

8. (a) Since  $1 \text{ cm}^3 = 10^{-6} \text{ m}^3$ , the magnitude of the current density vector is

$$J = nev = \left( \frac{8.70}{10^{-6} \text{ m}^3} \right) (1.60 \times 10^{-19} \text{ C}) (470 \times 10^3 \text{ m/s}) = 6.54 \times 10^{-7} \text{ A/m}^2 .$$

- (b) Although the total surface area of Earth is  $4\pi R_E^2$  (that of a sphere), the area to be used in a computation of how many protons in an approximately unidirectional beam (the solar wind) will be captured by Earth is its projected area. In other words, for the beam, the encounter is with a “target” of circular area  $\pi R_E^2$ . The rate of charge transport implied by the influx of protons is

$$i = AJ = \pi R_E^2 J = \pi (6.37 \times 10^6 \text{ m})^2 (6.54 \times 10^{-7} \text{ A/m}^2) = 8.34 \times 10^7 \text{ A} .$$