

41. If N closed loops are formed from the wire of length L , the circumference of each loop is L/N , the radius of each loop is $R = L/2\pi N$, and the area of each loop is $A = \pi R^2 = \pi(L/2\pi N)^2 = L^2/4\pi N^2$. For maximum torque, we orient the plane of the loops parallel to the magnetic field, so the dipole moment is perpendicular to the field. The magnitude of the torque is then

$$\tau = NiAB = (Ni) \left(\frac{L^2}{4\pi N^2} \right) B = \frac{iL^2 B}{4\pi N} .$$

To maximize the torque, we take N to have the smallest possible value, 1. Then $\tau = iL^2 B/4\pi$.