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

Q1.

This question is about cells.

(a) The half-equations for two electrodes that combine to make a non-rechargeable cell are

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ $E^o = -0.76$ V

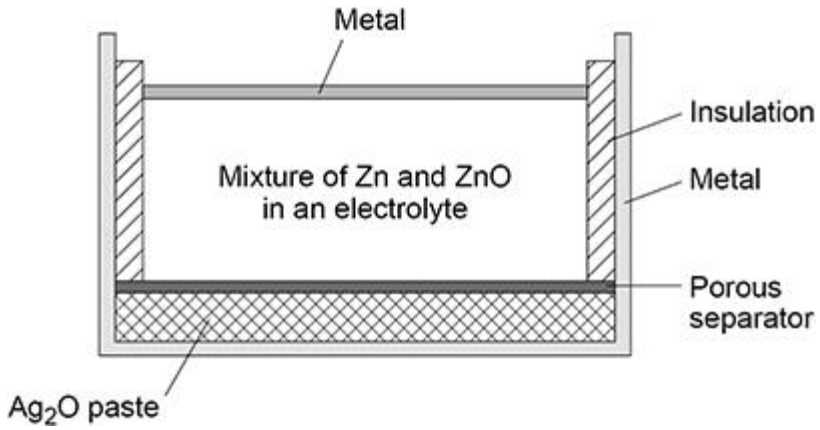
$2\ MnO_2(s) + 2\ NH_4^+(aq) + 2e^- \rightarrow Mn_2O_3\ (s) + 2\ NH_3(aq) + H_2O(l)$ $E^o = +0.52$ V

Identify the oxidising agent in this cell.

_____

(1)

The diagram below shows a cross-section through a rechargeable silver–zinc cell.



(b) Suggest the function of the porous separator in above diagram.

_____

(1)

(c) The standard electrode potentials for two half-equations for the silver–zinc cell are

$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2\ Ag(s) + 2\ OH^-(aq)$ $E^o = +0.34$ V

$ZnO(s) + H_2O(l) + 2e^- \rightarrow Zn(s) + 2\ OH^-(aq)$ $E^o = -1.26$ V

Give an equation for the overall reaction that occurs when the cell is recharging.

_____

(1)

Downloaded from www.merit-minds.com

The EMF of an alkaline hydrogen–oxygen fuel cell is +1.23 V
The standard electrode potential for one of the electrodes in the alkaline hydrogen–oxygen fuel cell is

$$2\ H_2O(l) + 2e^- \rightarrow 2\ OH^-(aq) + H_2(g) \qquad E^o = -0.83\ V$$

(d) Give the half-equation for the other electrode and calculate its standard electrode potential.

Equation

_____

E^θ _____

(2)

(e) Suggest why the EMF values of the acidic and alkaline hydrogen–oxygen fuel cells are the same.

_____

_____

(1)

(Total 6 marks)

Downloaded from www.merit-minds.com

Q2.

This question is about fuel cells.

In a methanol–oxygen fuel cell, the overall reaction is

$$CH_3OH(l) + 1\tfrac{1}{2}\ O_2(g) \text{ " } CO_2(g) + 2\ H_2O(l) \qquad EMF = +1.20\ V$$

(a) At the positive electrode, oxygen reacts with hydrogen ions to form water.

Give a half-equation for this reaction.

_____

(1)

(b) At the negative electrode, methanol reacts with water to produce carbon dioxide and hydrogen ions.

Give a half-equation for this reaction.

_____

(1)

(c) The standard electrode potential for the CO_2 / CH_3OH electrode is +0.03 V

Calculate the standard electrode potential for the O_2 / H_2O electrode.

_____

(1)

(d) State why a fuel cell does **not** need to be electrically recharged.

_____

_____

(1)

(e) Suggest **one** advantage of using methanol, rather than hydrogen, in a fuel cell for use in cars.

_____

_____

_____

(1)

(Total 5 marks)

Downloaded from www.merit-minds.com

Q3.

Which change to a hydrogen electrode has **no** effect on the electrode potential?

A the concentration of the hydrogen ions ⬭

B the pressure of the hydrogen ⬭

C the surface area of the platinum electrode ⬭

D the temperature of the acid ⬭

(Total 1 mark)

Downloaded from www.merit-minds.com

Q4.

Some electrode potential data are shown.

$Zn^{2+}(aq) + 2\ e^- \rightarrow Zn(s)$ $\quad E^\ominus = -0.76$ V

$Pb^{2+}(aq) + 2\ e^- \rightarrow Pb(s)$ $\quad E^\ominus = -0.13$ V

Which is a correct statement about this cell?

$$Zn(s)\,|\,Zn^{2+}(aq)\,\|\,Pb^{2+}(aq)\,|\,Pb(s)$$

A Electrons travel in the external circuit from zinc to lead. ⬭

B The concentration of lead(II) ions increases. ⬭

C The maximum EMF of the cell is 0.89 V ⬭

D Zinc is deposited. ⬭

(Total 1 mark)

Downloaded from www.merit-minds.com

Q5.

This question is about the development of lithium cells.
The value of E^{o} for lithium suggests that a lithium cell could have a large EMF.

The table below shows some electrode potential data.

	E^{o} / V
$Li^{+}(aq) + e^{-} \rightarrow Li(s)$	–3.04
$2\ H_2O(l) + 2\ e^{-} \rightarrow H_2(g) + 2\ OH^{-}(aq)$	–0.83
$\frac{1}{2}\ I_2(s) + e^{-} \rightarrow I^{-}(aq)$	+0.54

(a) Use data in the table above to explain why an aqueous electrolyte is **not** used for a lithium cell.

_____

_____

_____

(2)

(b) In the 1970s lithium-iodine cells became a common power source for heart pacemakers.
Lithium iodide is the final product of the cell reaction.
Use the data in the table above to calculate the cell EMF of a standard lithium-iodine cell.

_____

(1)

(c) An EMF value for a commercial lithium-iodine cell is 2.80 V
Suggest why this value is different from the value calculated in part (b).

_____

_____

(1)

(d) In some lithium cells, lithium perchlorate ($LiClO_4$) is used as the electrolyte.
Deduce the oxidation state of chlorine in $LiClO_4$

_____

(1)

In other lithium cells, lithium cobalt oxide electrodes **and** lithium electrodes are used.

(e) Give an equation for the reaction that occurs at the positive lithium cobalt oxide electrode.

_____

(1)

(f) Give an equation for the reaction that occurs at the negative lithium electrode.

_____

(1)

(Total 7 marks)

Downloaded from www.merit-minds.com