Answer on Question #75045, Physics / Electromagnetism

Question. The magnetic field at the centre due to motion of electron in first Bohr orbit is B. The magnetic field due to motion of electron in second Bohr orbit at the centre will be (1) $B/4$; (2) $B/8$; (3) $B/32$; (4) $B/64$.

Solution.

$$B = \frac{\mu_0}{4\pi} \cdot \frac{ev \sin 90^\circ}{r^2} = \frac{\mu_0}{4\pi} \cdot \frac{ev}{r^2}$$

But, for Bohr orbits the quantum condition is

$$mvr = \frac{nh}{2\pi} \quad or \quad v = \frac{nh}{2\pi mr}$$

$$B = \frac{\mu_0}{4\pi} \cdot \frac{enh}{2\pi m r^3},$$

where $r = 53 \cdot 10^{-12} n^2$.

$$B = \frac{\mu_0}{4\pi} \cdot \frac{enh}{2\pi m n^6 (53 \cdot 10^{-12})^3}.$$

So,

$$B \propto \frac{1}{n^5}$$

$$\frac{B}{B_2} = \frac{1}{1^5} : \frac{1}{2^5} \rightarrow \frac{B}{B_2} = 32 \quad \rightarrow \quad B_2 = \frac{B}{32}$$

Answer. (3) $B/32$.