1] Full Credit answer:

Power usage = time × power = 17 kWh → let E_{useful} = 17 kWh

Efficiency (\(\eta\)) = 72% = 0.72

Power input (P_{in}) = 580 W = 0.58 kW

\(E_{input} = P_{in} \times t \rightarrow \text{find } t\)

\(E_{useful} = \eta \cdot E_{input} = 0.72 \cdot P_{in} \cdot \frac{t}{t} = 0.72 \cdot 0.58 kW \cdot t\)

\[17 \text{ kWh} = t \cdot 0.72 \cdot 0.58 kW \rightarrow t = \frac{17 \text{ kWh}}{0.72 \cdot 0.58 kW} = 40.7088 \text{ hr}\]

\[t \approx 40.7 \text{ hours}\]

Partial Credit: (misunderstanding of how to use efficiency calculation, but clearly showed all work)

17,000 W·hrs × (0.72 efficiency) = 12,240 W·hrs actual

\[\frac{12,240 \text{ W·hrs}}{580 \text{ W}} = 21.034483 \text{ hrs} = 21.03 \text{ hrs}\]

2] Full Credit:

\[E_{\text{new}} = \frac{1}{2} \cdot Q_{\text{new}} \cdot v_{\text{new}} \cdot j_{\text{new}} = \frac{Q_{\text{old}}}{2} \cdot \frac{v_{\text{old}}}{j_{\text{old}}} \rightarrow V_{\text{new}} = \frac{Q_{\text{new}}}{C_{\text{new}}} = \frac{Q_{\text{old}}}{C_{\text{old}}} = \frac{1}{2} V_{\text{old}}\]

\[E_{\text{new}} = \frac{1}{2} \left(\frac{Q_{\text{old}}}{2}\right) \left(\frac{V_{\text{old}}}{2}\right) = \frac{1}{4} \cdot \frac{1}{2} Q_{\text{old}} V_{\text{old}} \quad \left(\text{by } E_{\text{old}}\right)\]

\[E_{\text{new}} = \frac{1}{4} E_{\text{old}} = \frac{1}{4} \cdot 8 \text{ J} = \boxed{2 \text{ J}}\]

Partial credit:

\[E_{\text{old}} = \frac{1}{2} \left(\frac{Q_{\text{old}}}{2}\right) = 8 \text{ J}\]

\[\frac{1}{2} \left(\frac{Q_{\text{old}}}{2}\right) = x \quad \text{dropped } 2\]

\[\frac{1}{8} \frac{Q_{\text{old}}}{2} = x\]

\[x = \frac{8}{4} = 2 \text{ J}\]

Low Credit: (work is confusing and doesn't show which equations are being used or what each number represents)

\[E = 8 \text{ J}\]

\[\left(\frac{1}{2}\right)^2 = \frac{1}{4} \rightarrow \frac{8}{4} = 2\]