Changing a car battery

Battery capacity measured in Ah (e.g., 50 Ah for 1 hour)

What total energy can be supplied by a 12V, 50Ah battery if internal resistance = 0.5 Ω?

\[ P = \frac{\text{Work}}{\text{Time}} = \frac{W}{t} \Rightarrow W = Pt \]

but \( P = IV \) also,

So,

\[ W = Pt = (IV)t \]

\[ (50\text{A})(12V)(17.4 \times \frac{3600\text{s}}{1\text{h}}) \approx 2.59 \times 10^6 \text{J} \]

\[ W = 2.59 \times 10^6 \text{J} \]

What volume (in liters) of gasoline has a total combustion heat equal to part a energy?

Section 17-6/Thermodynamics, p. 660

Heat of combustion of gasoline is

\[ L_c = 4.6 \times 10^7 \text{J/kg} \]

What mass of gasoline needed to give off \( 2.59 \times 10^6 \text{J} \)?

\[ m_{\text{gas}} = \frac{\text{Total energy released}}{\text{energy/\text{kg of gas}}} = \frac{2.59 \times 10^6 \text{J}}{4.6 \times 10^7 \text{J/kg}} \]

\[ m_{\text{gas}} = 56 \text{g of gas} \]

May assume density of gasoline as \( \rho = 900 \text{kg/m}^3 \)

\[ \rho = \frac{\text{mass}}{\text{volume}} \Rightarrow V = \frac{m}{\rho} = \frac{56.0 \times 10^{-3} \text{kg}}{900 \text{ kg/m}^3} \]

\[ V = 6.22 \times 10^{-5} \text{m}^3 = 0.0622 \times \left(\frac{10^3 \text{m}^3}{1 \text{m}^3}\right) = 0.0622 \text{L} \]

Why?

\[ 1 \text{L} = 1000 \text{mL} = 1000 \text{cm}^3 = 1000 \times (10^{-2} \text{m})^3 = 1 \times 10^{-3} \text{m}^3 \]

\[ 1 \text{mL} = 1 \text{cm}^3 = 1 \times 10^{-3} \times (10^{-2} \text{m})^3 \]
If a generator with avg. electrical power output of 0.45 kW is connected to the storage battery, how long will it take to charge it fully?

\[ P = \frac{W}{t} \Rightarrow t = \frac{W}{P} \]

\[ W = 2.59 \times 10^6 \text{ J} \]

Convert this to kWh (kilowatt hours)

\[ 1 \text{ kWh} = 3.6 \times 10^6 \text{ J} \]

\[ \frac{2.59 \times 10^6 \text{ J}}{3.6 \times 10^6 \text{ J/kWh}} = 0.719 \text{ kWh} = 719 \text{ Wh} \]

52. \[ W = VI = (12 \text{ V})(60 \text{ Ah}) = 720 \text{ Wh} \]

\[ V \cdot \frac{C}{h} = \frac{5}{3} \text{ h} = Wh \]

\[ t = \frac{W}{P} = \frac{720 \text{ Wh}}{0.45 \text{ kW}} = \frac{720}{450} \text{ h} = 1.6 \text{ hr} \]

Units are so much fun!!