task_w3wf215v2u98ty07_with_calculation

Student Group

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efficiency, charges, power, exam ee1 SS2023

Exercise E1 Efficiency
(written test, approx. 14 % of a 60-minute written test, SS2023)

[illegible] V$. The battery shall provide energy for a
[illegible] $R_\rm L=2~\Omega$. The following values are from [illegible]
[illegible] $e=1.602 \cdot 10^{-19} ~\rm C$.

Result
Solution
Solution

- Internal resistance [illegible]
- Maximum discharge current: $I_{\rm Dis max} = 3 ~\rm A$
- Typical capacity: $2600 ~\rm mAh$

Solution

\begin{align*} I_{\rm Dis max} &= {U_\rm S}\over{R_\rm L + R_\rm i} \\ &= {{2 ~\Omega}\over{2 ~\Omega + 0.05 ~\Omega}} \end{align*}

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

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