

UNIT 8

REDOX REACTIONS

Answer the questions. (1 Score each)

1) What is disproportionation reaction?

Ans) The reaction in which same element undergo oxidation and reduction is called disproportionation reaction.

2) The oxidation number of sulphur in SO_4^{2-} is

Ans) $x + 4 \times (-2) = -2$

$$x + -8 = -2$$

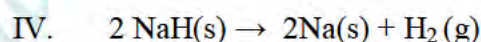
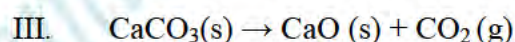
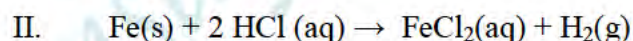
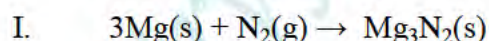
$$\text{so } x = -2 + 8 = 6$$

3) Calculate the oxidation number of Cr in $\text{K}_2\text{Cr}_2\text{O}_7$ and P in $\text{H}_2\text{P}_2\text{O}_5$.

Ans) Oxidation no. of Cr in $\text{K}_2\text{Cr}_2\text{O}_7 = +6$ ($2 + 2x + 7 \times (-2) = 0$, $2x = 12$, $x = 6$)

Oxidation no. of P in $\text{H}_2\text{P}_2\text{O}_5 = +4$ ($2 + 2x + 5 \times (-2) = 0$, $2x = 8$, $x = 4$)

4) Among the following reactions, identify the one which is NOT a redox reaction.

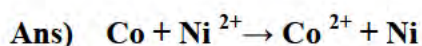


Ans) III. $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO (s)} + \text{CO}_2(\text{g})$

5) Calculate the oxidation number of Cr in Cr_2O_3 and S in H_2SO_4 .

Ans. (a) Oxidation no. of Cr in Cr_2O_3 is +3 ($2x + 3 \times (-2) = 0$, $2x = 6$, $x = 6/2 = 3$) and the oxidation number of S in H_2SO_4 is +6. ($2 + x + 4 \times (-2) = 0$, $x = 8 - 2$, $x = 6$)

6) Write the redox reaction involved when metallic cobalt is placed in a nickel sulphate solution.



7) How are oxidation and reduction related to the oxidation number?

Ans) Oxidation is the process of increase in the oxidation number of an element and reduction is the process of decrease in the oxidation number of an element.

Answer the questions. (2 Score each)

8) In the reaction: $\text{Pb (s)} + \text{PbO}_2 \text{(s)} + 2\text{H}_2\text{SO}_4 \text{(aq)} \longrightarrow 2 \text{PbSO}_4 \text{(s)} + 2\text{H}_2\text{O (l)}$, identify the following.

- (i) The substance oxidised (ii) The substance reduced
(iii) The oxidising agent (iv) The reducing agent

Ans) (i) The substance oxidised: Pb (Oxidation number increased from 0 to +2)

(ii) The substance reduced: Pb in PbO₂ (Oxidation number decreased from +4 to +2)

(iii) The oxidising agent: PbO₂

(iv) The reducing agent: Pb

9) When CuSO₄ solution stored in iron vessel, the blue colour changes to pale green. Do you agree with it? Justify

Ans) Yes. Iron can displace copper from CuSO₄ solution and form FeSO₄. So the blue colour changes to pale green. FeSO₄ is green in colour.



10) Redox reactions can be considered as electron transfer reactions. In an experiment a copper rod is dipped in AgNO₃ solution.

- a) What happens to the colour of the solution and why?
b) Identify the oxidising and reducing agents in this reaction.

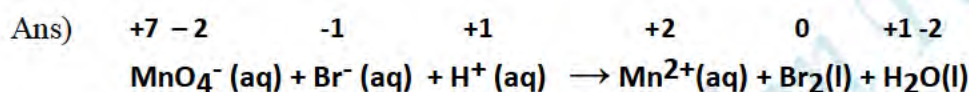
Ans) a) The solution becomes pale blue in colour. This is because Cu displaces Ag from AgNO₃ solution. Cu(NO₃)₂ is blue in colour.



(b) Oxidising agent : AgNO₃

Reducing agent : Cu

11) Identify the oxidant and reductant in the following ionic equation



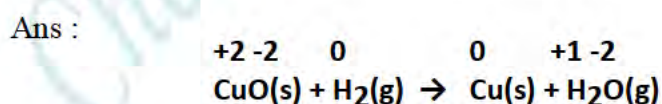
oxidation number of Mn decreased from 7 to 2, so undergone reduction. (oxidising agent/oxidant)

oxidation number of Br⁻ increased from -1 to 0, so undergone oxidation. (reducing agent/reductant)

12) Consider the reaction, CuO(s) + H₂(g) → Cu(s) + H₂O(g)

i) Identify the species which undergo reduction and which undergo oxidation.

ii) Identify the reductant and oxidant in the above reaction



i) Substance oxidised: H₂ (0 increased to +1)

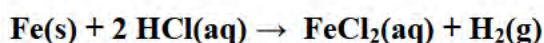
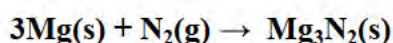
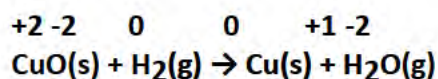
Substance reduced: CuO (+2 decreased to 0)

ii) Reductant: H₂, Oxidant: CuO

13) Redox reactions are those reactions in which oxidation and reduction takes place simultaneously.

Write any two redox reactions.

Ans)



14) During a group discussion, one of your friends argues that thermal decomposition of KClO_3 is a redox reaction while that of CaCO_3 is not a redox reaction. Give your opinion and substantiate.

Ans) In decomposition of KClO_3 , Cl is reduced and O is oxidised. This reaction is a redox reaction since there is both oxidation and reduction.

In decomposition of CaCO_3 , there is no change in oxidation number of any species. So it is not a redox reaction.

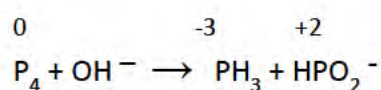
Answer the questions. (3 Score each)

15) Balance the following Redox process by ion-electron method (Half reaction method)
(Basic Medium)



Ans) Step-1:

Assign the oxidation number of each element and find out the substance oxidised and reduced.



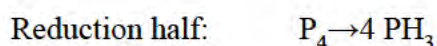
Here P_4 is simultaneously oxidised and reduced.

Step-2: Separate the equation into oxidation half reaction and reduction half reaction.



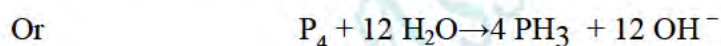
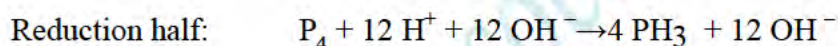
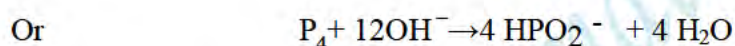
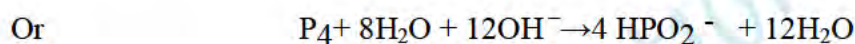
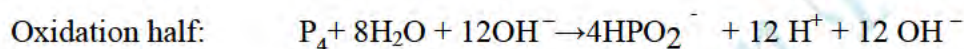
Step-3:

Balance the atoms other than O and H in each half reaction individually.

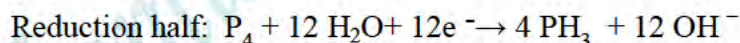
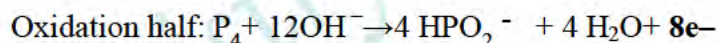


Step-4:

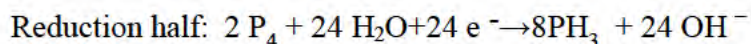
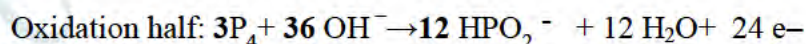
Now balance O and H atoms. Add H_2O to balance O atoms and H^+ to balance H atoms. Since the reaction occurs in basic medium also add equal number of OH^- ions on both sides of the equation.



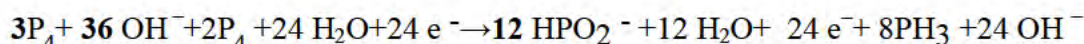
Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.

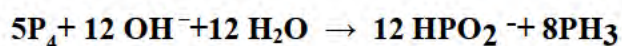
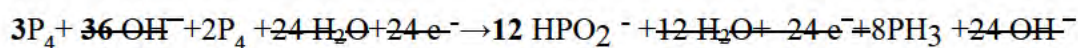


Step-6: Now equate the electrons.

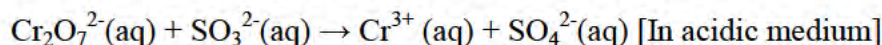


Step-7: Now add the two half reactions

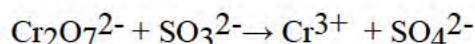
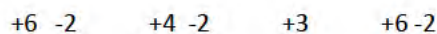




16) Balance the following equation using half reaction method.



Ans) Step-1:



Assign the oxidation number of each element and find out the substance oxidised and reduced.

Here S got oxidised and Cr got reduced.

Step-2:

Separate the equation into oxidation half reaction and reduction half reaction.



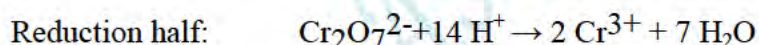
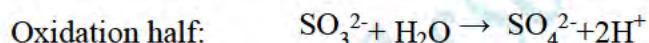
Step-3:

Balance the atoms other than O and H in each half reaction individually.

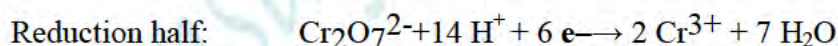
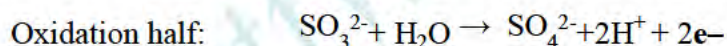


Step-4:

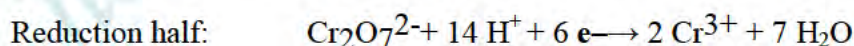
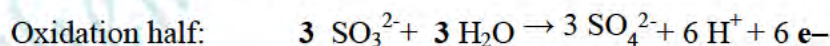
Now balance O and H atoms. Add H₂O to balance O atoms and H⁺ to balance H atoms.



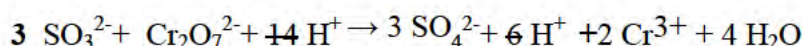
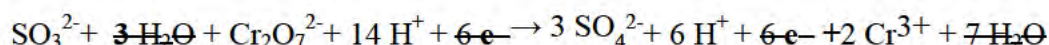
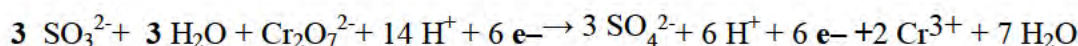
Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.

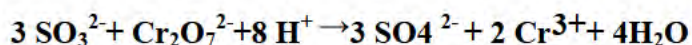


Step-6: Now equate the electrons.



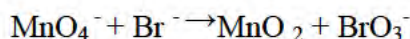
Step-7: Now add the two half reactions





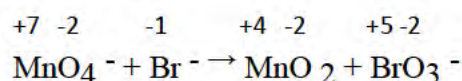
17) Permanganate ion reacts with bromide ion in basic medium to give manganese dioxide and bromate ion. Write the balanced equation for the reaction using half reaction method.

Ans) Skeletal equation is:



Step-1:

Assign the oxidation number of each element and find out the substance oxidised and reduced.



Here Br got oxidised and Mn got reduced.

Step-2:

Separate the equation into oxidation half reaction and reduction half reaction.



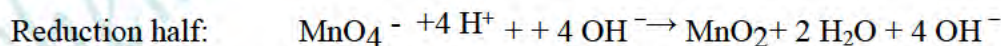
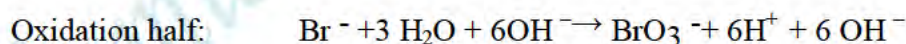
Step-3:

Balance the atoms other than O and H in each half reaction individually.

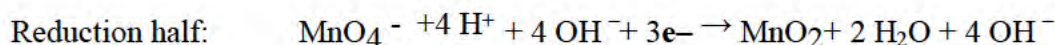
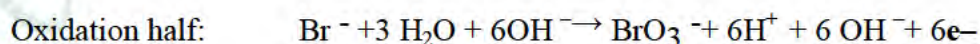


Step-4:

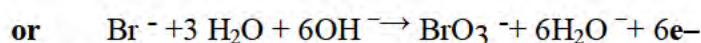
Now balance O and H atoms. Add H₂O to balance O atoms and H⁺ to balance H atoms. Since the reaction occurs in basic medium also add equal number of OH⁻ ions on both sides of the equation.

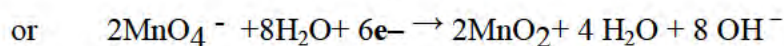
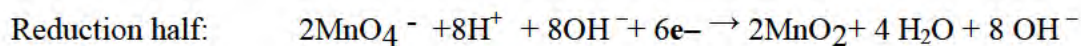


Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.

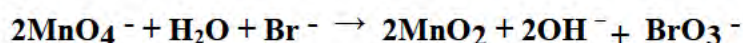
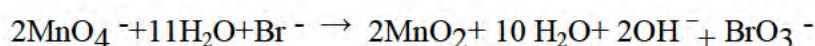
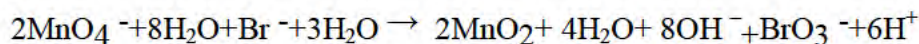
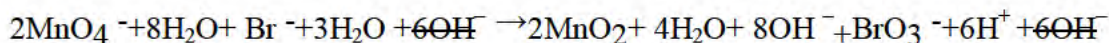
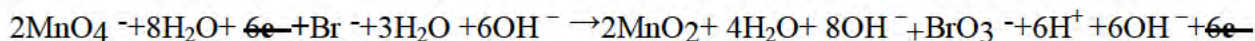


Step-6: Now equate the electrons.

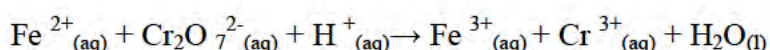




Step-7: Now add the two half reactions

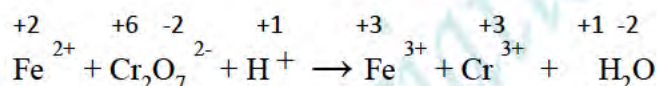


18) Balance the following equation by the half reaction method. (Acidic Medium)



Ans) Step-1:

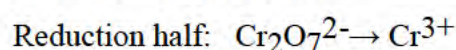
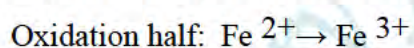
Assign the oxidation number of each element and find out the substance oxidised and reduced.



Here Fe got oxidised and Cr got reduced.

Step-2:

Separate the equation into oxidation half reaction and reduction half reaction.

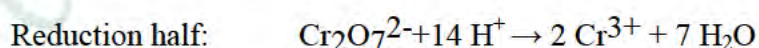


Step-3: Balance the atoms other than O and H in each half reaction individually.

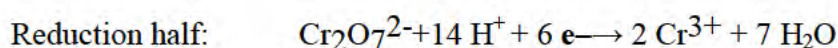


Step-4:

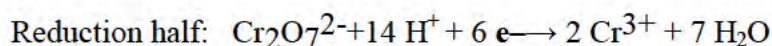
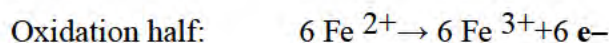
Now balance O and H atoms. Add H₂O to balance O atoms and H⁺ to balance H atoms.



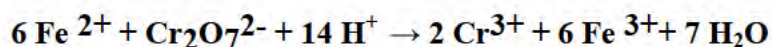
Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.



Step-6: Now equate the electrons.



Step-7: Now add the two half reactions

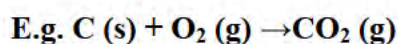


Answer the questions. (4 Score each)

19) Redox reactions are classified into four types. Describe them with suitable examples.

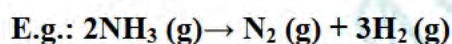
Ans) **Combination reactions:**

A combination reaction may be denoted as $\text{A} + \text{B} \rightarrow \text{C}$ Here either A or B or both A and B must be in the elemental form.



Decomposition reactions:

Decomposition reactions are the opposite of combination reactions. It involves the breakdown of a compound into two or more components, in which at least one must be in the elemental state. It may be denoted as: $\text{C} \rightarrow \text{A} + \text{B}$.



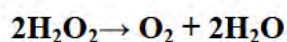
Displacement reactions:

Here an ion (or an atom) in a compound is replaced by an ion (or an atom) of another element. It may be denoted as: $\text{X} + \text{YZ} \rightarrow \text{XZ} + \text{Y}$



Disproportionation reaction

The reaction in which same element undergo oxidation and reduction is called disproportionation reaction.



(here oxygen in Hydrogen peroxide having oxidation number -1 changed to 0 in oxygen and -2 in water).