task_w3wf215v2u98ty07_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

efficiency, charges, power, exam ee1 SS2023

Exercise E17 Efficiency
(written test, approx. 14 % of a 60-minute written test, SS2023)

A lithium-ion battery ... $U_\rm S = 3.5 ~\rm V$. 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 datasheet:

- internal resistance ...
- Maximum discharge current: $I_{\rm Dis max} = 3 ~\rm A$
- Typical capacity: $2'600 ~\rm mAh$

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

Solution

Result

Solution

\begin{align*} ... &= {{2 ~\Omega}\over{2 ~\Omega + 0.05 ~\Omega}} \end{align*}

Lowest efficiency for highest current, so for ... in this case, the efficiency ...

\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