Marks

- 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. **2**

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.

- 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+}. **2**

Cu^{2+} has the electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$ (or [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 3*d* orbitals with the arrangement:

↑↓	↑↓	↑↓	↑↓	↑

- Complete the following table. **6**

Formula	Oxidation state of transition metal	Coordination number of transition metal	Number of *d*-electrons in metal in complex ion	Species formed upon dissolving in water
$K_2[Ni(CN)_4]$	**II**	**4**	**8**	**K^+(aq), $[Ni(CN)_4]^{2-}$(aq)**
$[Cr(NH_3)_5Cl]Cl_2$	**III**	**6**	**3**	**$[Cr(NH_3)_5Cl]^{2+}$(aq), Cl^-(aq)**
$[Co(en)_3]Br_3$	**III**	**6**	**6**	**$[Co(en)_3]^{3+}$(aq), Br^-(aq)**

en = ethylenediamine = $NH_2CH_2CH_2NH_2$