

Marks
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- Explain in terms of their electronic configurations and trends in ionisation energies across a period why the alkali metals (Group 1) are powerful *reducing* agents.

Ionisation energies increase across a period in the periodic table because the increasing nuclear charge holds the electrons more tightly. Hence, in any period, the Group 1 element is the one that most easily loses its electron (from the *s* subshell).

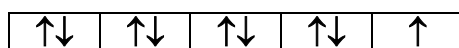
This electron is then available to reduce another species.

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

Cu^{2+} has the electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$ (or $[\text{Ar}] 3d^9$).

Hence as it has an odd number of electrons, the Cu^{2+} ion has an unpaired electron and must therefore be paramagnetic. The nine electrons occupy the *3d* orbitals with the arrangement:



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- Complete the following table.

Formula	Oxidation state of transition metal	Coordination number of transition metal	Number of <i>d</i> -electrons in metal in complex ion	Species formed upon dissolving in water
$\text{K}_2[\text{Ni}(\text{CN})_4]$	II	4	8	$\text{K}^+(\text{aq}), [\text{Ni}(\text{CN})_4]^{2-}(\text{aq})$
$[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$	III	6	3	$[\text{Cr}(\text{NH}_3)_5\text{Cl}]^{2+}(\text{aq}), \text{Cl}^-(\text{aq})$
$[\text{Co}(\text{en})_3]\text{Br}_3$	III	6	6	$[\text{Co}(\text{en})_3]^{3+}(\text{aq}), \text{Br}^-(\text{aq})$

en = ethylenediamine = $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$