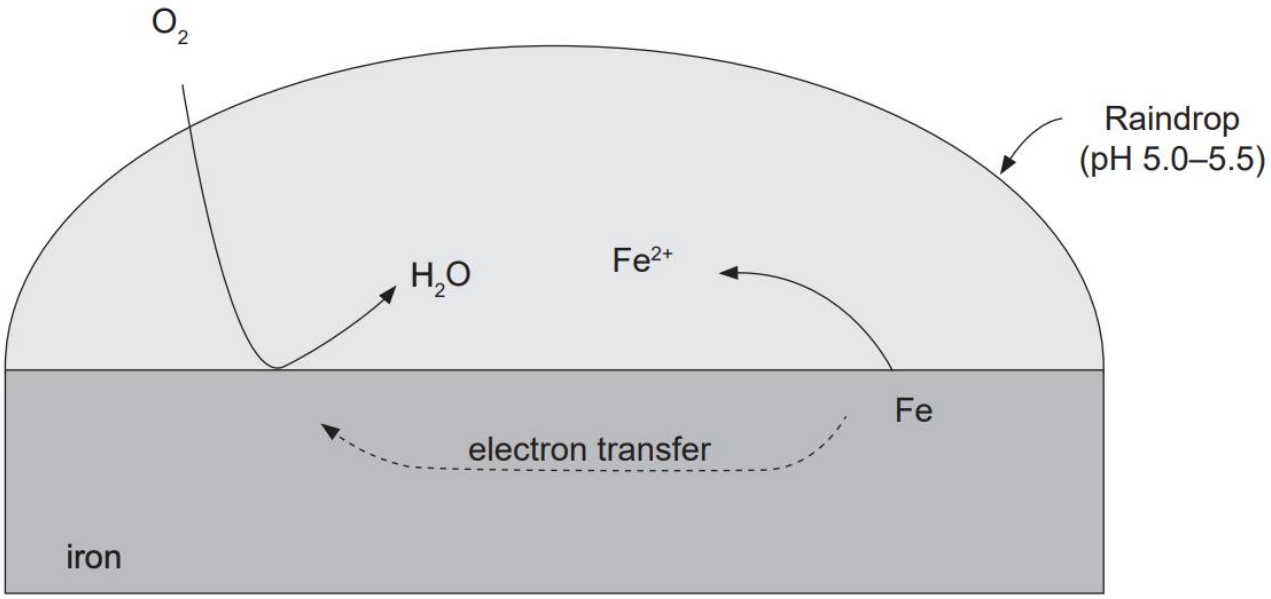
Question 31 **(9 marks)**

The corrosion of iron is an electrochemical process that results in the formation of a reddish-brown solid commonly known as rust, $Fe_2O_3.H_2O(s)$. Iron objects exposed to rainwater corrode relatively quickly.

Iron corrosion occurs in two stages. During the first stage, an electrochemical cell is established on the iron surface, with electron transfer and Fe^{2+} ion formation occurring. This can be seen in the following diagram.



(a) Write half-equations and the overall balanced equation for the reaction occurring in the above electrochemical cell. State symbols are **not** required. (4 marks)

Oxidation half-equation	
Reduction half-equation	
Redox equation	

(b) During the second stage of iron corrosion, the newly formed Fe^{2+} ions migrate away from the iron surface and react with water and dissolved oxygen to form rust. The balanced equation for this reaction is shown below.

$$4\ Fe^{2+}(aq) + O_2(g) + 6\ H_2O(\ell) \rightarrow 2\ Fe_2O_3.H_2O(s) + 8\ H^+(aq)$$

Use oxidation numbers to show that this reaction is a redox reaction. (2 marks)

A corrosion chemist inspected an outdoor playground and found that most of the equipment containing iron showed signs of corrosion. The chemist suggested several different methods for protecting the playground equipment from further corrosion, including the use of sacrificial anodes.

(c) State what is a sacrificial anode. (1 mark)

(d) State the name of a metal that can be used as a sacrificial anode to protect the equipment from further corrosion. Use Standard Reduction Potentials to justify your choice. (2 marks)