

p-block elements(F,CL,BR,I)-CBSE

✍ 1 Mark Questions

1. What happens when, chlorine gas reacts with cold and dilute solution of NaOH?
 2. Draw the structure of the following
 HClO_3
 3. How can you prepare Cl_2 from HCl and HCl from Cl_2 ? Write reactions only.
 4. Arrange the following in increasing order of property indicated, giving reason :
Hydrides of group 17-acidic strength.
 5. Despite lower value of its electron gain enthalpy with negative sign, fluorine, F_2 is a stronger oxidising agent than Cl_2 .
- Or Although electron gain enthalpy of fluorine is less negative than that of chlorine, yet fluorine is a better oxidising agent than chlorine.
6. Give reason :
When Cl_2 reacts with excess of F_2 , ClF_3 is formed and not FCl_3 .

7. Arrange the following in the decreasing order of their reducing character
HF, HCl, HBr, HI
8. Give reason, electron gain enthalpies of halogens are largely negative.
9. F_2 is a stronger oxidising agent than Cl_2 . Why?
10. Name two poisonous gases which can be prepared from chlorine gas.
11. Give reason for the following :
Fluorine does not exhibit any positive oxidation state.
12. Draw the structure of BrF_3 molecule.
13. Give reason for the following :
 F_2 is more reactive than ClF_3 but ClF_3 is more reactive than Cl_2 .
14. Bond enthalpy of F_2 is less than that of Cl_2 . Why?
15. Give reason for the following :
 $PbCl_4$ is more covalent than $PbCl_2$.
16. Account for the following: HF is not stored in glass bottles but is kept in wax-coated bottles?
17. Predict the shape and the asked angle (90° or more or less) in the following case :
 ClF_3 and the angle: $F-Cl-F$
18. Why is ICl more reactive than I_2 ?
19. The halogens are coloured, why?
20. Draw the structure of ClF_3 molecule.
21. Draw the structure of $HClO_4$.
22. Complete the following reaction :
 $NaOH$ (hot and conc.) + $Cl_2 \longrightarrow$
23. Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.
24. Complete the following chemical equation:
 $Cl_2 + F_2$ (excess) \longrightarrow
25. Account for the following:
Chlorine water loses its yellow colour on standing.
26. F_2 is most reactive of all the four common halogens. Explain.
27. What happens when chlorine gas is passed through a hot conc. solution of $NaOH$?
28. Why does fluorine not play the role of a central atom in interhalogen compounds?
29. How would you account for the following?
The oxidising power of oxoacids of chlorine follows the order
 $HClO_4 < HClO_3 < HClO_2 < HClO$
30. Complete the following chemical equation:
 $Br_2 + F_2$ (excess) \longrightarrow
31. Explain in aqueous medium, HCl is stronger acid than HF
32. Draw the structure of $HOClO_2$ molecule.
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33. Complete the following reaction:
 $I_2 + H_2O + Cl_2 \longrightarrow$
34. Electron gain enthalpy with negative sign for fluorine is less than that for chlorine.
35. Arrange F_2 , Cl_2 , Br_2 and I_2 in the order of increasing bond dissociation enthalpy.

36. Fluorine forms the largest number of interhalogen compounds amongst the halogens.
37. How would you account for the order of increase in strength of acids?
 $\text{PH}_3 < \text{H}_2\text{S} < \text{HCl}$

Or The acidic strength decreases in the order $\text{HCl} > \text{H}_2\text{S} > \text{PH}_3$. Explain.

38. Halogens are strong oxidising agents. Why?
39. ClF_3 molecule has a T-shaped structure and not a trigonal planar one. Explain why?
40. Which is stronger acid in aqueous solution, HCl or HI and why?
41. Complete the following chemical equation:
 $\text{SiO}_2 (g) + \text{HF} (g) \longrightarrow$
42. Arrange the following in the order of increasing oxidising power:
 $\text{HClO}_4, \text{HClO}, \text{HClO}_2, \text{HClO}_3$
43. Why are pentahalides of a metal more covalent than its trihalides?
44. Arrange the following in the order of increasing acidic strength.
 $\text{HCl}, \text{HBr}, \text{HI}, \text{HF}$

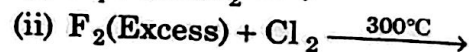
2 Marks Questions

45. Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidizing power of F_2 and Cl_2 .
46. Draw the structures of the following :
 (i) H_2SO_3 (ii) HClO_3
47. Give reasons:
 (i) Thermal stability decreases from H_2O to H_2Te .

(ii) Fluoride ion has higher hydration enthalpy than chloride ion.

48. Give reasons:
 (i) SO_2 is reducing while TeO_2 is an oxidising agent.
 (ii) ICl is more reactive than I_2 .
49. (a) Why is dioxygen a gas but sulphur a solid?
 (b) Why are halogens coloured?
50. Account for the following:
 (i) Iron on reaction with HCl forms FeCl_2 and not FeCl_3 .
 (ii) The two O—O bond lengths in the ozone molecule are equal.
51. (i) Compare the oxidising action of F_2 and Cl_2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.
 (ii) Write the conditions to maximise the yield of H_2SO_4 by contact process.

52. Complete the following chemical equations



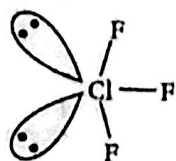
53. Arrange the following in the order of property indicated against each set.
 (i) HF, HCl, HBr, HI (increasing bond dissociation enthalpy)
 (ii) $\text{H}_2\text{O}, \text{H}_2\text{S}, \text{H}_2\text{Se}, \text{H}_2\text{Te}$ (increasing acidic character)
54. How are interhalogen compounds formed? What general compositions can be assigned to them?

3 Marks Questions

55. (i) Write the balanced equations for the following reactions :
 (a) Chlorine reacts with dry slaked lime
 (b) Carbon reacts with concentrated H_2SO_4

16. HF forms fluorosilicate ion on reaction with glass. Hence, it is stored in wax-coated bottles. (1)

17. Structure of ClF_3 is given below:



Shape Bent T-shaped

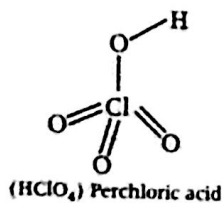
Angle $\text{F}-\text{Cl}-\text{F}$: Less than 90° (1)

18. Interhalogen compounds are more reactive than halogens (except fluorine) because $X-X'$ bond ($\text{I}-\text{Cl}$ bond in question) in interhalogens is weaker than $X-X$ bond ($\text{I}-\text{I}$ bond) in halogens, except $\text{F}-\text{F}$ bond. (1)

19. All halogens are coloured due to the absorption of radiations in visible region which results in the excitation of outer electrons to higher energy level. By absorbing different quanta of radiation, they display different colours. (1)

20. Refer to solution 17. (1)

21. Structure of HClO_4 is given below:

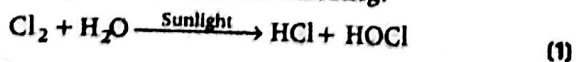


22. $3\text{Cl}_2 + 6\text{NaOH} \longrightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$
(Hot and conc.)
(Disproportionation reaction) (1)

23. Higher boiling point of H_2O is due to the extensive H-bonding than HF. (1)

24. $\text{Cl}_2 + 3\text{F}_2$ (excess) $\xrightarrow{573\text{K}}$ 2ClF_3 (1)

25. Due to formation of HCl and HClO , chlorine water loses its yellow colour on standing.



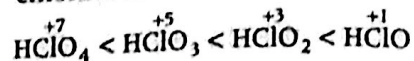
26. It is due to low bond dissociation energy and high hydration energy and high electron affinity. (1)

27. Refer to solution 22. (1)

28. Fluorine does not have d -orbitals and it cannot show higher oxidation state. Therefore, it

does not play the role of a central atom in interhalogen compounds.

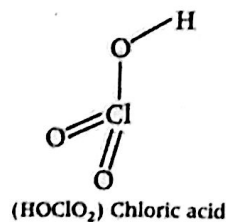
29. As the oxidation number of halogen atom in oxoacid increases, its oxidising power decreases. Therefore, HClO is least stable and gives $[\text{O}]$ most easily, so its oxidising power is greater than HClO_4 . Thus, the oxidising power of oxoacids of chlorine is



30. $\text{Br}_2 + 5\text{F}_2$ (excess) $\longrightarrow 2\text{BrF}_5$ (1)

31. $\text{H}-\text{Cl}$ is a stronger acid than HF in aqueous medium because with increase in $\text{H}-\text{X}$ bond length, bond dissociation energy decreases and H^+ ion is easily produced. (1)

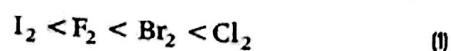
32. Structure of HOClO_2 is given below: (1)



33. $\text{I}_2 + 6\text{H}_2\text{O} + 5\text{Cl}_2 \longrightarrow 2\text{HIO}_3 + 10\text{HCl}$
Iodic acid (1)

34. Due to small size of fluorine atom there are strong interelectronic repulsions in the relatively smaller $2p$ -orbitals of fluorine. Thus, incoming electron does not experience much attraction. (1)

35. The order of increasing bond dissociation enthalpy is as follows:



36. Fluorine is the most electronegative element among halogens and it cannot exhibit any positive oxidation state. Therefore, it combines with other halogen atoms and forms largest number of interhalogen compounds. (1)

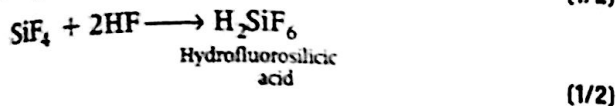
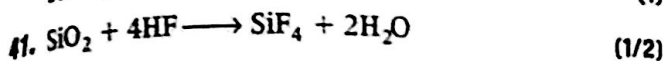
37. Greater the electronegativity of central atom, more will be the polarity and more will be the acidic character. (1)

As the order of electronegativity of the elements of third period is $\text{P} < \text{S} < \text{Cl}$. Therefore, the order of acid strength of their hydrides is $\text{PH}_3 < \text{H}_2\text{S} < \text{HCl}$. This is due to greater polarity in HCl than H_2S . H_2S has more polarity than PH_3 , due to large difference in electronegativity. (1)

38. The easy acceptance of an electron by halogens to obtain noble gas configuration is the reason for the strong oxidising nature of halogens. (1)

39. In ClF_3 , central atom Cl has three bond pairs and two lone pairs. According to VSEPR theory, the two lone pairs will occupy the equatorial positions to minimise $lp-lp$ and $lp-bp$ repulsions. In addition, the axial fluorine atoms will be bent towards the equatorial fluorine in order to minimise the $lp-lp$ repulsions. That's why, ClF_3 has a bent T-shaped structure. For figure, refer to solution 17. (1/2+1/2=1)

40. H—I bond length is greater than H—Cl bond length. As the bond length increases, bond dissociation energy decreases thus, tendency to give a proton increases. Therefore, HI is the stronger acid. (1)

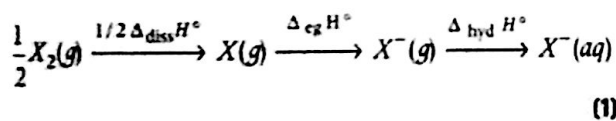


42. The correct order is $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$. For details refer to solution 29. (1)

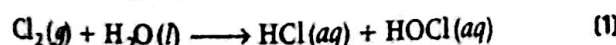
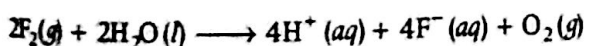
43. It is because pentahalides of a metal have higher polarising power than its trihalides. (1)

44. The increasing order of acidic strength is $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$. (1)

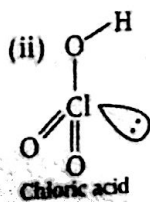
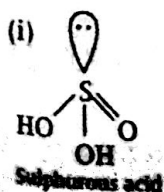
45. The bond dissociation enthalpy and electron gain enthalpy are higher for chlorine but hydration energy is much higher for fluorine. It compensates the effect of other two and thus, makes fluorine more oxidising than chlorine.



The relative oxidising power of the halogens can be further illustrated by their reactions with water.



46. Structures of H_2SO_3 and HClO_3 are as follows :



(2)

47. (i) The thermal stability of hydrides decreases on moving down the group. This is due to the decrease in the bond dissociation enthalpy ($H-E$) of hydrides on moving down the group. (where $E = \text{O, S, Se, Te}$). (1)

(ii) Hydration enthalpy is a measure of energy released when attractions are set-up between positive or negative ions and water molecules. These attractions are stronger when the ion is smaller.

As we know that F^- ion is smaller than Cl^- ion. So, F^- ion possess higher hydration enthalpy than Cl^- ion. (1)

48. (i) In SO_2 , S exists in + 4 oxidation state which is less stable than its + 6 oxidation state, therefore, it can easily oxidises from + 4 to + 6 state, hence SO_2 acts as a reducing agent. Whereas in TeO_2 , Te exists in + 4 oxidation state which is its most stable state and it cannot oxidise further to + 6 state, but can reduce easily to + 2 or - 2 state. Hence, TeO_2 acts as an oxidising agent. (1)

(ii) Refer to solution 18. (1)

49. (a) Refer to solution 8 of Topic 1. (1)

(b) Refer to solution 19. (1)

50. (i) HCl reacts with Fe and produces H_2 .
 $\text{Fe} + 2\text{HCl} \longrightarrow \text{FeCl}_2 + \text{H}_2$
Liberation of hydrogen prevent the formation of ferric chloride (FeCl_3). (1)

(ii) Refer to Solution 25 of Topic 1. (1)

51. (i) Refer to solution 45. (2)

(ii) The manufacturing of sulphuric acid by catalytic oxidation of SO_2 in the presence of V_2O_5 is favoured by low temperature (720 K) and high pressure (2 bar). (1)

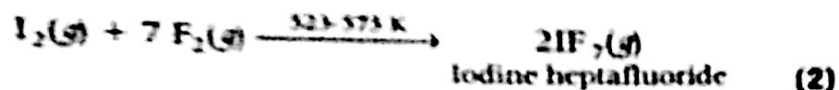
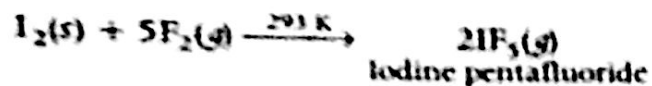
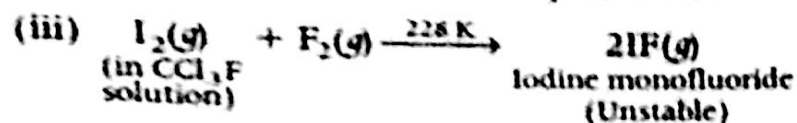
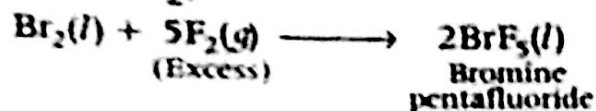
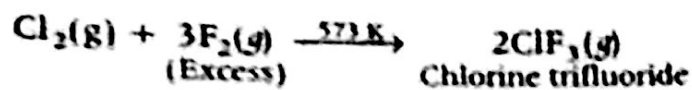
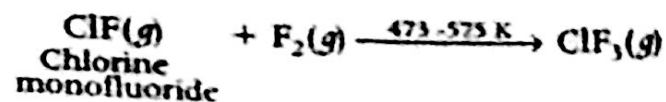
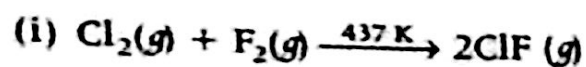
52. (i) $\text{P}_4 + 8 \text{SOCl}_2 \longrightarrow 4 \text{PCl}_3 + 4 \text{SO}_2 + 2 \text{S}_2\text{Cl}_2$ (1)

(ii) Refer to solution 24. (1)

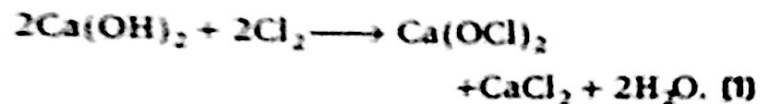
53. (i) Increasing bond dissociation enthalpy.
 $\text{H—I} < \text{H—Br} < \text{H—Cl} < \text{H—F}$ (1)

(ii) Increasing acidic character
 $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$ (1)

54. Interhalogen compounds are formulated as XX' , XX'_3 , XX'_5 , etc. The interhalogen compounds can be prepared by direct combination or by the action of halogen on lower interhalogen compounds. The product formed depends upon some specific conditions. e.g.,



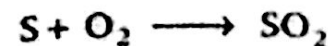
55. (i)(a) Chlorine reacts with dry slaked lime to give bleaching powder.



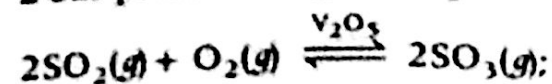
(b) Refer to solution 24 of Topic 1. (1)

(ii) **Manufacture of sulphuric acid** It is manufactured by the contact process, which involves three main steps:

(a) Sulphur or sulphide ores burns in O₂ to give SO₂.



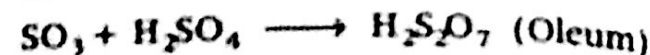
(b) This SO₂ reacts with O₂ in the presence of V₂O₅, which acts as a catalyst at 720 K and 2 bar pressure to give SO₃.



$$\Delta_r H^\circ = -196.6 \text{ kJ mol}^{-1}$$

This step is the key step in the manufacture of sulphuric acid.

(c) After that SO₃ is absorbed in H₂SO₄ (conc.) to form oleum (H₂S₂O₇).



The reaction is **exothermic**, reversible and the forward reaction leads to decrease in volume.

Thus, oleum is then diluted with H₂O to form H₂SO₄ of required concentrations.



The sulphuric acid obtained by contact process is 96-98% pure. (1)

56. (i) Refer to solution 12.

(ii) (a) The correct order of electron gain enthalpy



(b) Refer to solution 35.