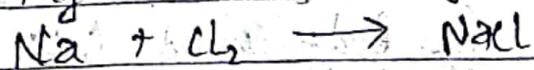
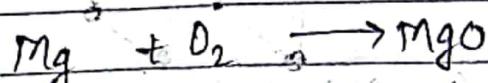


## Oxidation & Reduction:-

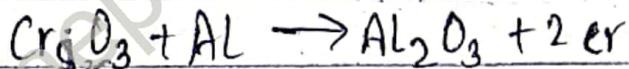
### # Classical Concept of Oxidation:-

→ The process that involves addition of oxygen or any other electronegative element or removal of hydrogen or any other electropositive element is called oxidation.



### # Classical concept of reduction:-

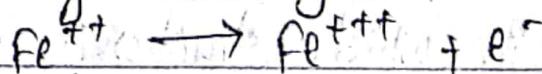
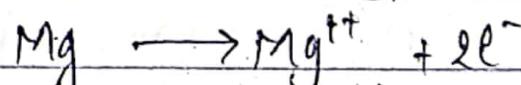
→ The process that involves removal of oxygen or any other electronegative elements or addition of hydrogen or any other electropositive element is called reduction.



IMP

### # Modern Concept of oxidation:- [Electronic Concept]:-

→ According to electronic concept, the process that involves loss of electron is called Oxidation. Simply loss of electron is called oxidation.

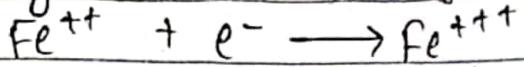
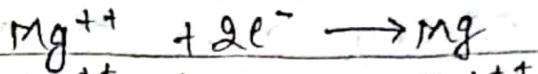


In short oxidation is,

- Loss of Electron
- Increase in positive charge
- decrease in negative charge

## # Modern (electronic) concept of Reduction:-

→ According to electronic concept the process that involves gain of electron is called reduction. Simply, gain of electron is called reduction.



In short Reduction is;

- i) gain of electron
- ii) decrease in positive charge
- iii) increase in negative charge

## # Oxidising agent (Oxidant):-

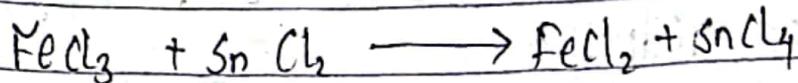
→ A substance that oxidises another substance but itself get reduced is known as oxidising agent. All non-metals are oxidising agent except C, H and P. Acid like  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  are oxidising agent. Other substance like  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{O}_3$  etc.

## # Reducing agent (Reductant):-

→ A substance that reduces another substance but itself get oxidised is known as reducing agent. All the metals are reducing agent. Non-metal like C, H, P are also reducing agent.

## # Oxidising agent according to electronic Concept:-

↪ A substance that accept electron is known as oxidising agent.



Here  $\text{FeCl}_3$  is oxidising agent and  $\text{SnCl}_2$  is reducing agent.

A substance which donate electrons is known as reducing agent.

## # Oxidation Number:-

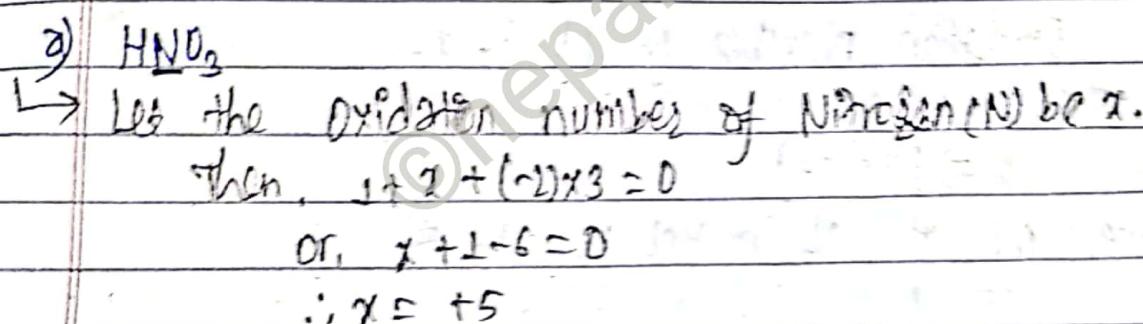
↪ The residual charge that an atom appears to have when all other atoms present in a molecule are removed in the form of ions is called Oxidation number.

## # Rules for remembering Oxidation Number:-

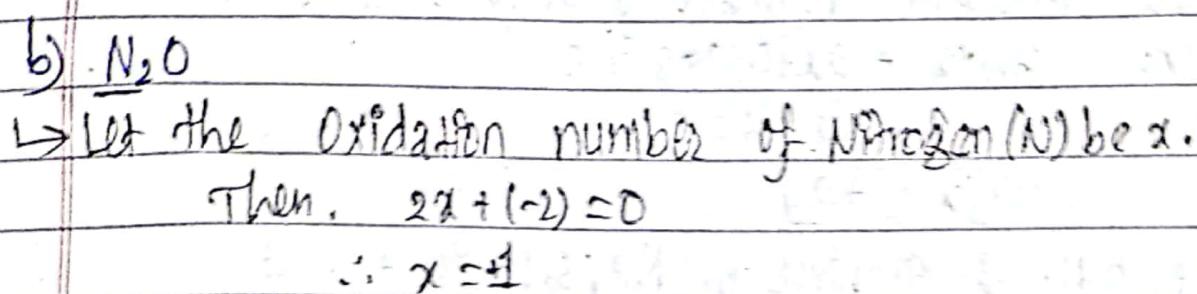
- The oxidation number of an element in its free state is taken as zero. For example, oxidation number of Na, Cu, Zn, Ca is zero:  $\text{H}_2 = \text{Cl}_2 = \text{O}_2 = 0$
- The oxidation number of element of group IA, IIA & IIIA. are these compounds.
- The oxidation number of oxygen in its combined state is -2 except peroxide where it is -1. e.g.  $\text{H}_2\text{O}_2$ ,  $\text{Na}_2\text{O}_2$ ,  $\text{K}_2\text{O}_2$ ,  $\text{BaO}_2$  in these compounds oxidation number of oxygen is -1.

- i) The oxidation number of Hydrogen in its combined state is +1 except metal hydrides where it is -1. e.g.: the oxidation number of Hydrogen in  $\text{NaH}, \text{KH}, \text{CaH}_2, \text{MgH}_2$  etc. is -1.
- v) The sum of positive oxidation number & negative oxidation numbers in a neutral molecule is equal to zero.  
 e.g.  $\text{AlCl}_3 = \text{Al}^{+++} + 3\text{Cl}^-$   
 $= +3 + (-3) = 0$
- vi) The sum of positive & negative oxidation number in a charged ion is equal to its ionic charge.

# Calculate the oxidation number of following underlined elements:-



Hence, The oxidation number of Nitrogen in  $\text{HNO}_3$  is +5. #



Hence, The oxidation number of N in  $\text{N}_2\text{O}$  is +1. #

Q. 10.

Let the width of rectangle be  $x$ .  
Then,  $2x + 2(2x) = 22$

$$\Rightarrow 12x = 22$$

Hence, width of rectangle is  $\frac{11}{6}$ .

Q. 11.

Let the width of rectangle be  $x$ .  
Then,  $2x + 2(2x) - 22 = 2$

$$6x - 22 = 2$$

$$\Rightarrow 6x = 24$$

Hence, width of rectangle is  $4$ .

Q. 12.

Let the width of rectangle be  $x$ .

$$2x + 2(2x) = 28$$

$$\Rightarrow 6x = 28$$

Hence, width of rectangle is  $\frac{14}{3}$ .

D. 12. 2023

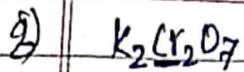
Let the width of rectangle be  $x$ .

$$\text{Thus, } 4x + 2x + 2x = 20$$

$$8x + 2x = 20$$

$$\Rightarrow 10x = 20$$

Hence, width of rectangle is  $2$ .



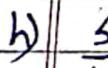
Let the O.N. of Chromium is  $x$ ;

$$\text{Then, } +1 \times 2 + 2x + (-2) \times 7 = 0$$

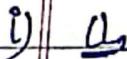
$$\text{or, } 2 + 2x - 14 = 0$$

$$\Rightarrow x = 6$$

Hence, O.N. of Chromium in  $K_2Cr_2O_7$  is 6. #



Let the oxidation Number of sulphur in  $S$  is 0.



The oxidation number of chlorine in  $Cl_2$  is 0.



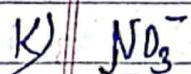
Let the O.N. of Oxygen in  $Na_2O_2$  be  $x$ ;

$$\text{Then, } +1(2) + 2x = 0$$

$$\text{or, } 2x = -2$$

$$\Rightarrow x = -1$$

Hence, The O.N. of Oxygen in  $Na_2O_2$  is -1. #



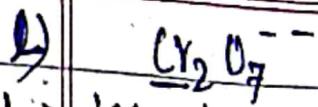
Let the O.N. of Nitrogen in  $NO_3^-$  be  $x$ ;

$$\text{Then, } x + (-2) \times 3 = -1$$

$$\text{or, } x - 6 = -1$$

$$\Rightarrow x = +5$$

Hence, The O.N. of Nitrogen in  $NO_3^-$  is +5. #



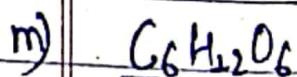
Let the O.N. of chromium be  $x$ ;

$$\text{Then, } 2x + (-2) \times 7 = -2$$

$$2x = 12$$

$$\Rightarrow x = 6$$

Hence, The O.N. of Chromium is 6. #



Let the O.N. of Carbon be  $x$ ;

$$\text{Then, } 6x + 1(12) + (-2) \times 6 = 0$$

$$\text{or, } 6x = 0$$

$$\Rightarrow x = 0$$

Hence, The O.N. of Carbon in  $\text{C}_6\text{H}_{12}\text{O}_6$  is 0. #



Let the O.N. of Iron be  $x$ . (Let).

$$\text{Then, } 3x + (-2) \times 4 = 0$$

$$\Rightarrow x = \frac{8}{3}$$

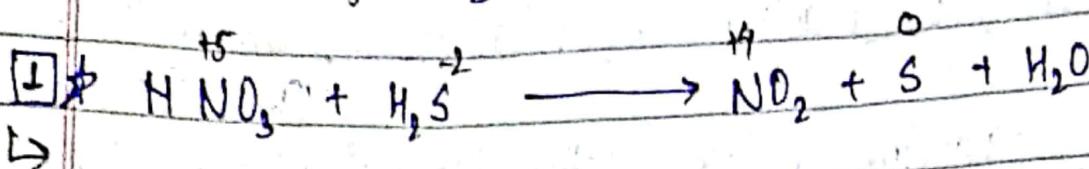
Hence, The oxidation number of Iron in  $\text{Fe}_3\text{O}_4$  is  $\frac{8}{3}$ . #

## # Balancing a redox reaction by oxidation number method:-

### \* Rules for balancing redox reaction by oxidation number method:-

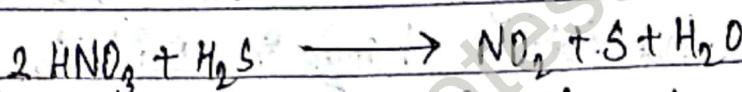
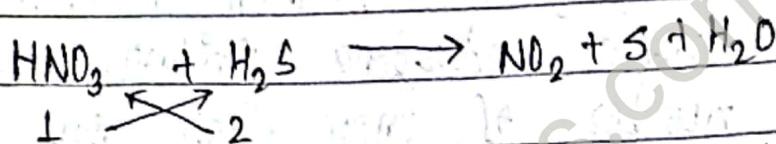
- 1) Write unbalanced chemical equation and assign the Oxidation number above the symbol of element.
- 2) Calculate the change in Oxidation numbers of those elements which have undergone Oxidation or reduction. When Oxidation number of more than one atom changed in a molecule then total change in Oxidation number is calculated.
- 3) Write Change in Oxidation number below the formula of Oxidising agent and reducing agent in bracket.  
**Note:-** When both the changes are odd, double them
- 4) To balance, increase in Oxidation number with decrease in oxidation numbers multiplying cross with change in Oxidation number.
- 5) Balance the main elements on product side by hit & trial method.
- 6) Balance other elements first metal then non-metal except Hydrogen and Oxygen.
- 7) Balance hydrogen and finally oxygen.

# Balance the following redox reactions by oxidation number method.

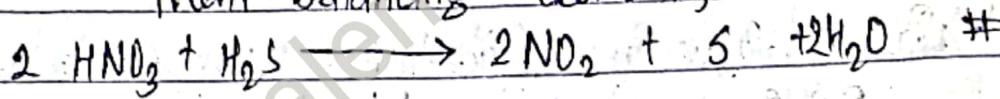


Change in oxidation number of N = final - initial  
 $= +4 - (+5)$   
 $= -1$

Change in oxidation number of (S) per atom = O - (-2)  
 $= +2$



Then, balancing elements;

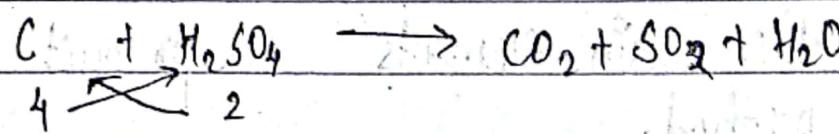


2)

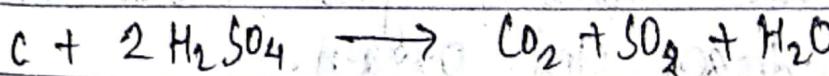


Change in O.N. of Carbon = 4 - 0 = +4

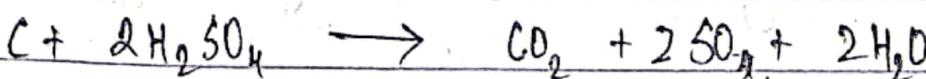
ds. Change in O.N. of Sulphur = 6 - 4 = -2



2 : 1 [∴ 2 is common]

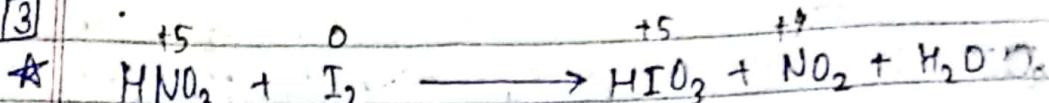


Then, Balancing elements:-



#

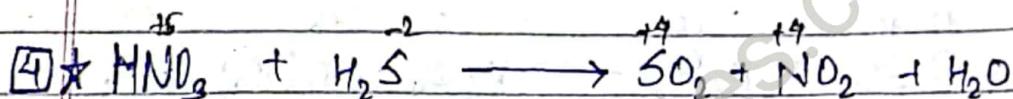
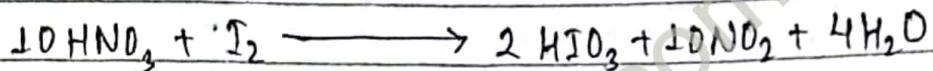
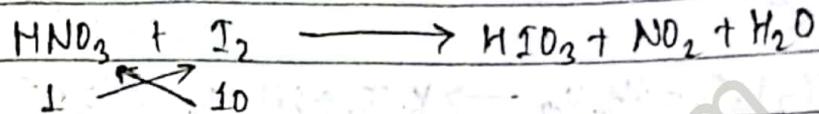
[3]



Now,

$$\text{Change in O.N. of N} = 4 - 5 = -1$$

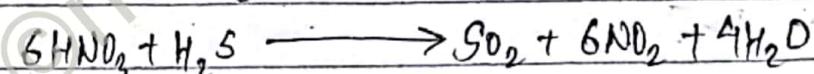
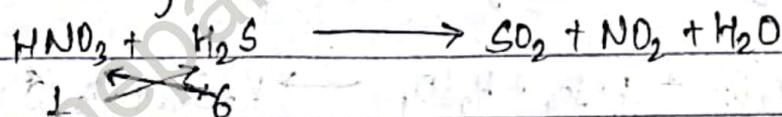
$$\text{Change in O.N. of I}_2 = (5 - 0)2 = 10 \quad [\because \text{I have two atoms}]$$



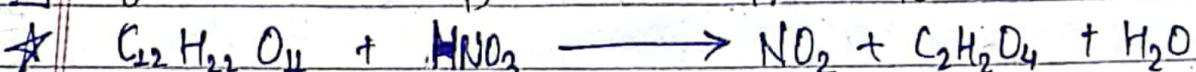
Now,

$$\text{Change in O.N. of N} = 4 - 5 = -1$$

$$\text{Change in O.N. of S} = 4 + 2 = 6$$



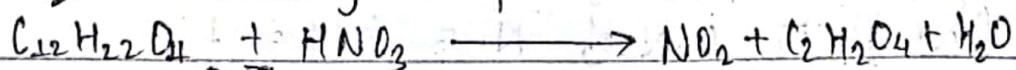
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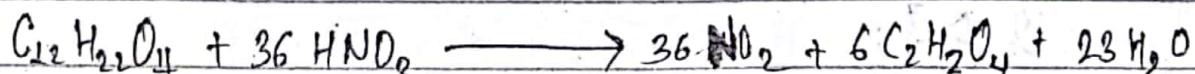
Now;

$$\text{Change in O.N. of C for 12 atom} = (3 - 0)12 = +36$$

$$\text{Change in O.N. of N per atom} = +4 - 5 = -1$$

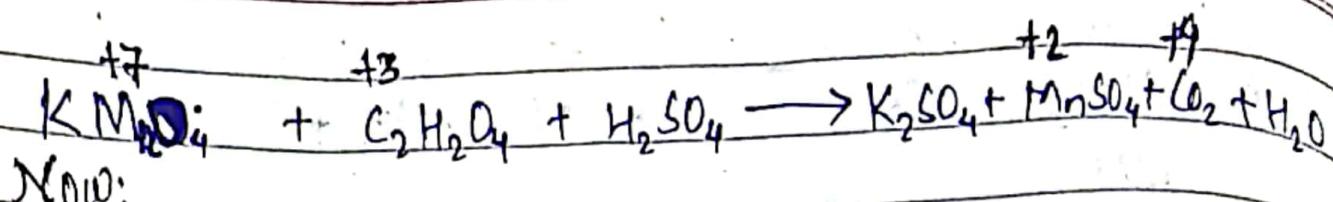


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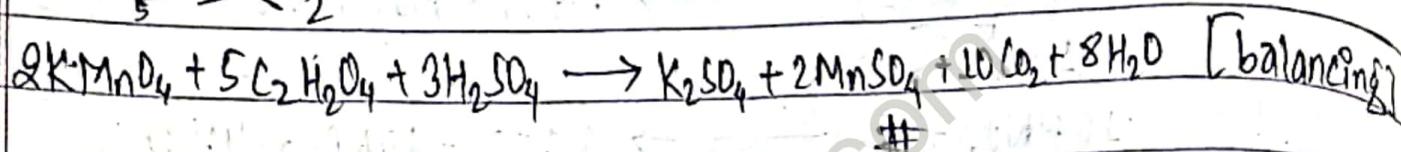
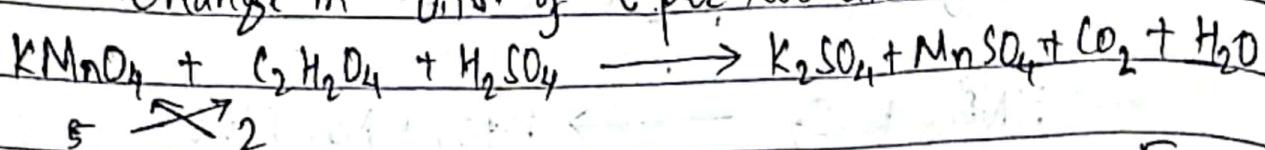
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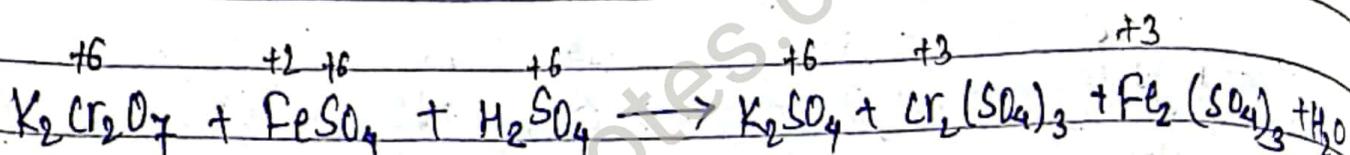


Change in O.N. of Mn =  $+2 - 7 = -5$

Change in O.N. of C per two atom =  $(4 - 3)2 = +2$



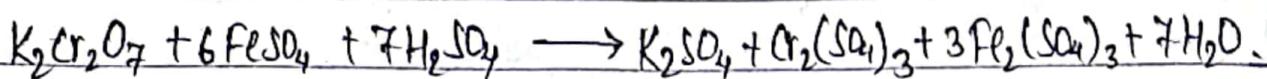
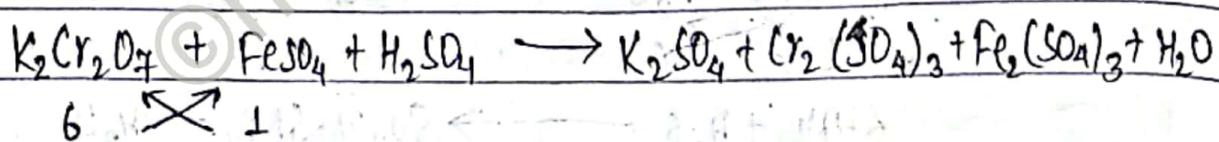
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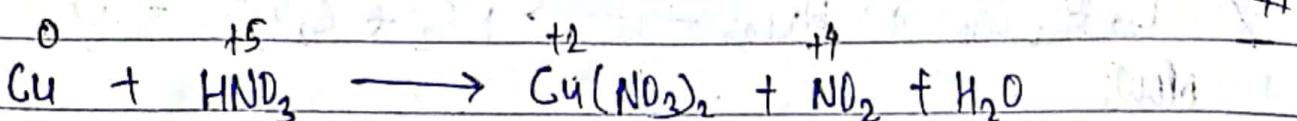
Now,

Change in O.N. of Chromium per two atom =  $(3 - 6) \times 2 = +6$

Change in O.N. of Iron per atom =  $3 - 2 = +1$



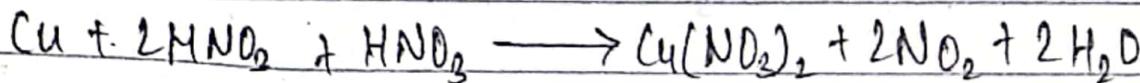
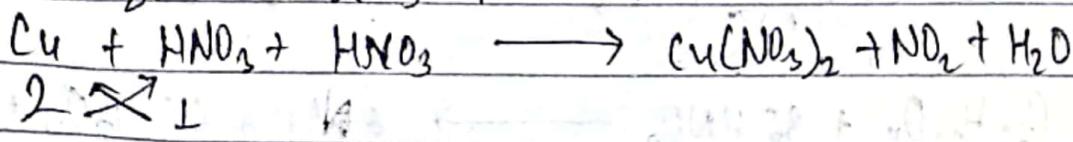
8



Now:

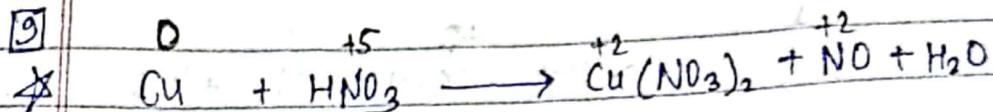
Change in O.N. of Cu =  $2 - 0 = 2$

Change in O.N. of N =  $4 - 5 = -1$



#

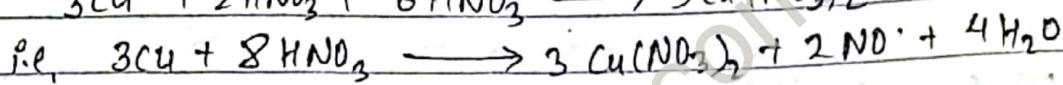
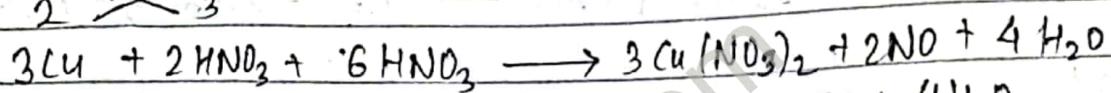
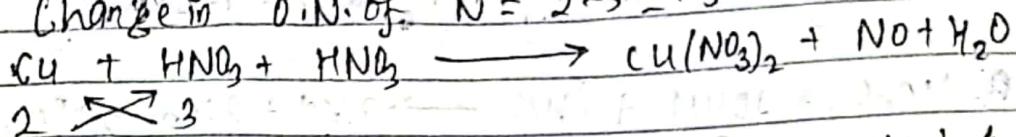
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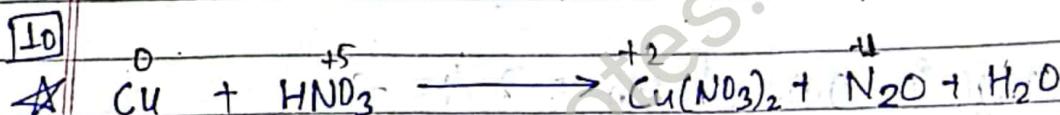
NOW,

$$\text{Change in O.N. of Cu} = 2 - 0 = 2$$

$$\text{Change in O.N. of N} = 2 - 5 = -3$$



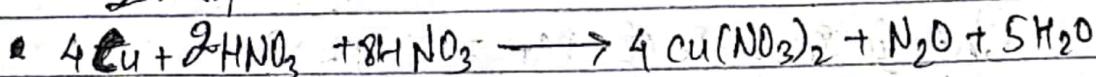
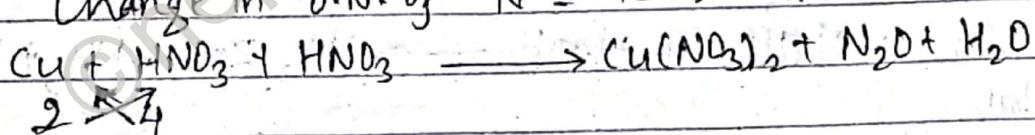
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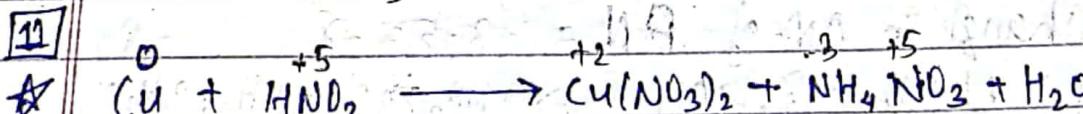
NOW,

$$\text{Change in O.N. of Cu} = +2 - 0 = 2$$

$$\text{Change in O.N. of N} = +1 - 5 = -4$$

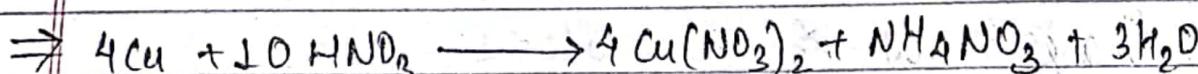


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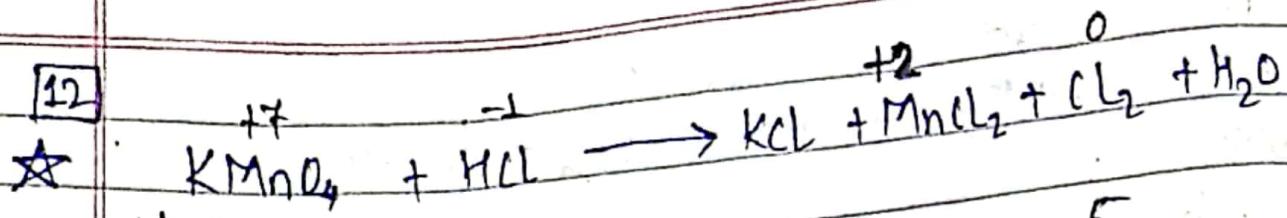


Change in O.N. of Copper = 2 - 0 = 2

Change in O.N. of Nitrogen = -3 - 5 = -8



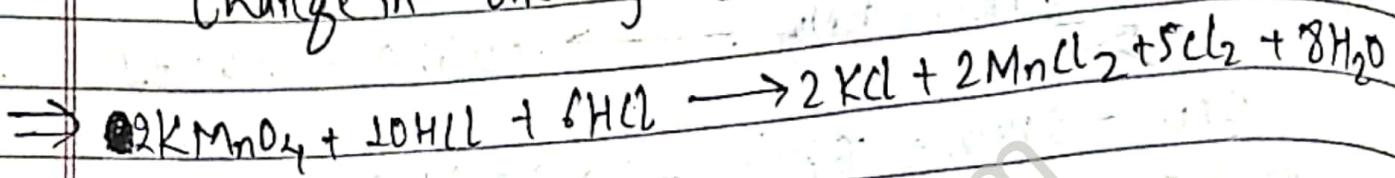
12



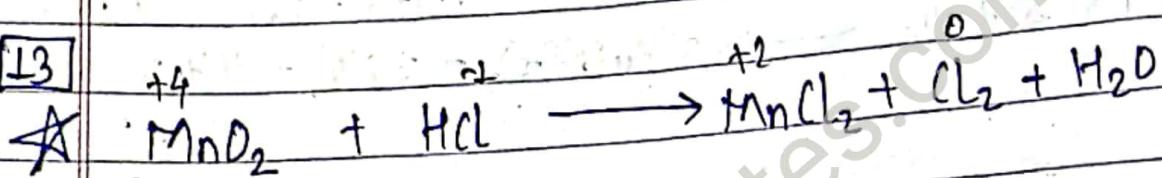
Now;

$$\text{Change in O.N. of Mn} = 2 - 7 = -5$$

$$\text{Change in O.N. of Cl} = [0 - (-1)] = 1 \times 2$$



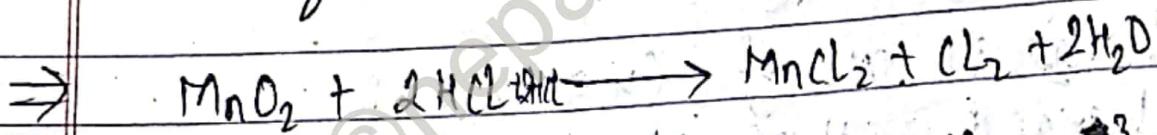
13



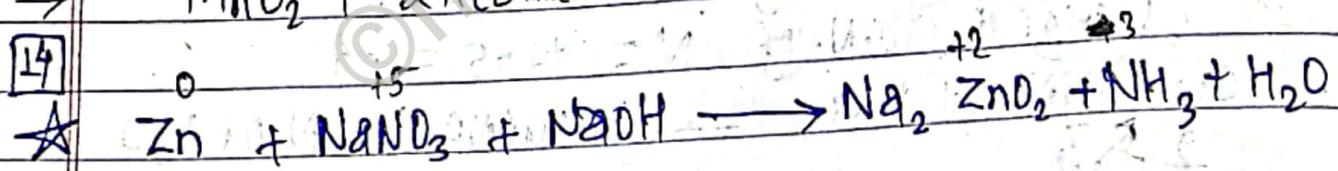
Now;

$$\text{Change in O.N. of Mn} = 2 - 4 = -2$$

$$\text{Change in O.N. of Cl} = 0 + 1 = 1$$



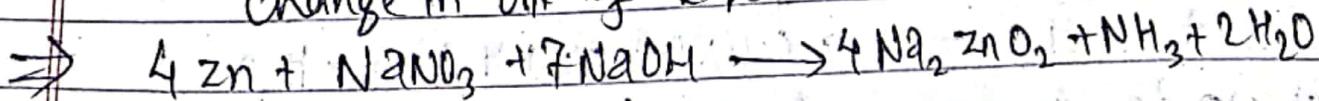
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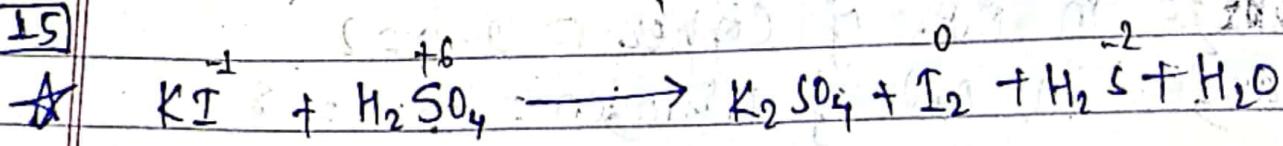
Now,

$$\text{Change in O.N. of Mn} = 2 - 0 = +2$$

$$\text{Change in O.N. of N} = -3 - 5 = -8$$



15



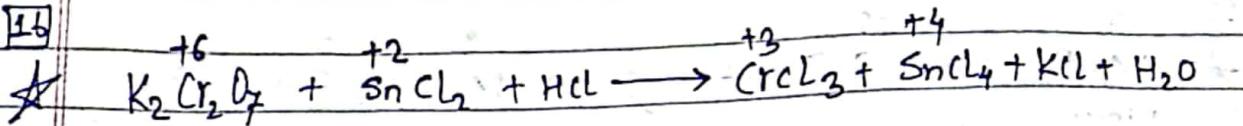
Now,

$$\text{Change in O.N. of I} = 0 + 1 = 1$$

$$\text{Change in O.N. of S} = -2 - 6 = -8$$



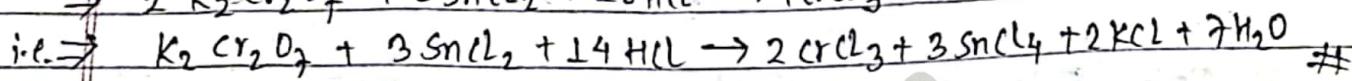
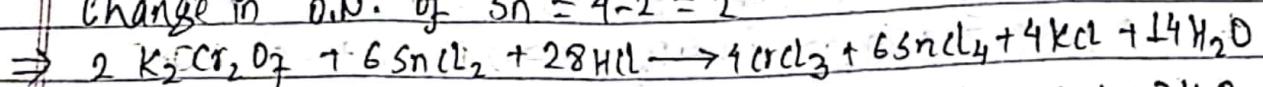
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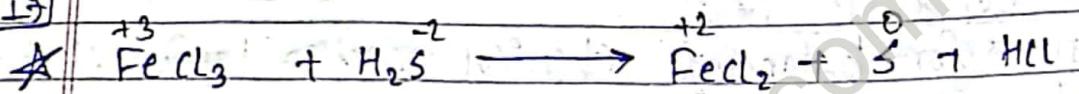
Now,

$$\text{Change in O.N. of Cr} = 3 - 6 = -3$$

$$\text{Change in O.N. of Sn} = 4 - 2 = 2$$



[17]



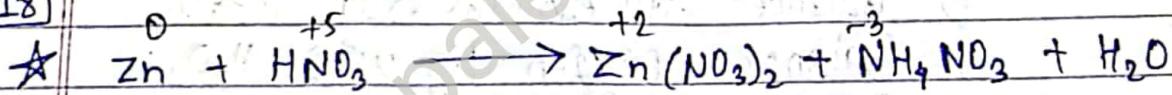
Now,

$$\text{Change in O.N. of Fe} = 2 - 3 = -1$$

$$\text{Change in O.N. of S} = 0 + 2 = 2$$

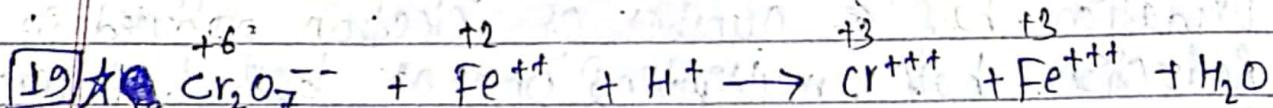
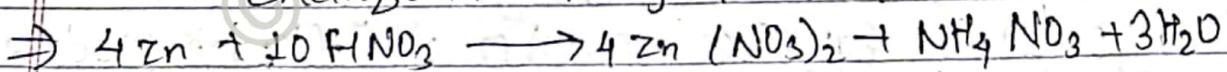


[18]



$$\text{Now, Change in O.N. of Zn} = 2 - 0 = 2$$

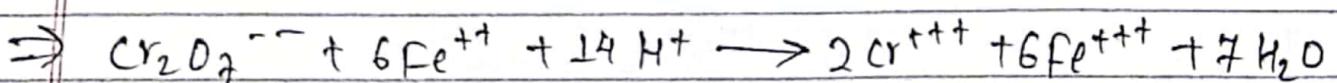
$$\text{Change in O.N. of N} = -3 - 5 = -8$$



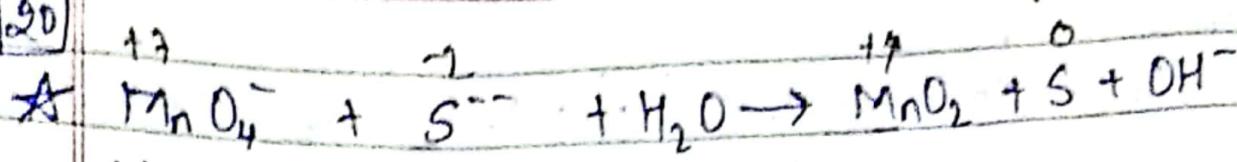
Now,

$$\text{Change in O.N. of Cr}_2 = (3 - 6) \times 2 = -3 \times 2 = -6$$

$$\text{Change in O.N. of Fe} = 3 - 2 = 1$$



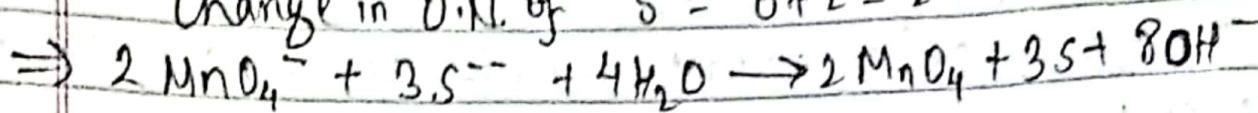
QD



Now,

$$\text{Change in O.I.N. of Mn} = 4 - 7 = -3$$

$$\text{Change in O.I.N. of S} = 0 + 2 = 2$$



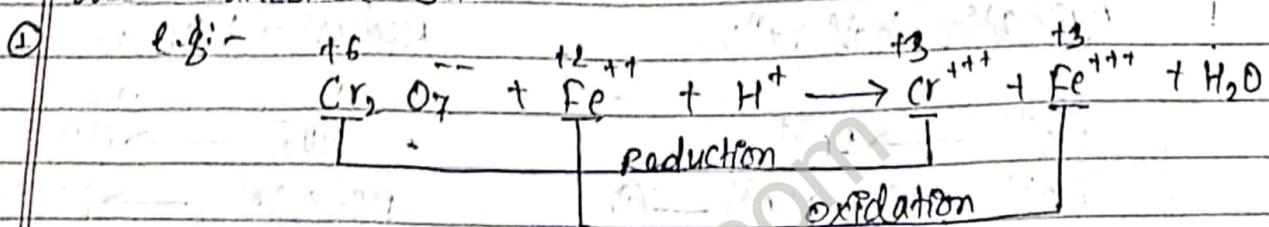
### # Ion Electron Method:-

↳ The rules for balancing chemical reaction by ion electron method are:-

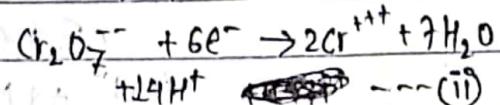
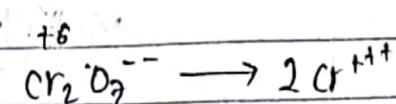
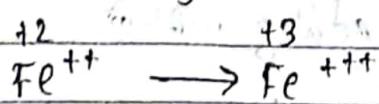
- i) split redox reaction into Oxidation half & reduction half.
- ii) for each half reaction
  - a) Balance all elements except H & O.
  - b) Balance Oxygen by using  $\text{H}_2\text{O}$ .
  - c) Balance Hydrogen by using  $\text{H}^+$  ions.
  - d) Balance charges by using  $e^-$ .
- iii) In order to equalize number of electron produced in Oxidation half & number of electron produced in Reduction half, multiplying one or both half reaction by suitable integers.
- iv) Add both half reaction to get balanced redox reaction.

Date: / /

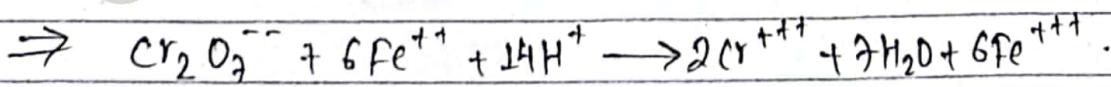
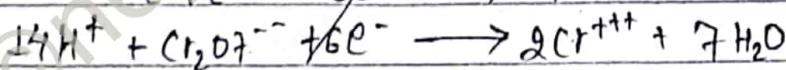
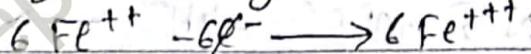
vi) Both the balanced half reactions are multiplied by suitable number to make equal no. of electrons in both half reactions. Both half reactions are added and common terms which appears on both sides are cancelled out.



Oxidation half rxn:-

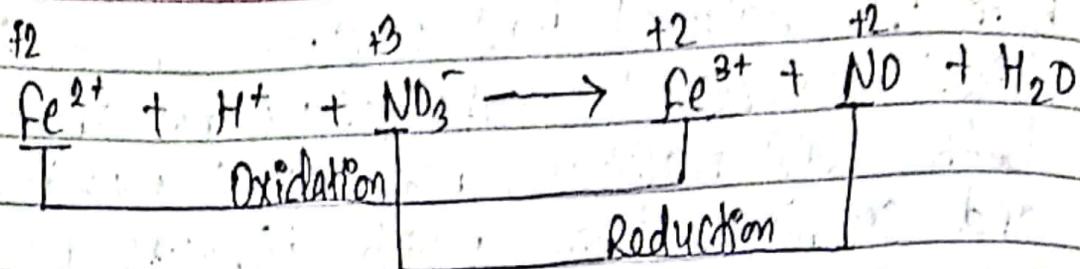


Multiplying eqn (i) by 6 & adding with (ii)

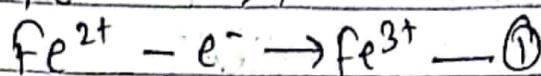
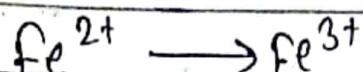


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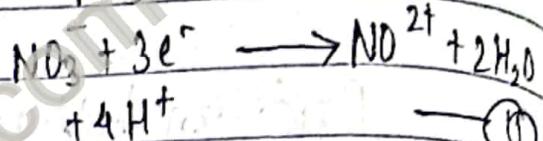
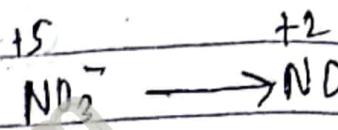
②



Oxidation half rxn:



Reduction half rxn

Multiplying  $\textcircled{1}$  by 3 & adding with  $\textcircled{11}$ 