Problem 27.35

a.) We know that $i = q/t$, so $q = it$ (units amp seconds or amp hours). That means, from what we are given, that:

$$q = it = 55\ \text{A} \bullet \text{h}$$

Using the definition of potential difference and current (q/t):

$$\Delta V \equiv \frac{\Delta U}{q} \quad \Rightarrow \quad \Delta U = q\Delta V \qquad \text{(units Joules=Coulombs} \bullet \text{volts)}$$

$$\begin{aligned} &= (it)\Delta V \\ &= (55\ \text{A} \bullet \text{h})(12.0\ \text{V}) \\ &= 660\ \text{A} \bullet \text{h} \bullet \text{V} \end{aligned}$$

Dimensionally:

$$i = q/t \Rightarrow 1 = \frac{\text{C}}{\text{A} \bullet \text{sec}}$$

$$\text{power} = \frac{\text{Work}}{\text{time}} \Rightarrow 1 = \frac{\text{Watt}}{\text{J}/\text{t}} \Rightarrow 1 = \frac{\text{W} \bullet \text{t}}{\text{J}}$$

$$V = U/q \Rightarrow 1 = \frac{\text{U}}{\text{qV}} \Rightarrow 1 = \frac{\text{J}}{\text{C} \bullet \text{V}}$$

a.) Using dimensional analysis:

$$\Delta U = (660\ A \bullet h \bullet V)\left(\frac{C}{A \bullet sec}\right)\left(\frac{J}{C \bullet V}\right)\left(\frac{1\ W \bullet sec}{J}\right)$$
$$= 660\ W \bullet h$$
$$= .660\ kW \bullet h$$

b.) at 11 cents per kW-hr, how much is the energy in the battery worth?

$$\text{cost} = (0.660\ kW \bullet h)\left(\frac{\$0.11}{kW \bullet h}\right)$$
$$= \$0.07$$