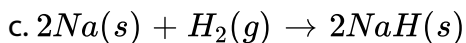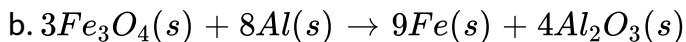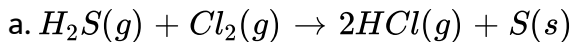# CHEMISTRY

NCERT - NCERT CHEMISTRY(ENGLISH)

REDOX REACTIONS

Solved Example

1. Identify the species undergoing oxidation and reduction.

a. $H_2S(g) + Cl_2(g) \rightarrow 2HCl(g) + S(s)$

b. $3Fe_3O_4(s) + 8Al(s) \rightarrow 9Fe(s) + 4Al_2O_3(s)$

c. $2Na(s) + H_2(g) \rightarrow 2NaH(s)$

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2. Justify that the reaction : $2Na(s) + H_2(g) \rightarrow 2NaH(s)$ is a redox change .

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3. Using Stock notation , represent the following compounds , $HAuCl_4, Tl_2O, FeO, Fe_2O_3, C, CuO, MnO$ and MnO_2 .
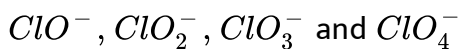
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4. Justify that the reaction $2Cu_2O_s + Cu_2S(s) \rightarrow 6Cu(s) + SO_2(g)$ a redox reaction. Identify the species oxidised / reduced. Which acts as an oxidanat and which acts as a reductant?
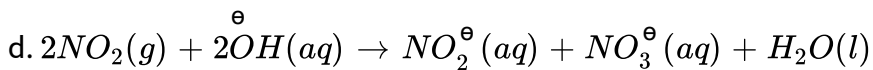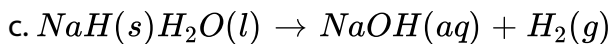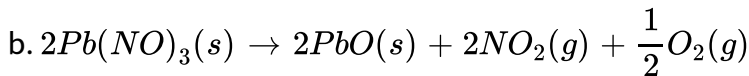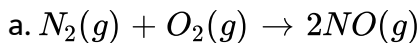
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5. Which of the following species, do not show disproportionation reaction and why ?

ClO^-, ClO_2^-, ClO_3^- and ClO_4^-

Also write reaction for each of the species that disproportionates.

6. Classify the following redox reactions:

a. $N_2(g) + O_2(g) \rightarrow 2NO(g)$

b. $2Pb(NO)_3(s) \rightarrow 2PbO(s) + 2NO_2(g) + \dfrac{1}{2}O_2(g)$

c. $NaH(s)H_2O(l) \rightarrow NaOH(aq) + H_2(g)$

d. $2NO_2(g) + 2\overset{\ominus}{O}H(aq) \rightarrow NO_2^{\ominus}(aq) + NO_3^{\ominus}(aq) + H_2O(l)$

7. Why following two reaction proceed differently?

$Pb_3O_4 + 8HCl \rightarrow 3PbCl_2 + Cl_2 + 4H_2O$

and

$$Pb_3O_4 + 4HNO_3 \rightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$$
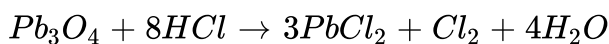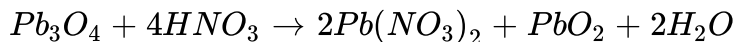
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8. Balance the net equtation fro th reaction of potassium dichromate (VI), $K_2Cr_2O_7$, with sodium sulphite, Na_2SO_3, in an acid solution to give chromium (III) ion and and sulphate ion.

Strategy : Follow the seven -step proceduce , one step at a time.

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9. Permanganate ion reacts with bromide ion in basic medium to give manganese dioxide and bromate ion. Write the balanced ionic equation for the reaction.

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10. Write a balanced ionic equation to describe the oxidation of iodide (I^-) in by permanganate (MnO_4^-) ion in basic solution to yield molecular iodine (I_2) and manganese (IV) oxide (MnO_2).

Strategy : We are given the formulas for two reactants and two prodcts. We use these to write the skeletal ionic equatin. We construct and balance th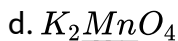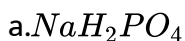e appropriate half-reactions using the rules just described. Then we add the half -reactions and eliminate common terms.
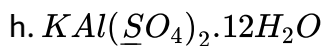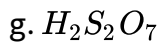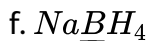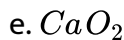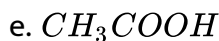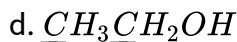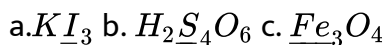
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Exercise

1. Assign oxidation number to the underlined elements in each of the following species:

a. NaH_2PO_4

b. $NaH\underline{S}O_4$

c. $H_4\underline{P_2}O_7$

d. $K_2\underline{Mn}O_4$

e. CaO_2

f. $Na\underline{B}H_4$

g. $H_2\underline{S}_2O_7$

h. $KAl(\underline{S}O_4)_2.12H_2O$

2. What are the oxidation number of the underlined elements in each of the following and how do you rationalise your results?

a. $K\underline{I}_3$ b. $H_2\underline{S}_4O_6$ c. $\underline{Fe}_3O_4$

d. $CH_3\underline{C}H_2OH$

e. $\underline{C}H_3COOH$

3. Justify that the following reaction are redox reactions:

a. $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

b. $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$

c. $4BCl_3(g) + 3LiAlH_4(s) \rightarrow 2B_2H_6(g) + 3LiCl(s) + 3AlCl_3(s)$

d. $2K(s) + F_2(g) \rightarrow 2K^\oplus F^\ominus(s)$

e. $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$
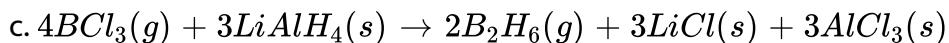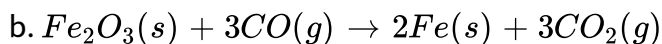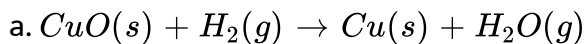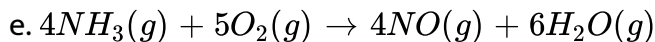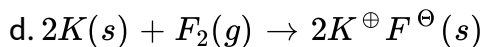
4. Fluorine reacts with ice and results in the change:

$H_2O(s) + F_2(g) \rightarrow HF(g) + HOF(g)$
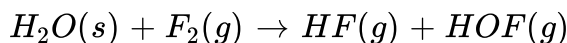
Justify that this reaction is a redox reaction.

5. Calculate the oxidation number of sulphur, chromium, and nitrogen in $H_2SO_5, Cr_2O_7^{2-}$ and $NO_3^\ominus$. Suggest the structure of these compounds. Count for the fallacy.

6. Write formulas for the following compounds:

a. Mercury (II) chloride b. Nickel (II) sulphate

c. Tin (IV) oxide d. Thallium (I) sulphate

e. Iron (III) sulphate f. Chromium (III) oxide

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7. Suggest a list of the substances where carbon can exhibit oxidation states from -4 to $+4$ and nitrogen from -3 to $+5$.

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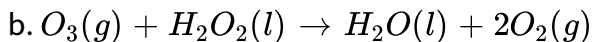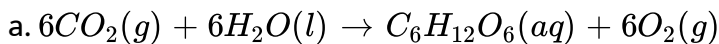
8. While sulphate dioxide and hydrogen peroxide can act as oxidising as well as reducing agents in their reactions, ozone and nitric acid act only as oxidants. Why?

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9. Consider the reaction:

a. $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$

b. $O_3(g) + H_2O_2(l) \rightarrow H_2O(l) + 2O_2(g)$

Why it is more appropriate to write these reaction as: a.

$6CO_2(g) + 12H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6H_2O(l) + 6O_2(g)$

$O_3(g) + H_2O_2(l) \rightarrow H_2O(l) + O_2(g) + O_2(g)$
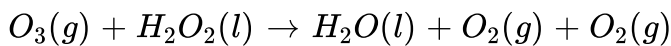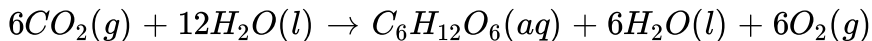
also suggest a technique to investigate the path of the above (a) and (b)

redox reactions.

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10. The compound AgF_2 is an unstable compound. However, if formed,

the compound acts as a strong oxidising agent. Why?

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11. Whenever a reaction between an oxidising agent and a reducing agent

is carried out, a compound of lower oxidation state is formed if the

reducing agent is in excess and a compound of higher oxidation state is formed if the oxidising agent is in excess. Justify this statement giving three illustrations.
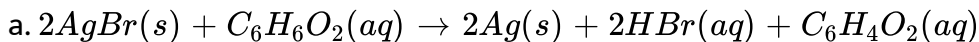
12. How do you count for the following observations ?

(a) Though alkaline potassium permanganate and acidic potassium permanganate both are used as oxidants, yet in the manufacture of benzoic acid from toluene we use alcoholic potassium permanganate as an oxidant. Why ? Write a balanced redox equation for the reaction.
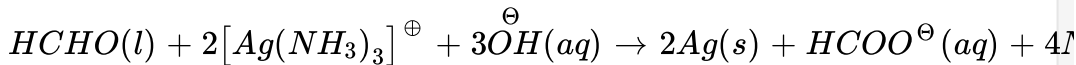
(b) When concentrated sulphuric acid is added to an inorganic mixture containing chloride, we get colourless pungent smelling gas HCl, but if the mixture contains bromide then we get red vapour of bromine. Why ?
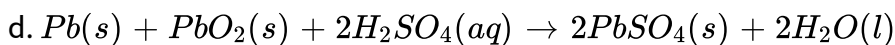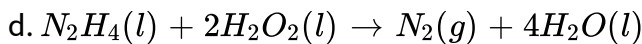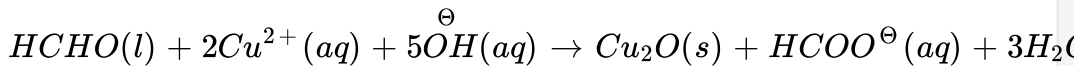
13. Identify the substance oxidised substance reduced, oxidising agent, and reducing agent for each of the following reactions:

a. $2AgBr(s) + C_6H_6O_2(aq) \rightarrow 2Ag(s) + 2HBr(aq) + C_6H_4O_2(aq)$

b.

$HCHO(l) + 2\left[Ag(NH_3)_3\right]^{\oplus} + 3\overset{\ominus}{O}H(aq) \rightarrow 2Ag(s) + HCOO^{\ominus}(aq) + 4N$

c.

$HCHO(l) + 2Cu^{2+}(aq) + 5\overset{\ominus}{O}H(aq) \rightarrow Cu_2O(s) + HCOO^{\ominus}(aq) + 3H_2O$

d. $N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(l)$

d. $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

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14. Consider the reaction:

$2S_2O_3^{2-}(aq) + I_2(s) \rightarrow S_4O_6^{2-}(aq) + 2I^{\ominus}(aq)$

$2S_2O_3^{2-}(aq) + 2Br_2(l) + 5H_2O(l) \rightarrow 2SO_4^{2-}(aq) + 4Br^{\ominus}(aq) + 10H^{\oplus}(a$
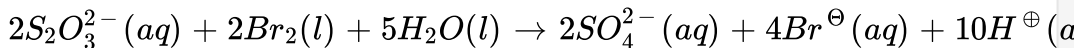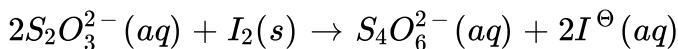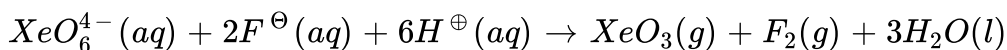
Why does the same reductant, thiosulphate, react differently with iodine and bromine?

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15. Justify giving reaction that among halogens, fluorine is the best oxidant and among hydrohalic compounds, hydroiodic acid is the best reductant.

16. Why does the following reaction occur?

$$XeO_6^{4-}(aq) + 2F^{\ominus}(aq) + 6H^{\oplus}(aq) \rightarrow XeO_3(g) + F_2(g) + 3H_2O(l)$$

What conclusion about the compound Na_4XeO_6 (of which XeO_6^{4-} is a part) can be drawn from the reaction?

17. Consider the reactions:

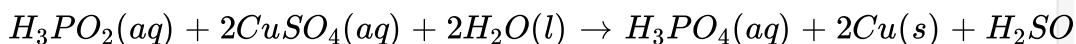a.

$$H_3PO_2(aq) + 4AgNO_3(aq) + 2H_2O(l) \rightarrow H_3PO_4(aq) + 4Ag(s) + 4HNO$$

b.

$$H_3PO_2(aq) + 2CuSO_4(aq) + 2H_2O(l) \rightarrow H_3PO_4(aq) + 2Cu(s) + H_2SO$$

c.

$$C_6H_5CHO(l) + 2\left[Ag(NH_3)_2\right]^{\oplus}(aq) + 3\overset{\ominus}{O}H(aq) \rightarrow C_6H_5COO^{\ominus}(aq) + 2$$

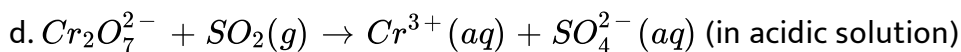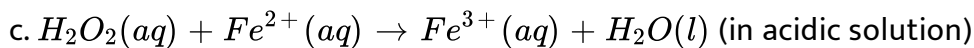d. $C_6H_5CHO(l) + 2Cu^{2+}(aq) + 5\overset{\ominus}{O}H(aq) \rightarrow$ No change observed
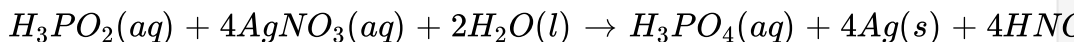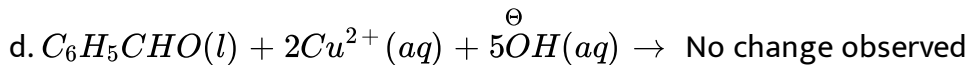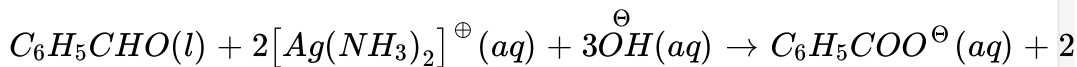
What inference do you draw about the behaviour of $Ag^{\oplus}$ and Cu^{2+}

from these reaction?

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18. Balance the following redox reactions by ion electron method:

a. $MnO_4^{\ominus}(aq) + I^{\ominus}(aq) \rightarrow MnO_2(s) + I_2(s)$ (in basic medium)

b. $MnO_4^{\ominus}(aq) + SO_2(g) \rightarrow Mn^{2+}(aq) + HSO_4^{\ominus}(aq)$ (in acidic

solution)

c. $H_2O_2(aq) + Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + H_2O(l)$ (in acidic solution)

d. $Cr_2O_7^{2-} + SO_2(g) \rightarrow Cr^{3+}(aq) + SO_4^{2-}(aq)$ (in acidic solution)
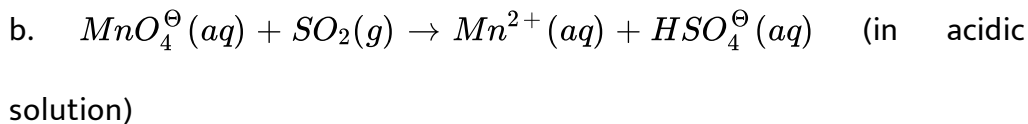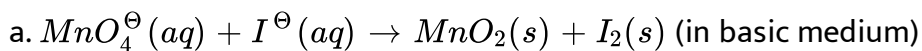
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19. Balance the following equations in basic medium by ion-electron method and oxidation number methods and identify the oxidising agent and the reducing agent.

(a) $P_4(s) + OH^-(aq) \rightarrow PH_3(g) + HPO_2^-(aq)$

(b) $N_2H_4(1) + ClO_3^-(aq) \rightarrow NO(g) + Cl^-(g)$

(c) $Cl_2O_7(g) + H_2O_2(aq) \rightarrow ClO_2^-(aq) + O_2(g) + H^+$
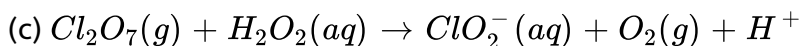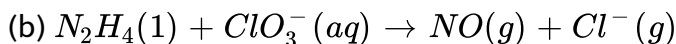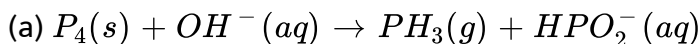
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20. What sort of informations can you draw from the following reaction?

$(CN)_2(g) + 2\overset{\ominus}{O}H(aq) \rightarrow CN^{\ominus}(aq) + CNO^{\ominus}(aq) + H_2O(l)$
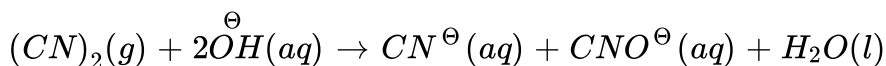
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21. The Mn^{3+} ion is unstable in solution and undergoes disproportionation reaction to give Mn^{+2}, MnO_2, and $H^{\oplus}$ ion. Write a balanced ionic equation for the reaction.

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22. Consider the elements:

Cs, Ne, I and F

a. Identify the element that exhibits only negative oxidation state.

b. Identify the element that exhibits only positive oxidation state.

c. Identify the element that exhibits both positive and negative oxidation states.

d. Identify the element which exhibits neither the negative nor does the positive oxidation state.

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23. Chlorine is used to purify drinking water. Excess of chlorine is harmful. The excess of chlorine is removed by treating with sulphur dioxide. Present a balanced equation for this redox change taking place in water.

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24. Refer to the periodic table given in your book and now answer the following questions:

a. Select the possible non metals that can show disproportionation reaction.

b. Select three metals that can show disproportionation reaction.

25. In Ostwald's process for the manufacture of nitric acid, the first step involves the oxidation of ammonia gas by oxygen gas to give nitric oxide gas and steam. What is the maximum weight of nitric oxide that can obtained starting only with $10.00g$ of ammonia and $20.00g$ of oxygen?

26. Using the standard electrode potentials given in Table, predict if the reaction between the following is feasible:

a. $Fe^{3+}(aq)$ and $I^{c-}(aq)$
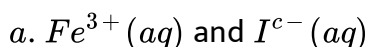
b. $Ag^{\oplus}(aq)$ and $Cu(s)$

c. $Fe^{3+}(aq)$ and $Br^{c-}(aq)$

d. $Ag(s)$ and $Fe^{3+}(aq)$

e. $Br_2(aq)$ and $Fe^{2+}(aq)$.

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27. Predict the products of electrolysis in eaCHM of the following :

a. An aqueous solution of $AgNO_3$ with silver electrodes.

b. An aqeous solution of $AgNO_3$ with platinum electrodes,

c. A dilute solution of H_2SSO_4 with platinum electrodes.

d. An aqueous solution of $CuCl_2$ with platinum electrodes.

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28. Arrange the following metals in the order in whiCHM they displace eaCHM other from the solution of their salts. $Al, Cu, Fe, Mg,$ and $Zn.$
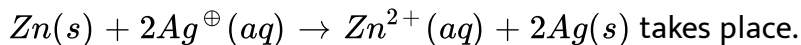
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29. Given standard electrode potentials

$$K^{\oplus} \mid K = -2.93V, \ Ag^{\oplus}|Ag = 0.80V,$$

$$Hg^{2+}|Hg = 0.79V$$

$$Mg^{2+}|Mg = -2.37V, \ Cr^3|Cr = -0.74V$$
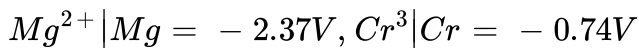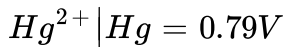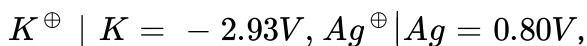
Arrange these metals in their increasing order of reducing power.

30. Depict the galvanic in whiCHM the reaction :

$$Zn(s) + 2Ag^{\oplus}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s) \text{ takes place.}$$

Further show :

$a.$ WhiCHM of the electrode is negatively CHMarged ?

$b.$ The carriers of the current in the cell.

$c.$ Individual reaction at eaCHM electrode.