Electrode potentials and electrochemical cells – A2 2022 Chemistry P1
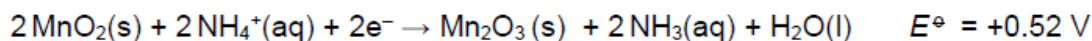
1. June/2022/Paper_7405/1/No.8

| 0 | 8 |

This question is about cells.
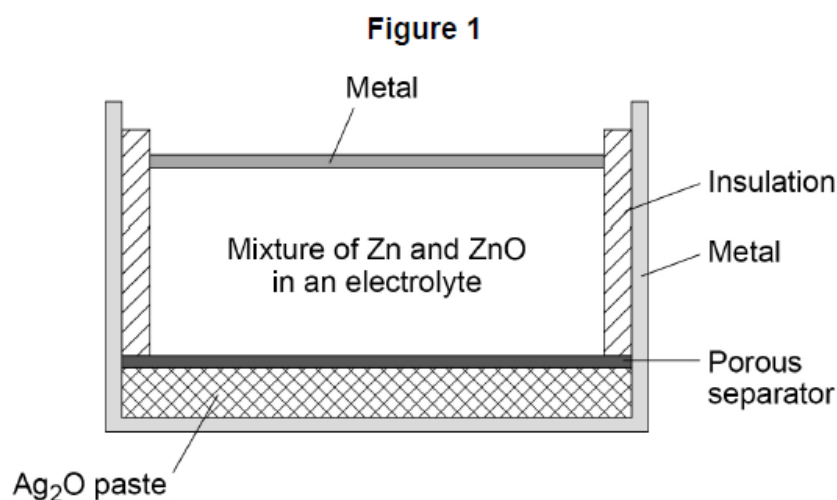
| 0 | 8 |.| 1 |

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

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

$$2MnO_2(s) + 2NH_4^+(aq) + 2e^- \rightarrow Mn_2O_3(s) + 2NH_3(aq) + H_2O(l) \qquad E^\ominus = +0.52 \text{ V}$$

Identify the oxidising agent in this cell.

[1 mark]

Figure 1 shows a cross-section through a rechargeable silver–zinc cell.
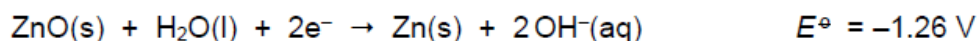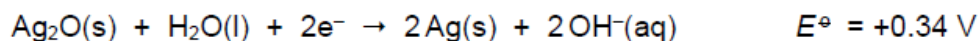
Figure 1

| 0 | 8 |.| 2 |

Suggest the function of the porous separator in **Figure 1**.

[1 mark]

| 0 | 8 |.| 3 |

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

$$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq) \qquad E^\ominus = +0.34 \text{ V}$$

$$ZnO(s) + H_2O(l) + 2e^- \rightarrow Zn(s) + 2OH^-(aq) \qquad E^\ominus = -1.26 \text{ V}$$

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

[1 mark]

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

$$2H_2O(l) + 2e^- \rightarrow 2OH^-(aq) + H_2(g) \qquad E^\ominus = -0.83 \text{ V}$$
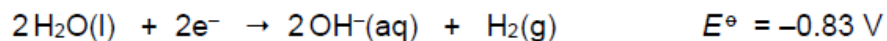
| 0 | 8 |.| 4 |

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

[2 marks]

Equation

_____

$E^\ominus$ _____

| 0 | 8 |.| 5 |

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

[1 mark]

_____

_____

2. June/2022/Paper_7405/3/No.11

Which change to a hydrogen electrode has **no** effect on the electrode potential?
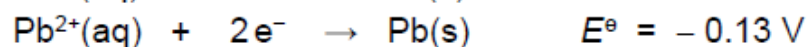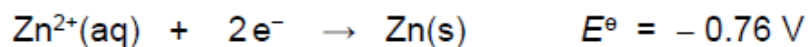
[1 mark]

A the concentration of the hydrogen ions ⬭

B the pressure of the hydrogen ⬭
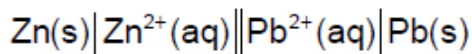
C the surface area of the platinum electrode ⬭

D the temperature of the acid ⬭

3. June/2022/Paper_7405/3/No.12

Some electrode potential data are shown.

$$Zn^{2+}(aq) \;+\; 2e^- \;\rightarrow\; Zn(s) \qquad E^{\ominus} = -0.76 \text{ V}$$
$$Pb^{2+}(aq) \;+\; 2e^- \;\rightarrow\; Pb(s) \qquad E^{\ominus} = -0.13 \text{ V}$$

Which is a correct statement about this cell?

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

[1 mark]

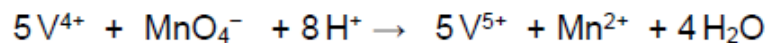A Electrons travel in the external circuit from zinc to lead. ⬭

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

C The maximum EMF of the cell is 0.89 V ⬭

D Zinc is deposited. ⬭

4. June/2022/Paper_7405/3/No.21

The reaction between vanadium(IV) ions and manganate(VII) ions in acidic solution can be represented by the equation

$$5V^{4+} + MnO_4^- + 8H^+ \rightarrow 5V^{5+} + Mn^{2+} + 4H_2O$$

What volume, in dm^3, of 0.020 mol dm^{-3} $KMnO_4$ is needed to oxidise 0.10 mol of vanadium(IV) ions completely?

[1 mark]

A 0.10 ⬭

B 0.50 ⬭

C 1.0 ⬭

D 5.0 ⬭