5 Redox reactions occur in the discharge of all electrochemical cells. Some of these cells are of commercial value.
The table below shows some redox half-equations and standard electrode potentials.

Half-equation	$E^{\ominus}$ / V
$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$	–0.76
$Ag_2O(s) + 2H^+(aq) + 2e^- \longrightarrow 2Ag(s) + H_2O(l)$	+0.34
$O_2(g) + 4H^+(aq) + 4e^- \longrightarrow 2H_2O(l)$	+1.23
$F_2(g) + 2e^- \longrightarrow 2F^-(aq)$	+2.87

5 (a) In terms of electrons, state what happens to a reducing agent in a redox reaction.

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(1 mark)

5 (b) Use the table above to identify the strongest reducing agent from the species in the table.

Explain how you deduced your answer.

Strongest reducing agent .....

Explanation .....

.....

(2 marks)

5 (c) Use data from the table to explain why fluorine reacts with water.
Write an equation for the reaction that occurs.

Explanation .....

.....

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Equation .....

.....

(3 marks)

5 (d) An electrochemical cell can be constructed using a zinc electrode and an electrode in which silver is in contact with silver oxide. This cell can be used to power electronic devices.

5 (d) (i) Give the conventional representation for this cell.

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(2 marks)

5 (d) (ii) Calculate the e.m.f. of the cell.

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(1 mark)

5 (d) (iii) Suggest **one** reason why the cell cannot be electrically recharged.

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(1 mark)

5 (e) The electrode half-equations in a lead–acid cell are shown in the table below.

Half-equation	$E^{\ominus}$ / V
$PbO_2(s) + 3H^+(aq) + HSO_4^-(aq) + 2e^- \longrightarrow PbSO_4(s) + 2H_2O(l)$	+1.69
$PbSO_4(s) + H^+(aq) + 2e^- \longrightarrow Pb(s) + HSO_4^-(aq)$	to be calculated

5 (e) (i) The $PbO_2/PbSO_4$ electrode is the positive terminal of the cell and the e.m.f. of the cell is 2.15 V.

Use this information to calculate the missing electrode potential for the half-equation shown in the table.

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(1 mark)

5 (e) (ii) A lead–acid cell can be recharged.
Write an equation for the overall reaction that occurs when the cell is being recharged.

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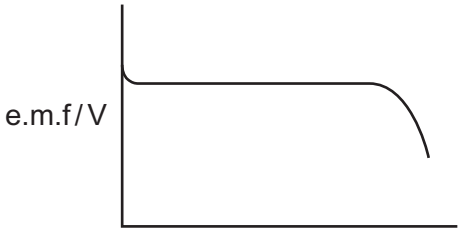
(2 marks)

Question 5 continues on the next page

Turn over ▶

5 (f) The diagrams below show how the e.m.f. of each of two cells changes with time when each cell is used to provide an electric current.

Lead–acid cell



Cell X

5 (f) (i) Give **one** reason why the e.m.f. of the **lead–acid cell** changes after several hours.

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(1 mark)

5 (f) (ii) Identify the type of cell that behaves like **cell X**.

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(1 mark)

5 (f) (iii) Explain why the voltage remains constant in **cell X**.

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(2 marks)

(Extra space) .....

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