_2SO_4 \to H_2O_2$ (peroxide: O = -1). O stays at -1! Just a double displacement. NOT REDOX.

Common Mistake

Students option (2) $BaO + O_2 \longrightarrow BaO_2$ ko miss karte hain. BaO mein O = -2, O_2 mein O = 0, BaO_2 mein O = -1. DONO oxygen ki ON change hui! **Yeh redox hai.** Option (3) ka redox nahi hai kyunki BaO_2 mein aur H_2O_2 mein dono mein O = -1 hi rehta hai.

Answer

Option (3): $BaO_2 + H_2SO_4 \to BaSO_4 + H_2O_2$ (O stays at -1, NOT a redox change)

Q18. Which is a redox reaction?

Explanation

- (1) $_2CuI_2 \longrightarrow {}_2CuI + I_2$: Cu: $+2 \to +1$ (reduced); I: $-1 \to 0$ in I_2 (oxidized). **REDOX!**
- (2) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$: Precipitation. All ON unchanged. NOT REDOX.
- (3) $NH_4Cl + NaOH \longrightarrow NH_3 + NaCl + H_2O$: Acid-base. N: $-3 \to -3$. NOT REDOX.
- (4) $Cr_2(SO_4)_3 + {}_6KOH \longrightarrow {}_2Cr(OH)_3 + {}_3K_2SO_4$: Double displacement. Cr: $+3 \to +3$. NOT REDOX.

Approach

Option (1) mein CuI_2 decompose hoti hai with Cu reduced (+2→+1) and I oxidized ($-1 \to 0$). REDOX!

Answer

Option (1): $2CuI_2 \to 2CuI + I_2$ (Cu: +2→+1; I: $-1 \to 0$)

Q19. Which is NOT a redox reaction?

Explanation

- (1) $CaCO_3 \longrightarrow CaO + CO_2$: Ca: $+2 \to +2$; C in $CaCO_3$: $+4$; C in CO_2: $+4$; O: -2 throughout. **NO CHANGE IN ON! ⇒ NOT REDOX.**
- (2) $_2H_2 + O_2 \longrightarrow {}_2H_2O$: H: $0 \to +1$; O: $0 \to -2$. **REDOX.**
- (3) $Na + H_2O \longrightarrow NaOH + \frac{1}{2}H_2$: Na: $0 \to +1$; H: $+1 \to 0$. **REDOX.**
- (4) $MnCl_3 \longrightarrow MnCl_2 + \frac{1}{2}Cl_2$: Mn: $+3 \to +2$ (reduced); Cl: $-1 \to 0$ (oxidized). **REDOX.**

Approach

Key: $CaCO_3$ decomposition = C stays at +4 in $CaCO_3$ AND CO_2. No ON change $\Rightarrow$ NOT REDOX.

Answer

Option (1): $CaCO_3 \rightarrow CaO + CO_2$ (All ON unchanged, NOT a redox reaction)

Q20. Which involves NEITHER oxidation nor reduction?

Explanation

- (1) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$: Cr: $+6 \rightarrow +6$; O: $-2 \rightarrow -2$. **NO CHANGE.**
- (2) Cr $\longrightarrow$ $CrCl_3$: Cr: $0 \rightarrow +3$. OXIDATION. REDOX.
- (3) Na $\longrightarrow$ Na^+: Na: $0 \rightarrow +1$. OXIDATION.
- (4) ${}_2S_2O_3^{2-} \longrightarrow S_4O_6^{2-}$: S in $S_2O_3^{2-}$: $2x + 3(-2) = -2 \Rightarrow x = +2$. S in $S_4O_6^{2-}$: $4x + 6(-2) = -2 \Rightarrow 4x = +10 \Rightarrow x = +2.5$. S: $+2 \rightarrow +2.5$ (oxidized). REDOX.

Option (1): $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$ is just condensation. Cr stays +6. NO REDOX.

Common Mistake

Option (4) ${}_2S_2O_3^{2-} \longrightarrow S_4O_6^{2-}$ mein students sochte hain S ka ON +2 se +2 hi rehta hai. **GALAT!** $S_4O_6^{2-}$ mein S ka ON = +2.5 hota hai (average). Yeh oxidation hai! **Thiosulphate to tetrathionate is actually a redox reaction.**

Approach

Eliminate karo: Options (2), (3), (4) sabhi REDOX hain. Option (1) mein Cr stays +6. $\Rightarrow$ Option (1).

Answer

Option (1): $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$ (Cr stays +6, NOT redox)

Q21 & Q22. Which involves oxidation and reduction?

Explanation

- (1) NaBr + HCl $\longrightarrow$ NaCl + HBr: Na:$+1 \rightarrow +1$, Br:$-1 \rightarrow -1$, H:$+1 \rightarrow +1$, Cl:$-1 \rightarrow -1$. NOT REDOX.
- (2) HBr + $AgNO_3$ $\longrightarrow$ AgBr + HNO_3: Precipitation. NOT REDOX.
- (3) ${}_2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + {}_2H_2O$: Neutralization. NOT REDOX.
- (4) $H_2 + Br_2 \longrightarrow {}_2HBr$: H: $0 \rightarrow +1$ (oxidized); Br: $0 \rightarrow -1$ (reduced). **REDOX!**

(Q22 option 3 is $Na_2O + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$ — same logic, NOT REDOX)

Approach

Pattern: Elements in free state (H_2, Br_2: ON = 0) forming compounds = always REDOX. Option (4) both elements start at ON = 0.

Answer

Option (4): $\mathbf{H_2 + Br_2 \rightarrow 2HBr}$ (H: $0 \rightarrow +1$; Br: $0 \rightarrow -1$) for both Q21 and Q22.

TYPE-4 — Disproportionation and Comproportionation

Q23. $H_2O_2 + H_2O_2 \longrightarrow {}_2H_2O + O_2$. Disproportionation because?

Explanation

Disproportionation definition: Ek hi element (same ON) ek saath oxidize bhi hota hai aur reduce bhi.
H_2O_2 mein O ka ON = -1 (peroxide!).

- O in H_2O: -2 (O ka ON ghata = **reduced**)
- O in O_2: 0 (O ka ON badha = **oxidized**)

Same element O (initially -1 in H_2O_2) $\rightarrow$ two different final states (-2 and 0).
O ka ON **both decreases and increases!** $\Rightarrow$ Disproportionation.

Approach

Start: O in $H_2O_2 = -1$.
End: O: $-1 \rightarrow -2$ (reduced) AND $-1 \rightarrow 0$ (oxidized). Both happen = disproportionation. Option (3).

Answer

Option (3): ON of oxygen decreases as well as increases

Q24. Which does NOT represent disproportionation?

Explanation

Disproportionation = **SAME element, SAME initial ON, DIFFERENT final ON**. Two alag-alag products.

- **(1)** $MnO_2 + {}_4HCl \longrightarrow MnCl_2 + Cl_2 + {}_2H_2O$:
  Mn: $+4 \rightarrow +2$ (reduced). Cl in HCl: $-1 \rightarrow -1$ in $MnCl_2$ (no change) and $-1 \rightarrow 0$ in Cl_2 (oxidized).
  Two different elements (Mn and Cl) involved. **NOT disproportionation!**
- **(2)** ${}_2H_2O_2 \longrightarrow {}_2H_2O + O_2$: O: $-1 \rightarrow -2$ and $-1 \rightarrow 0$. Same element. **DISPROPORTIONATION.**
- **(3)** ${}_4KClO_3 \longrightarrow {}_3KClO_4 + KCl$: Cl: $+5 \rightarrow +7$ and $+5 \rightarrow -1$. Same element Cl. **DISPROPORTIONATION.**
- **(4)** ${}_3Cl_2 + {}_6NaOH \longrightarrow {}_5NaCl + NaClO_3 + {}_3H_2O$: Cl: $0 \rightarrow -1$ and $0 \rightarrow +5$. Same element. **DISPROPORTIONATION.**

Common Mistake

Option (1) mein Mn bhi change hota hai aur Cl bhi — lekin yeh **DO ALAG ELEMENTS** hain (Mn reduced, Cl oxidized). Disproportionation mein **EK HI element** ke ONs alag-alag direction mein jaate hain!

Approach

Check: Kya ek hi element hai jo simultaneously oxidize + reduce ho raha hai?
Option (1) mein Mn aur Cl alag elements hain $\Rightarrow$ NOT disproportionation.

Answer

Option (1): $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$ (Two different elements: Mn reduced, Cl oxidized – NOT disproportionation)

Q25. Which represent disproportionation reactions?

Explanation

- **(1)** $Cl_2 + {}_2OH^- \longrightarrow ClO^- + Cl^- + H_2O$:
  Cl: $0 \rightarrow +1$ (in ClO^-, oxidized) AND $0 \rightarrow -1$ (in Cl^-, reduced). Same element Cl! **DISPROPORTIONATION!**
- **(2)** $Cu_2O + {}_2H^+ \longrightarrow Cu + Cu^{2+} + H_2O$:
  Cu in Cu_2O: $+1$. Cu in Cu: 0 (reduced) and Cu^{2+}: $+2$ (oxidized). Same element Cu! **DISPROPORTIONATION!**
- **(3)** ${}_2HCuCl_2 \longrightarrow Cu + Cu^{2+} + {}_4Cl^- + {}_2H^+$:
  Cu in $HCuCl_2$: $+1$. Products: Cu: 0 (reduced) and Cu^{2+}: $+2$ (oxidized). **DISPROPORTIONATION!**

Saare teen disproportionation hain!

Approach

Teeno mein ek hi element ek saath oxidize + reduce ho raha hai. All three = disproportionation. Option (4).

Answer

Option (4): All of the above (Teeno disproportionation reactions hain)

Q26. Select the example of disproportionation reaction.

Explanation

- (1) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + {}_2HCl$: Double displacement. NO redox.
- (2) $NH_4NO_3 \longrightarrow N_2O + {}_2H_2O$: N in NH_4^+: -3; N in NO_3^-: $+5$. Product N_2O: N = $+1$. Two DIFFERENT initial ON (-3 and $+5$) converging to SAME ($+1$). **This is COMPROPORTIONATION, NOT disproportionation!**
- (3) ${}_4H_3PO_3 \longrightarrow PH_3 + {}_3H_3PO_4$:
  P in H_3PO_3: $2(+1) + x + 3(-2) = 0 \Rightarrow x = +4$? Wait: H_3PO_3 has P in +3 state (phosphorous acid, H_3PO_3).
  Actually: 3(+1) + x + 3(-2) = 0 $\Rightarrow$ x = +3.
  P in PH_3: P + 3(+1) = 0 $\Rightarrow$ P = -3 (reduced).
  P in H_3PO_4: 3(+1) + x + 4(-2) = 0 $\Rightarrow$ x = $+5$ (oxidized).
  P: $+3 \rightarrow -3$ AND $+3 \rightarrow +5$. Same P, same initial ON, different final! **DISPROPORTIONATION!**
- (4) $AgCl + {}_2NH_3 \longrightarrow Ag(NH_3)_2Cl$: Complex formation. NOT REDOX.

Common Mistake

Option (2) $NH_4NO_3 \longrightarrow N_2O$ is commonly mistaken as disproportionation. Lekin yahan N ke **DO ALAG** initial ON hain (-3 in NH_4^+ and $+5$ in NO_3^-) jo same final ON ($+1$) pe aate hain. Yeh **COMPROPORTIONATION** hai!
Disproportionation mein: SAME initial ON $\rightarrow$ DIFFERENT final ON.

Approach

Start: P in H_3PO_3 = +3. Products: PH_3 (P = -3) and H_3PO_4 (P = $+5$).
End: Same P (+3) $\rightarrow$ two different states (-3 and $+5$) = DISPROPORTIONATION! Option (3).

Answer

Option (3): $4H_3PO_3 \rightarrow PH_3 + 3H_3PO_4$ (P: +3$\rightarrow-3$ AND +3$\rightarrow$+5 — disproportionation)

Q27. Which is disproportionation? [NCERT]

Explanation

- **(1)** ${}_3Cl_2 + {}_6OH^- \longrightarrow {}_5Cl^- + ClO_3^- + {}_3H_2O$:
  Cl: $0 \rightarrow -1$ (in $5Cl^-$, reduced) AND $0 \rightarrow +5$ (in ClO_3^-, oxidized). Same Cl. **DISPROPORTIONATION!**
- (2) $CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$: Cu: $+2 \rightarrow 0$; Zn: $0 \rightarrow +2$. Two different elements. NOT disproportionation.
- (3) ${}_2H_2O \longrightarrow {}_2H_2 + O_2$: H: $+1 \rightarrow 0$ (reduced); O: $-2 \rightarrow 0$ (oxidized). Two different elements. NOT disproportionation.
- (4) ${}_3Mg + N_2 \longrightarrow Mg_3N_2$: Two different elements. NOT disproportionation.

Approach

Option (1): Cl (0) $\rightarrow -1$ AND $+5$. Same element, same initial ON, different final = DISPROPORTIONATION.

Answer

Option (1): $3Cl_2 + 6OH^- \rightarrow 5Cl^- + ClO_3^- + 3H_2O$ (Cl: $0\rightarrow-1$ AND $0\rightarrow+5$)

Q28. White P + caustic soda → PH_3 + NaH_2PO_2. Reaction is?

Explanation

White P = P_4, ON of P = **0**.
Products:

- PH_3: P + 3(+1) = 0 ⇒ P = −3 (ON decreased from 0 = **REDUCED**)
- NaH_2PO_2 (sodium hypophosphite): Na(+1) + 2(+1) + P + 2(-2) = 0 ⇒ P = +1 (ON increased from 0 = **OXIDIZED**)

P: 0 → −3 AND 0 → +1. Same element P, same initial ON (0), different final ON (−3 and +1) ⇒ **DISPROPORTIONATION!**

Approach

Start: P in P_4 = 0 (free element).
End: P in PH_3 = −3 (reduced); P in NaH_2PO_2 = +1 (oxidized). Same P, different products = disproportionation.

Answer

Option (3): Disproportionation (P: 0→−3 AND 0→+1)

Q29. Which underlined element can undergo disproportionation? [NCERT]

Explanation

Key rule for disproportionation: Element ka ON **intermediate** hona chahiye — na highest, na lowest. Tabhi dono directions (oxidize + reduce) possible hain.

- (1) $K\underline{Mn}O_4$: Mn = +7 (HIGHEST ON for Mn in common compounds). Can only be reduced, not oxidized further easily. **Cannot disproportionate.**
- (2) $H\underline{N}O_3$: N = +5 (HIGHEST for N). Same issue. **Cannot disproportionate.**
- (3) $H\underline{Cl}O_4$: Cl = +7 (HIGHEST for Cl). Same issue. **Cannot disproportionate.**
- (4) $H\underline{N}O_2$: N = +3 (**INTERMEDIATE** for N, range: −3 to +5). Can go both up (+3 → +5) and down (+3 → +1 or lower). **CAN disproportionate!** Example: $3HNO_2 \rightarrow HNO_3 + 2NO + H_2O$: N: +3 → +5 and +3 → +2.

Common Mistake

Students $KMnO_4$ (Mn = +7) ko disproportionate karne wala samajhte hain. Lekin +7 is the MAXIMUM oxidation state of Mn in common compounds! Ek direction mein hi ja sakta hai (reduce). Disproportionation ke liye **intermediate state mandatory** hai!

Approach

Start: Har option mein element ka ON nikalo.
End: Intermediate ON wala element disproportionate kar sakta hai. HNO_2 mein N = +3 (intermediate between −3 and +5). Option (4).

Answer

Option (4): HNO_2 (N = +3, intermediate state ⇒ can disproportionate)

Q30. Which are disproportionation reactions? [NEET-2019]

Explanation (Step-by-Step)

- **(a)** $_2Cu^+ \longrightarrow Cu^{2+} + Cu^0$: Cu: $+1 \rightarrow +2$ (oxidized) AND $+1 \rightarrow 0$ (reduced). Same Cu, same initial ON. **DISPROPORTIONATION!**
- **(b)** $_3MnO_4^{2-} + {}_4H^+ \longrightarrow {}_2MnO_4^- + MnO_2 + {}_2H_2O$:
  Mn in MnO_4^{2-}: $+6$. Mn in MnO_4^-: $+7$ (oxidized). Mn in MnO_2: $+4$ (reduced).
  Same Mn, same initial ON ($+6$), different final ($+7$ and $+4$). **DISPROPORTIONATION!**
- **(c)** $_2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$:
  Mn in $KMnO_4$: $+7$. Mn in K_2MnO_4: $+6$ (reduced). Mn in MnO_2: $+4$ (reduced).
  O in $KMnO_4$: -2. O in O_2: 0 (oxidized!). So Mn (from $+7$) $\rightarrow +6$ and $+4$; and O: $-2 \rightarrow 0$.
  Actually multiple elements changing. But for Mn: $+7 \rightarrow +6$ and $+7 \rightarrow +4$ — same initial ON, different final. **DISPROPORTIONATION!**
- **(d)** $_2MnO_4^- + {}_3Mn^{2+} + {}_2H_2O \longrightarrow {}_5MnO_2 + {}_4H^+$:
  Mn in MnO_4^-: $+7$ (reduced to $+4$). Mn in Mn^{2+}: $+2$ (oxidized to $+4$).
  Two DIFFERENT initial ON ($+7$ and $+2$) $\rightarrow$ SAME final ON ($+4$). **COMPROPORTIONATION (NOT disproportionation)!**

$\therefore$ (a), (b), (c) are disproportionation.

Comproportionation vs Disproportionation — KEY CONCEPT!

Disproportionation	Comproportionation
Same initial ON	Different initial ON
Different final ON	Same final ON
One element splits	Two come together

Option (d) = COMPROPORTIONATION: MnO_4^- (Mn = +7) + Mn^{2+} (Mn = +2) $\rightarrow$ MnO_2 (Mn = +4). Different initial, same final!

Approach

Start: Har option mein same element ka ON check karo — same initial? Different final?
End: (a), (b), (c) = disproportionation. (d) = comproportionation. $\Rightarrow$ Option (2).

Answer

Option (2): (a), (b) and (c) only [Note: (d) is comproportionation, NOT disproportionation]

Q31. Which element undergoes disproportionation in water?

Explanation

- **(1) Cl_2:** $Cl_2 + H_2O \longrightarrow HCl + HClO$: Cl: $0 \to -1$ (in HCl, reduced) AND $0 \to +1$ (in HClO, oxidized). Same Cl. **DISPROPORTIONATION in water!**
- **(2) F_2:** $F_2 + H_2O \longrightarrow HF + HOF$ (or $_2HF + \frac{1}{2}O_2$). F is the most electronegative element — it ALWAYS goes to -1 in compounds. F: $0 \to -1$ (reduced only). **NOT disproportionation** (only one direction). In HOF: F = -1 (since F is more electronegative than O). Water is oxidized here (O: $-2 \to +1$), not F.
- **(3) K:** $_2K + {}_2H_2O \longrightarrow {}_2KOH + H_2$: K: $0 \to +1$ (only oxidized). H: $+1 \to 0$ (reduced). Two different elements. NOT disproportionation.
- **(4) Cs:** Same as K. NOT disproportionation.

Approach

Key: $Cl_2 + H_2O \to HCl + HClO$ is the classic disproportionation in water. Cl: $0 \to -1$ AND $0 \to +1$. Option (1).

Answer

Option (1): Cl_2 (Cl: $0 \to -1$ AND $0 \to +1$ in water)

TYPE-5 — Types of Redox Reactions

Q32. **Reaction of water with sodium. Example of?**

Explanation

Reaction: $_2Na + {}_2H_2O \longrightarrow {}_2NaOH + H_2$

- Na: $0 \to +1$ (oxidized)
- H: $+1 \to 0$ (reduced)
- Redox ho raha hai.
- Na aur H_2O = **DO ALAG MOLECULES** react kar rahe hain.

$\therefore$ **Intermolecular redox** (redox between two different molecules).

Approach

Intermolecular: Redox between two different molecules (Na + H_2O).
Intramolecular: Redox within same molecule.
Na aur H_2O dono alag molecules hain $\Rightarrow$ Intermolecular. Option (3).

Answer

Option (3): Intermolecular redox (Na oxidized by H_2O within two different molecules)

Q33. **Decomposition of $KClO_3$ to KCl and O_2. Example of?**

Explanation

Reaction: $_2KClO_3 \longrightarrow {}_2KCl + {}_3O_2$

- Cl: $+5 \rightarrow -1$ (reduced)
- O: $-2 \rightarrow 0$ (oxidized)
- Cl aur O **dono ek hi molecule ($KClO_3$) mein hain!**

Oxidation aur reduction ek hi molecule ke andar ho rahi hai $\Rightarrow$ **Intramolecular redox!**

Common Mistake

Students ise disproportionation sochte hain. GALAT! Disproportionation mein **EK HI ELEMENT** ek saath oxidize+reduce hota hai. $KClO_3$ mein Cl reduce hota hai aur O oxidize hota hai — **DO ALAG elements**, same molecule. Yeh INTRAMOLECULAR redox hai, disproportionation nahi.

Approach

Intra = within. Ek hi molecule ke andar two different elements mein redox = intramolecular. Option (2).

Answer

Option (2): Intramolecular redox change (Cl and O both in $KClO_3$, same molecule)

Q34. $2K_2MnO_4 + Cl_2 \rightarrow 2KMnO_4 + 2KCl$. Example of?

Explanation

- Mn in K_2MnO_4: $+6$; Mn in $KMnO_4$: $+7$ (ON badhaa = **oxidized**)
- Cl in Cl_2: 0; Cl in KCl: -1 (ON ghata = **reduced**)

Yeh ek normal **REDOX reaction** hai. Two different elements (Mn and Cl). Mn oxidized, Cl reduced.
Not disproportionation (different elements). **Not** comproportionation (Mn ki initial ON single hai). Just a straightforward redox.

Approach

Mn: +6→+7 (oxidized), Cl: $0 \rightarrow -1$ (reduced). Simple redox. Option (1).

Answer

Option (1): Redox (Mn oxidized: +6→+7; Cl reduced: $0 \rightarrow -1$)

Q35. Which is the spontaneous oxidation-reduction reaction?

Explanation

Spontaneous reaction = joh apne aap hoti hai, bina baahri energy ke. Strong oxidizing agent + strong reducing agent $\Rightarrow$ spontaneous.
$KMnO_4$ (Mn^{7+}) = bahut strong oxidizing agent. Fe^{2+} = common reducing agent.
Option (3): $MnO_4^- + {}_5Fe^{2+} + {}_8H^+ \longrightarrow Mn^{2+} + {}_5Fe^{3+} + {}_4H_2O$

- Mn: $+7 \rightarrow +2$ (reduced; MnO_4^- is OA)
- Fe: $+2 \rightarrow +3$ (oxidized; Fe^{2+} is RA)

This is the classical, spontaneous titration reaction used in volumetric analysis!
Options (1) and (4) are reverse reactions (backward = non-spontaneous).
Option (2): MnO_4^- + Fe^{3+} — Fe^{3+} is already oxidized, it can't reduce MnO_4^-.

Approach

$KMnO_4$ as OA (gets reduced, Mn: +7$\rightarrow$+2) + Fe^{2+} as RA (gets oxidized, Fe: +2$\rightarrow$+3) = spontaneous. Option (3).

Answer

Option (3): MnO_4^- + 5Fe^{2+} + 8H^+ $\rightarrow$ Mn^{2+} + 5Fe^{3+} + 4H_2O ($KMnO_4$ oxidizes Fe^{2+} in acidic medium)

TYPE-6 — Oxidation Number Calculations

Q36. Charge on cobalt in $[Co(CN)_6]^{3-}$?

Explanation (Step-by-Step)

Complex ion: $[Co(CN)_6]^{3-}$
Step 1: CN^- ka charge = -1 (cyanide ion always -1).
Step 2: 6 CN^- ligands hain: $6 \times (-1) = -6$.
Step 3: Total complex charge = -3:

$$x + (-6) = -3 \implies x = +3$$

Co ka charge = **+3**.

Approach

Start: Complex charge + ligand charges = total charge.
End: Co + 6(-1) = $-3 \Rightarrow$ Co = $+3$. Option (3).

Common Mistake

Students total complex charge (-3) ko hi Co ka charge samajh lete hain! Complex ka charge aur central metal ka charge alag hote hain. **Hamesha ligand charges subtract karo central metal charge paane ke liye!**

Answer

Option (3): +3 (Co: $x + 6(-1) = -3 \Rightarrow x = +3$)

Q37. Which halogen always shows ONLY ONE oxidation state?

Explanation

Fluorine (F) is the most electronegative element in the periodic table.

- F ki electronegativity = 3.98 (highest)
- F **HAMESHA electron accept karta hai** (never donate)
- F ka ON = **always** -1 **in ALL compounds**
- F2 mein = 0 (free element)
- Kisi bhi compound mein F = -1 (no positive state!)

Other halogens (Cl, Br, I) positive oxidation states bhi le sakte hain (ClO_4^-: Cl = +7, etc.).
Only F = only one oxidation state (-1) in compounds.

Approach

Most electronegative = always takes electrons = always -1. Only F fits. Option (2).

Answer

Option (2): F (Fluorine) — Always -1 in compounds (most electronegative element)

Q38. Cl_2 + hot conc. NaOH: Cl ON changes from?

Explanation (Step-by-Step)

Hot concentrated NaOH ke saath Cl_2 ka reaction:

$$3Cl_2 + 6NaOH \xrightarrow{\Delta,\text{conc.}} 5NaCl + NaClO_3 + 3H_2O$$

Cl ka ON track karo:

- Cl in Cl_2: **0** (free element)
- Cl in NaCl (Cl^-): -1 (ON decreased = reduced)
- Cl in $NaClO_3$ (ClO_3^-): $x + 3(-2) = -1 \Rightarrow x = +5$ (ON increased = oxidized)

Change: $0 \rightarrow -1$ AND $0 \rightarrow +5$
Note: Cold dilute NaOH mein: Cl_2 + 2NaOH $\rightarrow$ NaCl + NaOCl + H_2O (Cl: $0 \rightarrow -1$ and $0 \rightarrow +1$).
Lekin **hot conc.** mein: $0 \rightarrow -1$ and $0 \rightarrow +5$.

Common Mistake — Hot vs Cold NaOH!

Cold dilute NaOH mein product = NaCl + NaOCl $\Rightarrow$ Cl: $0 \rightarrow -1$ and $0 \rightarrow +1$.
Hot concentrated NaOH mein product = NaCl + $NaClO_3$ $\Rightarrow$ Cl: $0 \rightarrow -1$ and $0 \rightarrow$ **+5**.
Yeh distinction exam mein bahut important hai!

Approach

Start: Cl in Cl_2 = 0.
End: NaCl: Cl = -1; $NaClO_3$: Cl = $+5$. Change: $0 \to -1$ and $0 \to +5 \Rightarrow$ Option (4).

Answer

Option (4): Zero to -1 and zero to $+5$ (Hot conc. NaOH: 5NaCl + $NaClO_3$)

Q39. $K_2Cr_2O_7$ reacts with hydrazine. ON of Cr in product?

Explanation

- $K_2Cr_2O_7$: Cr = $+6$ (strong oxidizing agent — dichromate)
- Hydrazine (N_2H_4): N = -2 (reducing agent)

Dichromate (Cr: +6) oxidizes hydrazine $\Rightarrow$ Cr gets **reduced**.
In acidic/neutral medium, Cr^{6+} reduces to **Cr^{3+}** (the typical product of dichromate reduction):

$$Cr_2O_7^{2-} + {}_{14}H^+ + {}_6e^- \longrightarrow {}_2Cr^{3+} + {}_7H_2O$$

Product: **Cr^{3+}** (green color)

Approach

Dichromate Cr: +6 + reducing agent $\Rightarrow$ Cr gets reduced to +3. Classic result. Option (2).

Answer

Option (2): +3 (Cr: $+6 \to +3$, dichromate reduced by hydrazine)

Q40 & Q42. $KMnO_4$ + H_2O_2 in ACIDIC medium gives? / $KMnO_4$ + H_2O_2 in acidic: which formed?

Explanation

Acidic medium mein $KMnO_4$ ke saath H_2O_2:

- $KMnO_4$: Mn = $+7$ (strong OA in acidic medium)
- H_2O_2: O = -1 (here acts as **reducing agent**, giving electrons to Mn)
- In acidic medium: $Mn^{7+} \to$ **Mn^{2+}** (colorless/pale pink)
- H_2O_2 oxidized: O: $-1 \to 0$ (in O_2)

Reaction: ${}_2MnO_4^- + {}_5H_2O_2 + {}_6H^+ \longrightarrow {}_2Mn^{2+} + {}_5O_2 + {}_8H_2O$
Products: **Mn^{2+} and O_2**

$KMnO_4$ in Different Media — Must Know!

Medium	Mn Product	ON change
Strongly acidic (H^+)	Mn^{2+} (pale pink)	+7→+2
Neutral/weak alkaline	MnO_2 (brown ppt)	+7→+4
Strongly alkaline (OH^-)	MnO_4^{2-} (manganate, green)	+7→+6

Approach

Acidic medium + $KMnO_4$ = Mn^{2+}. H_2O_2 as RA = oxidized to O_2. Option (2) for Q40; Option (1) for Q42 (Mn^{2+}).

Answer

Q40: Option (2): Mn^{2+} and O_2 **Q42: Option (1): Mn^{2+}**

Q41. In weak alkaline medium, $KMnO_4$ is converted into?

Explanation

From the table above:
Neutral or WEAK ALKALINE medium mein $KMnO_4 \Rightarrow$ **MnO_2** (brown precipitate).
Mn: $+7 \rightarrow +4$

Approach

Medium rule yaad karo: Weak alkaline/neutral $\Rightarrow$ MnO_2 (brown). Option (1).

Answer

Option (1): MnO_2 (Brown precipitate in neutral/weak alkaline medium; Mn: +7→+4)

Q43. $H_2O(s) + F_2(g) \rightarrow HF(g) + HOF(g)$. ON of F changes from? [NCERT]

Explanation (Step-by-Step)

Step 1: F in F_2: ON = **0** (free element).
Step 2: F in HF: H = +1, so F = -1 (decreased).
Step 3: F in HOF (hypofluorous acid, H-O-F structure): F is the most electronegative element (more than O!). So F always gets -1, even in HOF.

$$H : +1, \quad O : x, \quad F : -1 \Rightarrow +1 + x + (-1) = 0 \Rightarrow x = 0$$

O in HOF = 0 (interesting! Water's O is oxidized from -2 to 0 here!)
F in HOF = -1.
Result: F changes from 0 (in F_2) to -1 (in BOTH HF and HOF).
F is only **reduced** ($0 \rightarrow -1$). No oxidation of F!
Key insight: F cannot be oxidized (it's already the most electronegative, has no positive states). Water's oxygen gets oxidized from -2 to 0!

UNIQUE NCERT CONCEPT — Exam Mein Aata Hai!

Is reaction mein:

- F: $0 \rightarrow -1$ (only reduced, never oxidized)
- O in H_2O: $-2 \rightarrow 0$ in HOF (WATER is oxidized! Water acts as reducing agent when reacting with F_2!)

Yeh **ek unique reaction hai** jahan pani khud oxidize ho jaata hai (reducing agent banta hai). F_2 is such a strong oxidizer that it can even oxidize water!

Approach

Start: F in F_2 = 0. F in HF = -1. F in HOF = -1 (F hamesha -1!).
End: F: only $0 \rightarrow -1$ in both products. $\Rightarrow$ Option (1).

Answer

Option (1): 0 to -1 (F always goes to -1; in HOF also F = -1 since F is more electronegative than O)