A toroid has a core (non-ferromagnetic) of inner radius 25 cm and outer radius 26 cm, around which 3500 turns of a wire are wound. If the current in the wire is 11 A, what is the magnetic field (a) outside the toroid, (b) inside the core of the toroid, and (c) in the empty space surrounded by the toroid.

Inner radius of the toroid, $r_1 = 25$ cm $= 0.25$ m

Outer radius of the toroid, $r_2 = 26$ cm $= 0.26$ m

Number of turns on the coil, $N = 3500$

Current in the coil, $I = 11$ A

(a) Magnetic field outside a toroid is zero. It is non-zero only inside the core of a toroid. (b) Magnetic field inside the core of a toroid is given by the relation,

$$B = \frac{\mu_0 NI}{l}$$

Where,

μ_0 = Permeability of free space = $4\pi \times 10^{-7}\ \mathrm{T\,m\,A^{-1}}$

l = length of toroid

$$= 2\pi\left[\frac{r_1 + r_2}{2}\right]$$

$$= \pi(0.25 + 0.26)$$

$$= 0.51\pi$$

$$\therefore B = \frac{4\pi \times 10^{-7} \times 3500 \times 11}{0.51\pi}$$

$$\approx 3.0 \times 10^{-2}\ \mathrm{T}$$

(c) Magnetic field in the empty space surrounded by the toroid is zero.