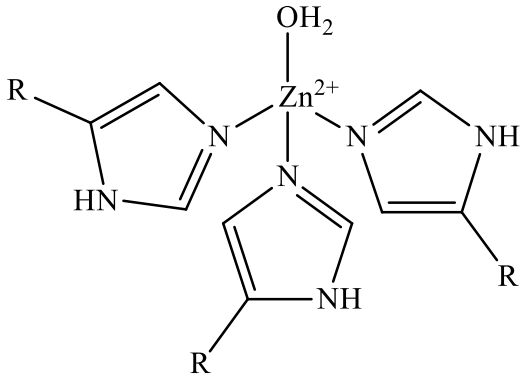
Marks 5

- The structure below represents the active site in carbonic anhydrase, which features a Zn^{2+} ion bonded to three histidine residues and a water molecule.



The pK_a of uncoordinated water is 15.7 but the pK_a of the water in carbonic anhydrase is around 7. Suggest an explanation for this large change.

The high charge on the Zn^{2+} ion draws electron density out of the O–H bonds in the water molecule. This weakens the O–H so the H^+ is more likely to leave.

The water in carbonic anhydrase is therefore more acidic, as shown by the large decrease in pK_a.

When studying zinc-containing metalloenzymes such as this, chemists often replace Zn^{2+} with Co^{2+} because of their different magnetic properties. Predict which of these species, if either, is attracted by a magnetic field. Explain your reasoning.

Zn^{2+}, $3d^{10}$	↑↓	↑↓	↑↓	↑↓	↑↓
Co^{2+}, $3d^{7}$	↑↓	↑↓	↑	↑	↑

Zn^{2+} has 0 unpaired *d* electrons, Co^{2+} has 3 unpaired *d* electrons. Co^{2+} is therefore paramagnetic and will be attracted by a magnetic field.