

Marks
2

- Explain in terms of their electronic configurations **and** ionisation energies why the halogens (Group 17) are powerful *oxidising* agents.

Oxidising agents are themselves reduced (*i.e.* they gain electrons).

The electronic configuration of the halogens (Group 17) is np^5 . They are small atoms (atomic size decreases across a period as the nuclear charge increases). In each period, the halogen is the element with the highest number of protons in the nucleus that also has an incomplete shell.

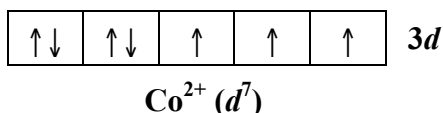
As a result, they will readily gain a single electron to form the X^- ion.

Similarly, the high nuclear charge and small size means that they have high ionisation energies. Hence halogens are poor reducing agents.

2

- Compounds of *d*-block elements are frequently paramagnetic. Using the box notation to represent atomic orbitals, account for this property in compounds of Co^{2+} .

A cobalt atom has 9 valence electrons: it is in Group 9 of the Periodic Table. A Co^{2+} cation has lost 2 electrons so has $(9 - 2) = 7$ valence electrons. The configuration of Co^{2+} is $3d^7$. These occupy the five *d*-orbitals to maximize the number of unpaired electrons (to minimize the electron-electron repulsion):



Paramagnetism arises as a result of the presence of 1 or more unpaired electrons. Co^{2+} has 3 unpaired electrons and so is paramagnetic.