

452.

Problem 34.57 (RHK)

The magnetic dipole moment of the Earth is $8.0 \times 10^{22} \text{ J T}^{-1}$. We may assume that this is produced by charges flowing in the molten outer core of the Earth and that the radius of the circular path is 3500 km. We have to calculate the required current.

Solution:

The magnetic dipole moment of a current carrying closed planar loop is

$$\mu = iA,$$

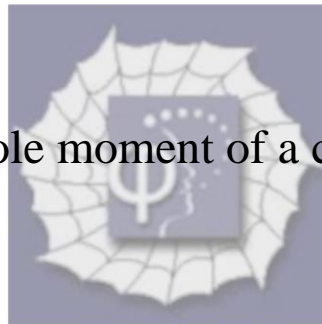
where i is the current flowing in the loop and A is the area enclosed by it.

As the magnetic dipole moment of the Earth,

$\mu_{\text{Earth}} = 8.0 \times 10^{22} \text{ J T}^{-1}$, and the area enclosed by the current loop

$$A = \pi \times (3500 \times 10^3)^2 \text{ m}^2,$$

the required current



$$i = \frac{8.0 \times 10^{22}}{\pi \times (3.5 \times 10^6)^2} \text{ A} = 2.078 \times 10^9 \text{ A} = 2.1 \text{ GA.}$$

