

HL Paper 3

Discuss the production of chlorine and sodium hydroxide from brine using a membrane cell. Include in your answer the materials used for the electrodes, the equations taking place at each electrode and why this method has replaced the mercury cell.

A fuel cell is an energy conversion device that generates electricity from a spontaneous redox reaction.

- a. The *Geobacter* species of bacteria can be used in microbial fuel cells to oxidise aqueous ethanoate ions, CH_3COO^- (aq), to carbon dioxide gas.

[2]

State the half-equations for the reactions at both electrodes.

Negative electrode (anode):

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Positive electrode (cathode):

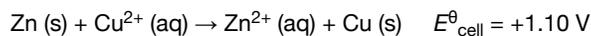
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- b. A concentration cell is an example of an electrochemical cell.

[3]

(i) State the difference between a concentration cell and a standard voltaic cell.

(ii) The overall redox equation and the standard cell potential for a voltaic cell are:



Determine the cell potential E at 298 K to three significant figures given the following concentrations in mol dm^{-3} :

$$[\text{Zn}^{2+}] = 1.00 \times 10^{-4} \quad [\text{Cu}^{2+}] = 1.00 \times 10^{-1}$$

Use sections 1 and 2 of the data booklet.

(iii) Deduce, giving your reason, whether the reaction in (b) (ii) is more or less spontaneous than in the standard cell.

- c. Dye-sensitized solar cells (DSSC) convert solar energy into electrical energy.

[4]

(i) Describe how a DSSC converts sunlight into electrical energy.

(ii) Explain the role of the electrolyte solution containing iodide ions, I^- , and triiodide ions, I_3^- , in the DSSC.