Engineering Chemistry

CO-1

Home Assignment - 1

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1) Given an account of the constitution, chemical reactions involved, merits, demerits, and applications of the following:

Ans) a) Dry cell

Construction: A dry cell is a primary battery, often used for small portable electronics. It typically consists of:

(i) Zinc case: Acts as the anode

(ii) Carbon rod: Acts as the cathode

(iii) Electrolyte paste: Mixture of ammonium chloride or zinc chloride, manganese dioxide, and powdered carbon for conduction.

(iv) Separator: Prevents direct contact between the zinc and manganese dioxide, allowing ions to pass.

Chemical reactions:

. Anode reaction (oxidation): $Zn \longrightarrow Zn^{2+} + 2e^-$

. Cathode reaction (reduction):

$$2MnO_2 + 2NH_4^+ + 2e^- \longrightarrow Mn_2O_3 + 2NH_3 + H_2O$$

Merits:

- Inexpensive and readily available
- Compact and easy to use in various devices.

[cont...]

Demerits:

- Limited lifespan and not rechargeable.
- voltage drops significantly as the cell discharges.

Applications:

- Commonly used in flashlights, remote controls, clocks, and other low-power devices.
- popular in applications where infrequent use is expected.

b) Lithium-Ion Battery:

Construction: A lithium-ion battery is a rechargeable battery with:

- Anode: Typically made of graphite or other carbon-based materials.
- Cathode: Made of lithium metal oxide.
- Electrolyte: Organic liquid electrolyte with lithium salts to allow ion movement.
- Separator: Porous powder that prevents direct contact between anode & cathode but allows ion flow.

Chemical Reactions:

The general reactions are:

- Charging (Lithium ion move from cathode to anode):

$$LiCoO_2 \longrightarrow Li_{1-x}CoO_2 + x\,Li^+ + xe^- \; xLi^+ + xe^- + C \longrightarrow Li_xC$$

- Discharge (Lithium ion move from anode to cathode)

$$Li_xC \longrightarrow xLi^+ + xe^- + C \; xLi^+ + xe^- + Li_{1-x}CoO_2 \longrightarrow LiCoO_2$$

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Merits:

- High energy density & lightweight, ideal for portable devices.
- Rechargeable, with hundreds to thousands of charge cycle.

Demerits:

- Can be expensive due to the complex manufacturing process.
- Overheating or damage may cause safety risks, including fires or explosions.

Applications:

- Widely used in mobile phones, laptops & electric vehicles.
- Also used in portable power tools and energy storage systems for renewable energy.