IB Chemistry: Batteries & Electrochemical Cells

Curated questions-only collection

Includes rechargeable batteries, fuel cells, voltaic/galvanic cells, electrolytic cells, standard electrode potentials and related electrochemistry.

In mixed-topic questions, clearly unrelated subparts were removed where possible while keeping context needed for the electrochemistry parts.

Markschemes and examiner reports are excluded.

Section 1 - Rechargeable Batteries & Fuel Cells

Dedicated C.6 questions plus direct rechargeable-battery questions from other units

Problems included: 19

Questions are extracted from the uploaded IB Chemistry problem collection.

Markschemes and examiner reports are not included in this questions-only edition.

Fuel cells may be twice as efficient as the internal combustion engine. Although fuel cells are not yet in widespread use, NASA has used a basic hydrogen-oxygen fuel cell as the energy source for space vehicles.

State the half-equations occurring at each electrode in the hydrogen-oxygen fuel cell in an alkaline medium.

(+) Cathode:

(–) Anode:

[2]

a.

Describe the composition of the electrodes and state the overall cell equation of the nickel-cadmium battery.

(+) Cathode:

(–) Anode:

Cell equation:

[3]

b.

Compare a fuel cell and a lead-acid battery, with respect to possible concerns about pollution of the environment.

[2]

c.

The high activity of lithium metal leads to the formation of an oxide layer on the metal which decreases the contact with the electrolyte in a battery.

Describe how this is overcome in the lithium-ion battery.

[2]
a.

Describe the migration of ions taking place at the two electrodes in the lithium-ion battery when it produces electricity.

Anode (–):

Cathode (+):

[2]
b.

Discuss **one** similarity and **one** difference between fuel cells and rechargeable batteries.

Similarity:

Difference:

[2]
c.

Rechargeable nickel-cadmium batteries are used in portable electrical equipment and emergency lighting.

The **discharge** process can be summarized by the equation below.

$$2NiO(OH)(s) + Cd(s) + 2H_2O(l) \rightleftharpoons 2Ni(OH)_2(s) + Cd(OH)_2(s)$$

State the change in oxidation number of the cadmium and deduce if it is acting as the positive or negative electrode during the discharge process.

[2]

a.

Identify a physical property of $Cd(OH)_2$ which allows this process to be reversed and the battery recharged.

[1]

b.

State the half-equations for the reactions taking place at the negative electrode (anode) and the positive electrode (cathode) in an alkaline hydrogen-oxygen fuel cell.

Negative electrode (anode):

Positive electrode (cathode):

[2]

a.

A different type of cell has the half-equation below.

$$Li^+(polymer) + MnO_2(s) + e^- \rightarrow LiMnO_2(s)$$

Identify this type of cell.

[1]
b.

Both fuel cells and rechargeable batteries offer great potential for the future. Compare these two power sources.

[2]
c.

Suggest **two** problems associated with using hydrogen gas in a fuel cell.

[2]
d.

Problem 2089 | |

Fuel cells convert chemical energy directly into electrical energy that can be used in applications ranging from spacecraft to remote weather stations.

Describe the composition of the electrodes in a hydrogen-oxygen fuel cell.

[1]
a.

State the half-equation at each electrode in the hydrogen-oxygen **alkaline** cell.

Positive electrode (cathode):

Negative electrode (anode):

[2]
b.