- Titanium has three common oxidation states, +II, +III and +IV. Using the box notation to represent atomic orbitals, predict whether compounds of Ti^{2+}, Ti^{3+} and Ti^{4+} would be paramagnetic or diamagnetic. **2**

Ti is in group 4: it has 4 valence electrons. Ti^{2+} therefore has (4 – 2) = 2 remaining: it has a d^2 configuration. Ti^{3+} therefore has (4 – 3) = 1 remaining: it has a d^1 configuration. Ti^{4+} therefore has (4 – 4) = 0 remaining: it has a d^0 configuration.

These electrons are arranged in the five *d* orbitals to minimise the repulsion between them. This is achieved by keeping the maximum number possible unpaired.

Ti^{2+}	↑	↑			
Ti^{3+}	↑				
Ti^{4+}					

Ti^{2+} and Ti^{3+} have unpaired electrons and are paramagnetic. Ti^{4+} has no unpaired electrons and is diamagnetic.

- Provide a systematic name for the complex *trans*-$[NiBr_2(en)_2]$ and draw its structure. Is this complex chiral? Explain your reasoning. **4**

en = ethylenediamine = ethane-1,2-diamine

***trans*-dibromidobis(ethylenediamine)nickel(II) or *trans*-dibromidobis(ethane-1,2-diamine)nickel(II)**

It is not chiral as it is superimposable on (*i.e.* identical to) its mirror image.