

task_w3wf215v2u98ty07_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

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efficiency, charges, power, exam ee1 SS2023

Exercise E1 Efficiency

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

8. (14.00 Points) A battery with an open-circuit voltage $U_S = 3.5 \text{ V}$ and an internal resistance $R_i = 0.05 \Omega$ is connected to a load resistor $R_L = 2 \Omega$. The battery shall provide energy for a device with an load resistance of $R_L = 2 \Omega$. The following values are from the battery data sheet.

begin{align*} U_S &= 3.5 \text{ V} \\ R_i &= 0.05 \Omega \\ R_L &= 2 \Omega \end{align*}

Solution: (14.00 Points) With the circuit diagram (see below) we have:

• Verify: $U_S = 3.5 \text{ V}$ and $R_i = 0.05 \Omega$

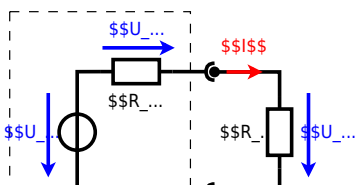
lowest efficiency for highest current (for $R_L = R_i$) in this case, the

.. Draw the equivalent circuit diagram with the internal resistance and an external load.

begin{align*} Q &= 2.6 \text{ Ah} \\ U_S &= 3.5 \text{ V} \\ R_i &= 0.05 \Omega \\ R_L &= 2 \Omega \end{align*}

begin{align*} \eta &= \frac{U_L \cdot I_{\text{Dis max}}}{U_S \cdot I_{\text{Dis max}}} \\ &= 1 - \frac{R_i}{R_L + R_i} \cdot \frac{I_{\text{Dis max}}}{U_S} \end{align*}

Result: $\eta = 1 - \frac{0.05 \Omega}{2 \Omega + 0.05 \Omega} \cdot \frac{3.5 \text{ V}}{3.5 \text{ V}} = 1 - 0.05 = 0.95$



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