**(1)** An electron in an atom revolves around the nucleus in an orbit of radius 0.53 Å. Calculate the equivalent magnetic moment, if the frequency of revolution of electron is $6.8 \times 10^9$ MHz (Given : $e = 1.6 \times 10^{-19}$).

Soln

$r = 0.53 \times 10^{-10}$ m

$M_0 = ?$

$f = 6.8 \times 10^{15}$ Hz

$e = 1.6 \times 10^{-19}$ C

$$M_0 = \frac{evr}{2} = \frac{er}{2} \cdot \frac{2\pi r}{T} = \pi e r^2 f$$

$$= 3.142 \times 1.6 \times 10^{-19} \times (0.53 \times 10^{-10})^2 \times 6.8 \times 10^{15}$$

$$= 9.603 \times 10^{-24} \text{ Am}^2$$

(2) The electron in the hydrogen atom is moving with a speed at $2.3 \times 10^6$ m/s in an orbit of radius 0.53 Å. Calculate the magnetic moment of the revolving electron.

Soln:

$v = 2.3 \times 10^6 \text{ m/s}$

$r = 0.53 \times 10^{-10} \text{ m}$

$M_0 = 7$

$$M_0 = \frac{evr}{2} = \frac{1.6 \times 10^{-19} \times 2.3 \times 10^6 \times 0.53 \times 10^{-10}}{2}$$

$$= 9.752 \times 10^{-24} \text{ Am}^2$$

The space within a current carrying toroid is filled with tungston of susceptibility $6.8 \times 10^{-5}$. What is the percent increase in the magnetic field B ?

Soln

$$\chi = 6.8 \times 10^{-5}$$

$$\% \text{ change} = \frac{B - B_0}{B_0} \times 100$$

$$= \frac{\mu_0(1+\chi)H - \mu_0 H}{\mu_0 H} \times 100$$

$$= \chi \times 100$$

$$= 6.8 \times 10^{-3} \%$$

Find the magnetization of a bar magnet of length 5 cm and cross-sectional area 2 $cm^2$, if the magnetic moment is 1 $Am^2$.

Soln

$l = 0.05 m$

$A = 2 \times 10^{-4} m^2$

$M = 1 Am^2$

$$M_I = \frac{M}{Vol} = \frac{M}{A \times l}$$

$$= \frac{1}{2 \times 10^{-4} \times 0.05} = 10^5 A/m$$

(1) A circular coil of 300 turns and diameter 14 cm carries a current of 15A. What is the magnitude of magnetic moment associated with the coil?

(Ans : 69.27 $Am^2$)

(2) An electron in an atom revolves around the nucleus in an orbit of radius 0.5A. Calculate the equivalent magnetic moment, if the frequency of revolution of electron is $10^{10}$ MHz

(Ans : $1.257 \times 10^{-23}$ $Am^2$)

(3) Find the percent increase in the magnetic field B when the space within a current-carrying toroid is filled with aluminum. The susceptibility of aluminum is $2.1 \times 10^{-5}$.

(Ans. : $2.1 \times 10^{-3}$)

(4) A bar magnet made of steel has magnetic moment of 2.5 $Am^2$ and a mass of $6.6 \times 10^{-3}$ kg. If the density of steel is $7.9 \times 10^3$ $kg/m^3$, find the intensity of magnetization of the magnet.

(Ans : $3.0 \times 10^6$ A/m)

(5) The susceptibility of annealed iron at saturation is 5500. Find the permeability of annealed iron at saturation.

(Ans. : $6.9 \times 10^{-3}$)

(6) The susceptibility of magnesium at 300 K is $1.2 \times 10^{-5}$. At what temperature will the susceptibility increase to $1.8 \times 10^{-5}$ ?

(Ans : 200 K)

(7) The magnetic field B and the magnetic intensity H in a material are found to be 1.6 T and 1000 A/m respectively. Calculate the relative permeability '$\mu_r$' and the susceptibility '$\chi$' of the material ?

(Ans. : $1.273 \times 10^3$, 1272)