task_w3wf215v2u98ty07_with_calculation

Student Group

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Exercise E10 Efficiency
(written test, approx. 14 % of a 60-minute written test, SS2023)

A lithium-ion battery cell [illegible] **lowest possible efficiency**? V$. The battery shall provide energy for a mobile device with a load resistance of $R_\rm L=2~\Omega$. The following values are from the lithium-ion battery data sheet.

Result

Solution

$e=1.602 \cdot 10^{-19}~\rm C$.

Solution

- Internal impedance: [illegible]
- Maximum discharge current: $I_{\rm Dis max} = 3 ~\rm A$ \\ &= {{2
- \Omega}\over{2 ~\Omega + 0.05 ~\Omega}} \end{align*}
- Typical capacity: $2'600 ~\rm mAh$

Lowest efficiency for highest current, so for $I_{\rm Dis max}$. In this case, the efficiency is:

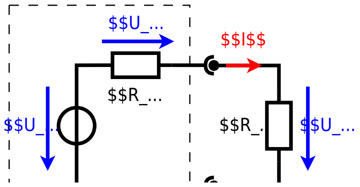
\end{align*}

1. Draw an **equivalent circuit diagram** with the internal resistance and an external load. Label all voltages and currents.

\begin{align*} n_{\rm Li^+} ={{Q}\over{q_\rm e}} \\ \\ Q &= 2.6 {~\rm Ah} \\ &= 2.6 \cdot 3600 {~\rm As} \\ &= 9360 {~\rm As} = 9360 {~\rm C} \end{align*}

\begin{align*} \eta &= {{U_\rm S - R_\rm i \cdot I_{\rm Dis max}}\over{U_\rm S}} \\ &= 1 - R_\rm i \cdot {{I_{\rm Dis max}}\over{U_\rm S}} \\ &= 1 - 0.05 {~\rm \Omega} \cdot {{3~\rm A}\over{3.5 ~\rm V}} \\ \end{align*}

Result



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