Group-17 elements

Cl_2 Br_2 I_2 F_2

⇒ Physical properties of group 17.

→ As we go down the group the MP and BP increases

→ F_2 and Cl_2 are gases, Br_2 is liquid, I_2 is solid.

→ No. of e^- increases down the group ∴ VDW forces increases ∴ more energy required to break.

→ Size of molecules increase down the group, hence there are more surface contact points.

→ F_2 - Pale yellow

Cl_2 - yellow-green

Br_2 - red brown

I_2 - black

→ down the group reactivity decreases

→ halogens become less electronegative down the group.

→ halogens become weaker oxidising agents down the group.

→ halogens become stronger reducing agents down the group.

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⇒ Reactions of halogens (X_2) with hydrogen (H_2)

→ as we go down the group, the rate of reaction between X_2 and H_2 decreases and activation energy increases.

→ as we go down the group, H-X bonds become weaker

→ reaction is less vigorous down the group.

⇒ Displacement Reaction

→ A more reactive halogen displaces a less reactive halogen from its salt solution.

⇒ Testing for halide ions

→ we add $AgNO_3$ to the solution, which forms a precipitate because AgX forms, which is insoluble.

→ White ppt - Chlorine

→ Cream ppt - Bromine

→ Yellow ppt - Iodine

→ It is difficult to distinguish between white and cream ppt so we add dilute ammonia to the ppt. Cl ions dissolve but Br ions dont. Iodine ions also dont dissolve.

→ if it is conc ammonia, both AgCl and AgBr will dissolve AgI still does not dissolve.

$$\underbrace{AgCl}_{\text{insoluble}} + 2NH_3 \rightarrow \underbrace{Ag(NH_3)_2Cl}_{\text{soluble}}$$

⇒ Uses of halogens

→ Chlorine are used to kill bacteria in water

→ NaCl and NaClO are used in bleach

⇒ halide ions + conc H_2SO_4

→ Cl^- ions

$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ → acid-base reaction

→ steamy fumes of HCl

→ HCl is not further decomposed.

→ Br^- ions

$NaBr + H_2SO_4 \rightarrow NaHSO_4 + HBr$ → acid-base and redox reaction.

$2HBr + H_2SO_4 \rightarrow Br_2 + SO_2 + 2H_2O$

→ red brown vapour

→ HBr is decomposed to Br_2

→ I^- ions

$NaI + H_2SO_4 \rightarrow NaHSO_4 + HI$

$2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$

→ purple vapour

→ HI is decomposed to I_2

⇒ Disproportionation

→ oxidation and reduction takes place on the same species.

$Cl_2(aq) + 2NaOH(aq) \rightarrow NaCl(aq) + NaClO(aq) + H_2O(l)$ (cold alkali)

0 → -1 (reduction), 0 → +1 (oxidation)

$3Cl_2 + 6NaOH \rightarrow NaCl + NaClO_3 + 3H_2O$ (hot alkali)

0 → -1 (reduction), 0 → +5 (oxidation)