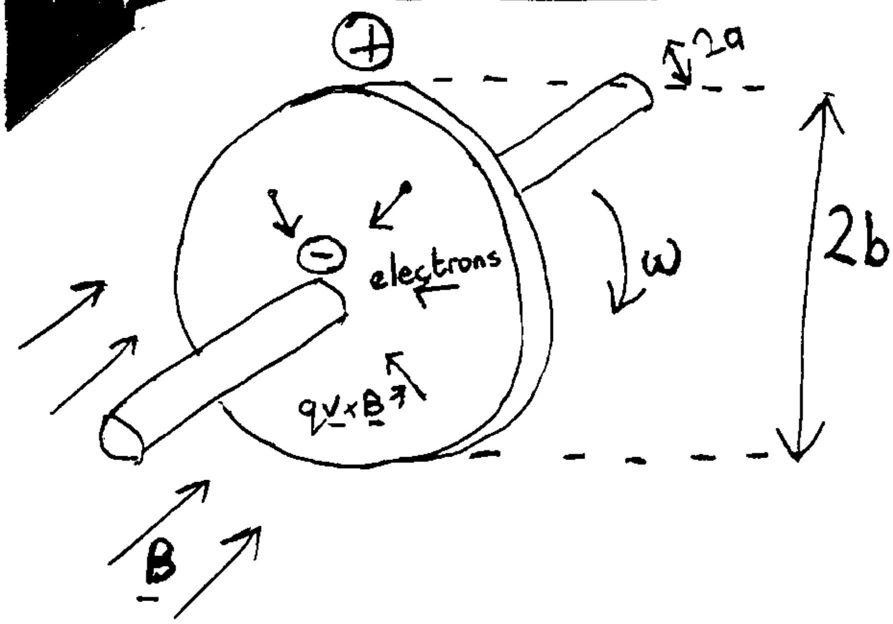
# Q2 Answer




The $q\underline{v}\times\underline{B}$ force on the electrons causes them to move in the direction shown (given the above $\underline{B}$ and rotation directions) and hence there is an induced $\underline{E}$ field which eventually discourages further movement in a radial direction.

At radius r the velocity of the electrons is

$$v = r\omega$$

magnetic force on electron is $F_m = q r \omega B$ ($\underline{v}$ and $\underline{B}$ are perpendicular)

In equilibrium this magnetic force is balanced by the electric force which has magnitude

$$F_e = q E(r) = q r \omega B$$

[Note – E is not uniform, it varies with r]

$$\therefore E(r) = r\omega B$$

The voltage appearing between the spindle and rim is thus given by

$$\int_a^b E(r)\,dr = \omega B \int_a^b r\,dr = \frac{\omega B}{2}\left[r^2\right]_a^b = \frac{\omega B}{2}(b^2 - a^2) = V_{oc}$$

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In this case,

$$V_{oc} = \frac{2\pi \times 2000 \times 1{\cdot}5}{60 \times 2}(0{\cdot}4^2 - 0{\cdot}03^2) = \underline{\underline{25\,V}}$$