

The Earth is receiving in the form of cosmic rays '9' protons per minute per cm<sup>2</sup> surface area. Compute the current received by the Earth due to the cosmic rays. The charge on a proton is  $1.6 \times 10^{-19}$  COULOMB and radius of earth is  $6.4 \times 10^6$  metre

### Solution

The current received by the Earth due to the cosmic rays  $I$ :

$$I = \oint \sigma ds,$$

where  $\sigma$  is the surface current density,  $ds$  is elementary surface and integration over surface area of the Earth.

The surface charge density is

$$\sigma = q \frac{dN}{dsdt} = 1.6 \times 10^{-19} * \frac{9}{60 * 10^{-4}} = 2.4 \times 10^{-16} \frac{C}{m^2 * s},$$

where  $q$  is the charge on a proton,  $\frac{dN}{dsdt}$  is number of protons per time per surface area.

So

$$I = \oint \sigma ds = \sigma S_{Earth} = \sigma * \frac{4}{3} \pi R^2 = \frac{4}{3} \pi * 2.4 \times 10^{-16} * (6.4 \times 10^6)^2 = 0.041 A \\ = 41 mA,$$

where  $S_{Earth}$  is the surface area of the Earth,  $R$  is radius of Earth.

**Answer: 41 mA.**