1. (a) Calculate the magnitude of the magnetic field created inside a toroid of \( N \) turns (a doughnut-shaped coil of current-carrying wire) carrying current \( I \) by using Ampere's law with loop 1. Do not look at your book while doing this.

\[
\oint \mathbf{B} \cdot d\mathbf{s} = \oint B \, ds = B \oint ds = B (2\pi r) = \mu_0 N I
\]

\[\rightarrow B = \frac{\mu_0 N I}{2\pi r}\]

(b) Calculate \( \oint \mathbf{B} \cdot d\mathbf{s} \) for loop 1 if it has a radius less than \( b \) or greater than \( c \) (which is not how it is drawn).

\( \oint \mathbf{B} \cdot d\mathbf{s} = 0 \) for these loops (they enclose no net current)

(c) If \( \oint \mathbf{B} \cdot d\mathbf{s} = 0 \) then what can you conclude about \( \mathbf{B} \) around the loops you used in (b)?

Not much, unfortunately. We definitely cannot conclude that \( \mathbf{B} = 0 \) on the loop.

\( \mathbf{B} \) might be perpendicular to the path, or the \( \mathbf{B} \) values might average to zero on the loop.

(d) Calculate \( \oint \mathbf{B} \cdot d\mathbf{s} \) for loop 2 in the figure. Is \( \mathbf{B} = 0 \) outside of the toroid?

Only \( I \) passes through loop 2

\( \oint \mathbf{B} \cdot d\mathbf{s} = \mu_0 I \)

So \( \mathbf{B} \) is definitely not zero outside the toroid.