

Physics 111 Homework Set #9

- 1) An electric car is designed to run off a bank of 12 V batteries with a total energy storage of 20MJ. (a) If the motor draws 8kW, what is the current? (b) If $P=8\text{kW}$ as the car moves at 20m/s, how far will the car travel before it is out of "juice"?
- 2) A resistor is constructed by forming a material of resistance ρ into the shape of a hollow cylinder of length L , inner radius r_a and outer radius r_b . In use, a potential difference is applied between the ends of the cylinder producing a current parallel to the axis. (a) Find a general expression for the resistance of such a device. (b) Obtain a numerical value if $L=4\text{cm}$, $r_a=0.5\text{cm}$, $r_b=1.2\text{cm}$ and $\rho=2.5 \times 10^5 \Omega\text{m}$.
- 3) A small sphere that carries 8mC is whirled in a circle at the end of an insulating string. The rotation frequency is 100π rad/s. What average current does this rotating charge represent?
- 4) Suppose that the current through a conductor decreases exponentially in time as $I(t) = I_0 e^{-t/\tau}$. Consider a fixed observation point. (a) How much charge passes this point between $t=0$ and $t=\tau$, (b) between $t=0$ and $t=10\tau$, (c) between $t=0$ and $t=\infty$?
- 5) Eighteen gauge wire has a diameter of 1.024 mm. Calculate the resistance of 15m of 18 gauge copper wire at 20°C .
- 6) Aluminum and copper wires of equal length are found to have the same resistance. What is the ratio of the radii?
- 7) A current density of $6 \times 10^{-13} \text{A/m}^2$ exists in the atmosphere where the E-field is 100V/m. Calculate the conductivity σ in this region.
- 8) At 45°C the resistance of a segment of gold wire is 85Ω . When the wire is placed in a liquid bath, the resistance decreases to 80Ω . What is the temperature of the bath?
- 9) A particular type of battery is characterized as 360 A-hr, 12 Volt. What total energy can the battery deliver?