Answers to Exercise 12.2
Colour

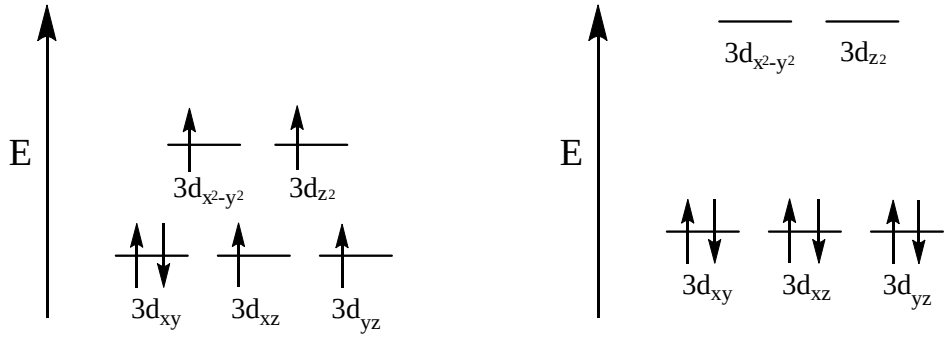
1.

(a) +2

(b) [Ar] $4s^2\ 3d^6$

(c) [Ar] $3d^6$

(d)



High Spin Low Spin

The gap between the lower-energy 3d orbitals and the higher-energy 3d orbitals must be larger for the low spin energy level diagram than for the high spin energy level diagram.

All of the orbitals on the high spin energy level diagram should be shown as having lower energy than the corresponding orbital on the low spin energy level diagram. (i.e. the energy of $3d_{xy}$ on the high spin diagram should be lower than the energy of $3d_{xy}$ on the low spin diagram.)

(e) low spin

CN^- is a strong field ligand.

You are not expected to memorize the spectrochemical series. It is included on test data sheets.

(f) coloured

The 3d orbitals of Fe(II) do not all have the same energy as each other in this complex.

An electron in one of the lower-energy 3d orbitals can absorb a photon of light and be excited into one of the higher-energy 3d orbitals.

The colour of a complex is a combination of the colours of light not absorbed by it. If one colour is absorbed, the remaining colours will be transmitted and the complex will therefore appear to be the complementary colour of the absorbed light.

Any time there are multiple energies for a d subshell and there is (a) at least one electron in the lowest energy d orbital(s) of the subshell and (b) at least one empty space in the highest energy d orbital(s) of the subshell, expect the co-ordination complex to be coloured.

Therefore, expect both high spin and low spin octahedral complexes of Fe^{2+} to be coloured.