Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A representation of a hydrogen–oxygen fuel cell that operates in alkaline conditions is

$$Pt|H_2|H_2O||O_2|OH^-|Pt$$

(a) (i) Write a half-equation for the reaction that occurs at each electrode.
Use the half-equations to deduce an overall equation for the cell.

Half-equation at positive electrode _____

Half-equation at negative electrode _____

Overall equation _____

(3)

(ii) State and explain the effect, if any, of increasing the pressure of oxygen on the e.m.f of this cell.

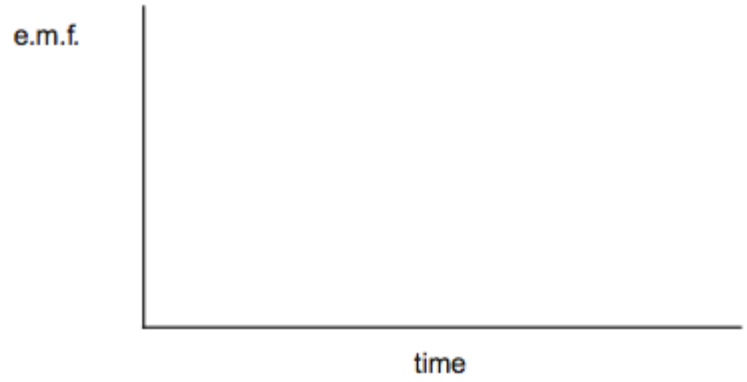
Effect on e.m.f. _____

Explanation _____

_____

(2)

(b) Complete the diagram to show how the e.m.f. of a hydrogen–oxygen fuel cell changes with time.



(1)

(c) (i) Suggest the effect, if any, on the e.m.f. of this cell if the surface area of each platinum electrode is increased.

_____

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(1)

(ii) State the main environmental advantage of using a hydrogen–oxygen fuel cell to power a car.

_____

_____

(1)

(d) Suggest why the use of a hydrogen–oxygen fuel cell might not be carbon-neutral.

_____

_____

_____

_____

(1)

(Total 9 marks)

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Q2.

The table shows some standard electrode potential data.

Electrode half-reaction	***E*°/V**
$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$	–0.76
$Co^{2+}(aq) + 2e^- \longrightarrow Co(s)$	–0.28
$\frac{1}{2}O_2(g) + 2H^+(aq) + 2e^- \longrightarrow H_2O(l)$	+1.23
$Au^+(aq) + e^- \longrightarrow Au(s)$	+1.68
$Co^{3+}(aq) + e^- \longrightarrow Co^{2+}(aq)/p>$	+1.82

(a) (i) Identify the weakest oxidising agent in the table.

_____

(1)

(ii) Give the conditions under which the electrode potential of the Zn^{2+}/Zn electrode is –0.76 V.

_____

_____

_____

(2)

(b) Two half-cells, involving species in the table, are connected together to give a cell with an e.m.f. = +0.48 V.

Use data from the table to deduce the conventional representation of this cell. Write the half-equation for the reaction that occurs at the negative electrode.

Conventional representation _____

_____

Half-equation _____

(3)

(c) Use data from the table to identify a cobalt species that can react with water.

Write an equation for the redox reaction that occurs and identify the oxidation product in the reaction.

Cobalt species _____

Equation _____

_____

_____

Oxidation product _____

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(3)

(d) Use data from the table to explain why gold jewellery is unreactive in moist air.

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

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