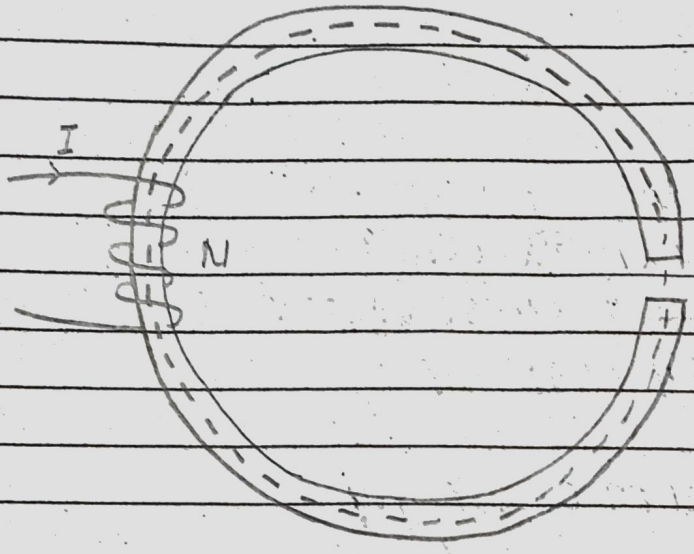
Numerical

Qn An iron ring of cross sectional area 6 cm^2 is wound with a wire of 100 turns and has a saw cut of 2 mm. Calculate the magnetizing current required to produce a flux of 0.1 mWb if mean length of magnetic path is 30 cm and relative permeability of iron is 470.



Soln, given,

$\phi = 0.1 \times 10^{-3}$ Wb

Area of cross-section = $6 * 10^{-4}\ m^2$

length of air gap = $2 * 10^{-3}$ m

no. of turns (N) = 100

μ_r of iron = 470

length of magnetic path = 30×10^{-2} m ↳ excludes air gap

To find,

I = ?

we have

$$AT_{total} = AT_{iron} + AT_{air\ gap}$$

For ampere turn of iron part,

$$AT_{iron} = NI$$
$$= Hl$$
$$= \frac{Bl}{\mu}$$
$$= \frac{\phi l}{\mu A}$$
$$= \frac{\phi l}{\mu_0 \mu_r A}$$
$$= \frac{0.1 \times 10^{-3} \times 30 \times 10^{-2}}{\mu_0 \times 470 \times 6 \times 10^{-4}}$$
$$= 84.6568 \text{ AT}$$

For ampere turn of air gap,

$$AT_{air\ gap} = \frac{\phi l_g}{\mu A}$$
$$= \frac{0.1 \times 10^{-3} \times 2 \times 10^{-3}}{\mu_0 \times 1 \times 6 \times 10^{-4}}$$
$$= 265.258 \text{ AT}$$

$\therefore AT_{total} = 349.9148 \text{ AT}$

Now,

$$I = \frac{AT_{total}}{N}$$

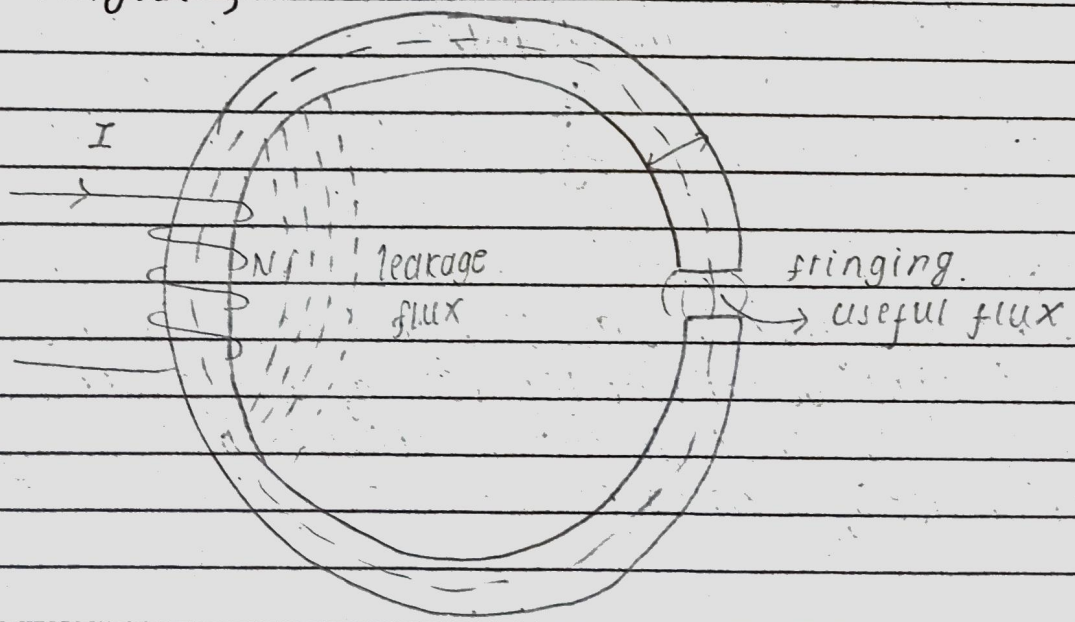
$$= \frac{349.9148}{100}$$

$$= 3.4991\ A$$

Hence, the magnetizing current is 3.4991 A.

Qn A circular iron ring has mean circumference 1.5 m and area of cross-section 0.01 m^2. A saw cut of 4 mm wide is made in the ring. Calculate the magnetizing current required to produce a flux of 0.8 m Wb in the air gap if the ring is wound with a coil of 175 turns. Relative permeability (μ_r) = 400 and leakage factor 1.25.

Soln, given,



leakage flux

The flux that does not flow the desired part in magnetic circuit is known as leakage flux.

In most of the case, a large part of flux flow through the magnetic circuit or magnetic material and some amount flow through the air. And the flux which flows through the air gap is known as useful flux, which is used for various useful purposes.

leakage factor

let ϕ_i be the total flux and ϕ_g be the flux in air gap

leakage flux $= \phi_i - \phi_g$

It is defined as the ratio of total flux to useful flux.

then,

$$\text{leakage factor } (\lambda) = \frac{\text{total flux}}{\text{useful flux}} = \frac{\phi_i}{\phi_g}$$

Note:

- leakage flux is undesirable because it increases the weight as well as the cost of the machine.
- Magnetic leakage can be reduced by placing the source of mmf near the air gap.

fringing

When magnetic lines of force (flux) crosses an air gap, the magnetic lines of force tends to repel each other due to which it bulge out in the air gap which is known as fringing.

soln, given,

$$\frac{\phi_i}{\phi_g} = 1.25$$