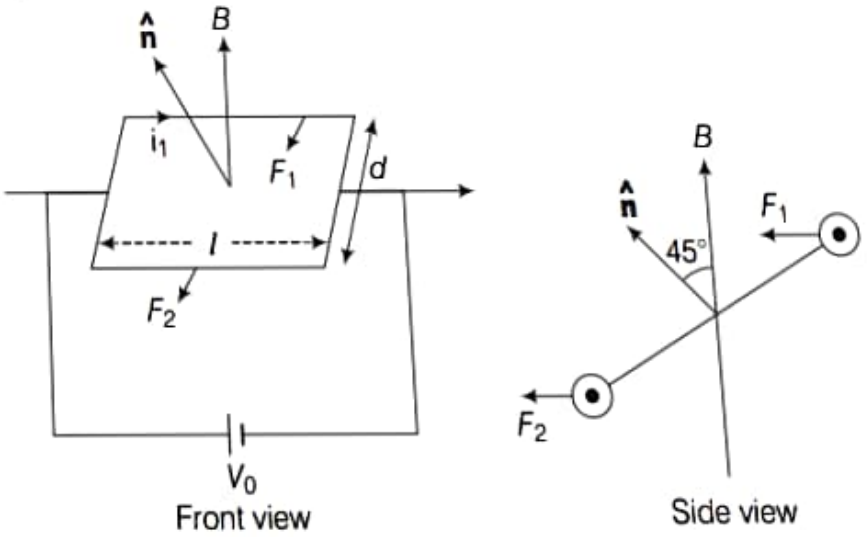
Q. 24 A rectangular conducting loop consists of two wires on two opposite sides of length l joined together by rods of length d. The wires are eachof the same material but with cross-sections differing by a factor of 2. The thicker wire has a resistance R and the rods are of low resistance, which in turn are connected to a constant voltage source V_0. The loop is placed in uniform a magnetic field **B** at 45° to its plane. Find τ, the torque exerted by the magnetic field on the loop about an axis through the centres of rods.

K **Thinking Process**

After finding current in both wires, magnetic forces and torques need to be calculated for finding the net torque.

Ans.



The thicker wire has a resistance R, then the other wire has a resistance $2R$ as the wires are of the same material but with cross-sections differing by a factor 2.

Now, the force and hence, torque on first wire is given by

$$F_1 = i_1 lB = \frac{V_0}{2R} lB,\ \tau_1 = \frac{d}{2\sqrt{2}} F_1 = \frac{V_0 ldB}{2\sqrt{2}R}$$

Similarly, the force hence torque on other wire is given by

$$F_2 = i_2 lB = \frac{V_0}{2R} lB,\ \tau_2 = \frac{d}{2\sqrt{2}} F_2 = \frac{V_0 ldB}{4\sqrt{2}\ R}$$

So, net torque, $\tau = \tau_1 - \tau_2$

$$\tau = \frac{1}{4\sqrt{2}} \frac{V_0 ldB}{R}$$