Home Work 5

5-1 In earth's lower atmospheric there are negative and positive ions, created by radioactive element's in the soil and cosmic rays from space. In a certain region, the atmospheric electric field strength is 120 V/m, directed vertically down. This field causes singly charged positive ions, 620 per cm^3, to drift downward and singly charged negative ions, 550 per cm^3, to drift upward (Fig 27-24). The measured conductivity is $2.70 \times 10^{-14}/\Omega \cdot m$. Calculate (a) the ion drift speed, assumed to be the same for positive and negative ions, and (b) the current density. (HRW26-30)

5-2 A resistor has the shape of a truncated right-circular cons (Fig. 27-25). The end radii are a and b, and the altitude is L. If the taper is small, we may assume that the current density is uniform across any cross section. (a) Calculate the resistance of this object. (b) Show that your answer reduce to ρ (L/A) for the special case of zero taper (that is, for a = b). (HRW26-35)

25.66 • **CALC** The region between two concentric conducting spheres with radii a and b is filled with a conducting material with resistivity ρ. (a) Show that the resistance between the spheres is given by

$$R = \frac{\rho}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$$

(b) Derive an expression for the current density as a function of radius, in terms of the potential difference V_{ab} between the spheres. (c) Show that the result in part (a) reduces to Eq. (25.10) when the separation $L = b - a$ between the spheres is small.

25.86 ••• **CALC** A source with emf $\mathcal{E}$ and internal resistance r is connected to an external circuit. (a) Show that the power output of the source is maximum when the current in the circuit is one-half the short-circuit current of the source. (b) If the external circuit consists of a resistance R, show that the power output is maximum when $R = r$ and that the maximum power is $\mathcal{E}^2/4r$.

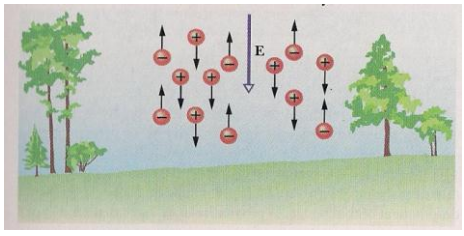

Fig 27-24

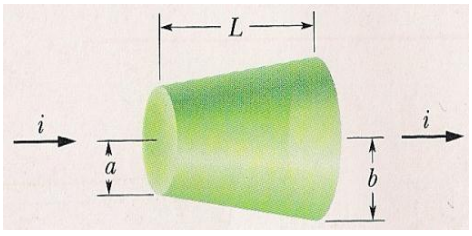

Fig 27-25