PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 7

Total Marks : 15

Max. Time : 15 min.

Topic : Mole Concept

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Short Subjective Questions ('–1' negative marking) Q.4 to Q.5	(3 marks, 3 min.)	[6, 6]

1. When white phosphorus reacts with caustic soda, the products are PH_3 and NaH_2PO_2. This reaction is an example of :

(A) Oxidation (B) Reduction

(C) Disproportionation (D) Neutralisation

2. Which of the following changes does not involve either oxidation or reduction :

(A) $VO^{2+} \rightarrow V_2O_3$ (B) $Na \rightarrow Na^+$

(C) $Zn^{+2} \rightarrow Zn$ (D) $CrO_4^{-2} \rightarrow Cr_2O_7^{-2}$

3. Which of the following is not a redox reaction :

(A) $Mg + N_2 \longrightarrow Mg_3N_2$ (B) $MnO_4^- + C_2O_4^{2-} \longrightarrow Mn^{2+} + CO_2$

(C) $CuSO_4 + KI \longrightarrow 2CuI + I_2 + K_2SO_4$ (D) $AgCl + NH_3 \longrightarrow [Ag(NH_3)_2]Cl$

4. Identify the oxidant and the reductant in the following reactions :

(a) $KMnO_4 + KCl + H_2SO_4 \longrightarrow MnSO_4 + K_2SO_4 + H_2O + Cl_2$

(b) $FeCl_2 + H_2O_2 + HCl \longrightarrow FeCl_3 + H_2O$

(c) $Cu + HNO_3$ (dil) $\longrightarrow Cu(NO_3)_2 + H_2O + NO$

(d) $Na_2HAsO_3 + KBrO_3 + HCl \longrightarrow NaCl + KBr + H_3AsO_4$

(e) $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + NaI$

5. Balance the following redox equations :

(i) $K_2Cr_2O_7 + H_2O_2 + H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O + O_2$

(ii) $Zn + NaNO_3 + NaOH \longrightarrow Na_2ZnO_2 + H_2O + NH_3$

(iii) $Al \longrightarrow [Al(OH)_4]^- + H_2$ (basic)

(iv) $Cu_3P + Cr_2O_7^{2-} \longrightarrow Cu^{2+} + H_3PO_4 + Cr^{3+} + H_2O$

(v) $ClO_3^- + Fe^{2+} + H^+ \longrightarrow Cl^- + Fe^{3+} + H_2O$

(vi) $N_2O_4 + BrO_3^- \longrightarrow NO_3^- + Br^-$ (in acidic medium)

(vii) $S_2O_3^{2-} + Sb_2O_5 \longrightarrow SbO + H_2SO_3$

(viii) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow Cr^{3+} + I_2 + H_2O$

(ix) $IO_4^- + I^- + H^+ \longrightarrow I_2 + H_2O$

Answer Key

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1. (C) **2.** (D) **3.** (D)

4. (a) $\overset{(+7)}{KMnO_4}$ (oxidant) ; $\overset{(-1)}{KCl}$ (reductant) (b) $\overset{(+2)}{FeCl_2}$ (reductant) ; $\overset{(-1)}{H_2O_2}$ (oxidant)

(c) $\overset{(0)}{Cu}$ (reductant) ; $\overset{+5}{HNO_3}$ (oxidant) (d) $Na_2H\overset{+3}{AsO_3}$ (reductant) ; $K\overset{+5}{BrO_3}$ (oxidant)

(e) $\overset{0}{I_2}$ (oxidant) ; $Na_2\overset{+2}{S_2}O_3$ (reductant)

5. (i) $K_2Cr_2O_7 + 3H_2O_2 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3O_2$.

(ii) $4Zn + NaNO_3 + 7NaOH = 4Na_2ZnO_2 + 2H_2O + NH_3$.

(iii) $2OH^- + 6H_2O + 2Al \longrightarrow 3H_2 + 2(Al(OH)_4]^-$.

(iv) $6Cu_3P + 11Cr_2O_7^{-2} + 124H^+ \longrightarrow 18Cu^{+2} + 6H_3PO_4 + 22Cr^{+3} + 53H_2O$.

(v) $6H^+ + ClO_3^- + 6Fe^{2+} \longrightarrow Cl^- + 6Fe^{3+} + 3H_2O$.

(vi) $3N_2O_4 + BrO_3^- + 3H_2O \longrightarrow 6NO_3^- + Br^- + 6H^+$.

(vii) $3S_2O_3^{2-} + 2Sb_2O_5 + 6H^+ + 3H_2O \longrightarrow 4SbO + 6H_2SO_3$

(viii) $Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$.

(ix) $IO_4^- + 7I^- + 8H^+ \longrightarrow 4I_2 + 4H_2O$.

Hints & Solutions

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1. $\overset{(0)}{P_4} + 6NaOH \longrightarrow \overset{(-3)}{PH_3} + 3Na_2\overset{(+1)}{H}PO_2$.

Disproportionation reaction. In this reaction, P element present in intermediate oxidation state and P udergoes both oxidation and reduction.

2. $\overset{(+6)}{Cr}O_4^{-2} \longrightarrow \overset{(+6)}{Cr_2}O_7^{-2}$

Oxidation number of both element Cr & O does not change.

3. Those reaction in which oxidation number of any element do not change not a redox reaction.

$AgCl + NH_3 \longrightarrow [Ag(NH_3)_2]Cl$.

4. (a) $K\overset{(+7)}{M}nO_4 + K\overset{(-1)}{C}l + H_2SO_4 \longrightarrow \overset{(+2)}{M}nSO_4 + K_2SO_4 + H_2O + \overset{(0)}{Cl_2}$.

$K\overset{(+7)}{M}nO_4$ (oxidant) $\longrightarrow \overset{(+2)}{M}nSO_4$ (reduction half).

$K\overset{(-1)}{C}l$ (reductant) $\longrightarrow \overset{(0)}{Cl_2}$ (oxidant half).

(b) $\overset{(+2)}{Fe}Cl_2 + H_2\overset{(-1)}{O}_2 + HCl \longrightarrow \overset{(+3)}{Fe}Cl_3 + H_2\overset{(-2)}{O}$ (oxidation half)

$\overset{(+2)}{Fe}Cl_2$ (reductant) $\longrightarrow \overset{(+3)}{Fe}Cl_3$ (oxidation half).

$H_2\overset{(-1)}{O}_2$ (oxidant) $\longrightarrow H_2O^{2-}$ (reduction half).

(c) $\overset{(0)}{Cu} + H\overset{(+5)}{N}O_3$ (dil) $\longrightarrow \overset{2+}{Cu}(NO_3)_2 + H_2O + \overset{2+}{N}O$.

$\overset{(0)}{Cu}$ (reductant) $\longrightarrow \overset{2+}{Cu}(NO_3)_2$ (oxidation half).

$H\overset{+5}{N}O_3$ (oxidant) $\longrightarrow \overset{+2}{N}O$ (reduction half).

(d) $Na_2H\overset{+3}{A}sO_3 + K\overset{+5}{B}rO_3 + HCl \longrightarrow NaCl + K\overset{-1}{B}r + H_3\overset{+5}{A}sO_4$

$Na_2H\overset{+3}{A}sO_3$ (reductant) $\longrightarrow H_3\overset{+5}{A}sO_4$ (oxidation half).

$K\overset{+5}{B}rO_3$ (oxidant) $\longrightarrow K\overset{-1}{B}r$.

(e) $\overset{0}{I_2} + Na_2\overset{+2}{S}_2O_3 \longrightarrow Na_2\overset{+2.5}{S}_4O_6 + Na\overset{-1}{I}$.

$\overset{0}{I_2}$ (oxidant) $\longrightarrow Na\overset{-1}{I}$ (reductant half).

$Na_2\overset{+2}{S}_2O_3$ (reductant) $\longrightarrow Na_2\overset{+2.5}{S}_4O_6$ (oxidant half).

5.

(i) $K_2Cr_2O_7 + H_2O_2 + H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O + O_2$

Mass Balance and Charge Balance :

Remove the spectator ion — $2K^+$, SO_4^{2-}.

$Cr_2O_7^{2-} + H_2O_2 + 2H^+ \longrightarrow 2Cr^{3+} + H_2O + O_2$.

Oxidation Half :

$H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-$.

Reduction Half :

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$.

Total loss electrons = total gain electrons.

$3H_2O_2 + Cr_2O_7^{2-} + 8H^+ \longrightarrow 2Cr^{3+} + 7H_2O + 3O_2$.

Add the spectator ion — $2K^+$, SO_4^{2-}.

(ii) $Zn + NaNO_3 + NaOH \longrightarrow Na_2ZnO_2 + H_2O + NH_3$

$4Zn + NaNO_3 + 7NaOH = 4Na_2ZnO_2 + 2H_2O + NH_3$.

Mass Balance and Charge Balance :

Remove the spectator ion — Na^+

$Zn + NO_3^- + OH^- \longrightarrow ZnO_2^{2-} + H_2O + NH_3$.

Oxidation Half :

$Zn + 4OH^- \longrightarrow ZnO_2^{2-} + 2H_2O + 2e^-$.

Reduction Half :

$NO_3^- + 6H_2O + 8e^- \longrightarrow NH_3 + 9OH^-$.

Total loss electrons = total gain electrons.

$4Zn + 7OH^- + NO_3^- \longrightarrow 4ZnO_2^{2-} + 2H_2O + NH_3$.

Add the spectator ion — Na^+.

$4Zn + 7NaOH + NaNO_3 \longrightarrow 4Na_2ZnO_2 + 2H_2O + NH_3$.

(iii) $Al \longrightarrow [Al(OH)_4]^- + H_2$ (basic)

$2OH^- + 6H_2O + 2Al \longrightarrow 3H_2 + 2(Al(OH)_4]^-$.

Mass Balance and Charge Balance :

Oxidation Half :

$Al + 4OH^- \longrightarrow [Al(OH)_4]^- + 3e^-$.

Reduction Half :

$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$.

Total loss electrons = total gain electrons.

$2Al + 2OH^- + 6H_2O \longrightarrow 2[Al(OH)_4]^- + 3H_2$.

Note : If H_2 or O_2 formed in reaction. It is means H_2 or O_2 produced from H_2O molecule.

(iv) $Cu_3P + Cr_2O_7^{2-} \longrightarrow Cu^{2+} + H_3PO_4 + Cr^{3+} + H_2O$

$Cu_3P + Cr_2O_7^{2-} \longrightarrow Cu^{2+} + H_3PO_4 + Cr^{3+} + H_2O$

$6Cu_3P + 11Cr_2O_7^{-2} + 124H^+ \longrightarrow 18Cu^{+2} + 6H_3PO_4 + 22Cr^{+3} + 53H_2O$.

Mass Balance and Charge Balance :

Oxidation Half :

$Cu_3P + 4H_2O \longrightarrow 3Cu^{2+} + H_3PO_4 + 5H^+ + 11e^-$.

Reduction Half :

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$.

Total loss electrons = total gain electrons.

$6Cu_3P + 11Cr_2O_7^{2-} + 124H^+ \longrightarrow 18Cu^{2+} + 6H_3PO_4 + 22Cr^{3+} + 53H_2O$.

(v) $ClO_3^- + Fe^{2+} + H^+ \longrightarrow Cl^- + Fe^{3+} + H_2O$

$6H^+ + ClO_3^- + 6Fe^{2+} \longrightarrow Cl^- + 6Fe^{3+} + 3H_2O$.

Mass Balance and Charge Balance :

Oxidation Half :

$Fe^{2+} \longrightarrow Fe^{3+} + 1e^-$.

Reduction Half :

$ClO_3^- + 6H^+ + 6e^- \longrightarrow Cl^- + 3H_2O$.

Total loss electrons = total gain electrons.

$6Fe^{2+} + 6H^+ \longrightarrow 6Fe^{3+} + Cl^- + 3H_2O$.

(vi) $N_2O_4 + BrO_3^- \longrightarrow NO_3^- + Br^-$ (in acidic medium)

$N_2O_4 + BrO_3^- \longrightarrow NO_3^- + Br^-$ (अम्लीय माध्यम में)

$3N_2O_4 + BrO_3^- + 3H_2O \longrightarrow 6NO_3^- + Br^- + 6H^+$.

Mass Balance and Charge Balance :

Oxidation Half :

$N_2O_4 + 2H_2O \longrightarrow 2NO_3^- + 4H^+ + 2e^-$.

Reduction Half :

$BrO_3^- + 6H^+ + 6e^- \longrightarrow Br^- + 3H_2O$.

Total loss electrons = total gain electrons.

$3N_2O_4 + 3H_2O + BrO_3^- \longrightarrow 6NO_3^- + 6H^+ + Br^-$.

(vii) $S_2O_3^{2-} + Sb_2O_5 \longrightarrow SbO + H_2SO_3$

$3S_2O_3^{2-} + 2Sb_2O_5 + 6H^+ + 3H_2O \longrightarrow 4SbO + 6H_2SO_3$

Mass Balance and Charge Balance :

Oxidation Half :

$S_2O_3^{2-} + 3H_2O \longrightarrow 2H_2SO_3 + 2H^+ + 4e^-$.

Reduction Half :

$Sb_2O_5 + 6H^+ + 6e^- \longrightarrow 2SbO + 3H_2O$.

Total loss electrons = total gain electrons.

$6S_2O_3^{2-} + 4Sb_2O_5 + 6H_2O + 12H^+ \longrightarrow 8SbO + 12H_2S_2O_3$.

(viii) $Cr_2O_7^{2-} + I^- + H^+ \longrightarrow Cr^{3+} + I_2 + H_2O$

$Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$.

Mass Balance and Charge Balance :

Oxidation Half :

$2I^- \longrightarrow I_2 + 2e^-$.

Reduction Half :

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$.

Total loss electrons = total gain electrons.

$6I^- + Cr_2O_7^{2-} + 14H^+ \longrightarrow 3I_2 + 2Cr^{3+} + 7H_2O$.

(ix) $IO_4^- + I^- + H^+ \longrightarrow I_2 + H_2O$

$IO_4^- + 7I^- + 8H^+ \longrightarrow 4I_2 + 4H_2O$.

Mass Balance and Charge Balance :

Oxidation Half :

$2I^- \longrightarrow I_2 + 2e^-$.

Reduction Half :

$2IO_4^- + 16H^+ + 14e^- \longrightarrow I_2 + 8H_2O$.

Total loss electrons = total gain electrons.

$14I^- + 2IO_4^- + 16H^+ \longrightarrow 8I_2 + 8H_2O$.