Problem IV.1 ... discharging the battery 3 points; průměr 2,43; řešilo 100 studentů

Robert found out that he had to put 3 batteries with capacity $1\,000\,\text{mAh}$ and voltage $U = 1.5\,\text{V}$ into his new headlamp. In the headlamp, the batteries are connected in series. How long does it take for the batteries to discharge if they power a headlamp of output power $P = 5\,\text{W}$ and efficiency $\eta = 90\,\%$? *Robert's headlamp was not working.*

The information about the connection of the batteries in the headlamp is redundant. The voltage and capacity of the battery already give us information about the energy stored in the battery. We can calculate this energy as

$$W = UQ\,,$$

where Q is the capacity of the battery. The headlamp has an input power of $P_0 = P/\eta$. We can calculate the input power also as $P_0 = W/t$, where W is the energy in the batteries, and t is the time when the headlamp is on. We put these two expressions of input power into equivalence, and get

$$\frac{P}{\eta} = \frac{3UQ}{t}\,.$$

By modifying this equation, we get the formula

$$t = \frac{3UQ\eta}{P} \doteq 2\,920\,\text{s} \doteq 49\,\text{min}\,.$$

The batteries will give us about $49\,\text{min}$ of light.

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