Part of this week’s lab involves working with tightly-wrapped coils of wire, known as solenoids, which produce a magnetic field when current flows through them. Figure 1 shows an idealized solenoid as well as a sketch of the field it produces.

1. **(4 pts) Axial and Radial Field Components.** Imagine the detector in Figure 1 moving upward through points A, B, and C. Circle the correct answer to each of the following:

   a. (1 pt) At point A, is the radial component positive or negative?

   b. (1 pt) At point B, is the axial component positive, negative, or zero?

   c. (1 pt) At point B, is the radial component positive, negative, or zero?

   d. (1 pt) At point C, is the radial component positive or negative?
2. **(6 pts) Ampère’s Law.** This question explores the relationship between the strength of a magnetic field and the current which produces it.

   a. (1 pt) **Write** Ampère’s law as it’s given in your lab manual.

   To understand what this means, we imagine sliding the detector through a circular loop, following the field line, as in Figure 2. A (very) simplified plot of the detected axial component vs. the distance around the loop is shown in Figure 3.

   b. (2 pts) **Calculate** the area of the shaded region in Figure 3. *(Hint: Break the region into simple shapes, like triangles and rectangles.)*

   \[
   \text{Area under the curve} = \boxed{\text{G} \cdot \text{m}}
   \]
c. (1 pt) The solenoid carries 10 A of current and has 10 turns (you should NOT use this much current in the lab). Calculate $I_{enc}$, the current enclosed by the detector’s path.  
*Hint: Consider how many coils are inside the path and how much current flows through each coil.*

$$I_{enc} = \underline{\text{A}}$$

d. (2 pts) Ampère’s law tells us that the area you found above will be proportional to the current passing through the loop. Mathematically, we could say

$$\text{Area under the curve} = \mu_0 I_{enc},$$

where $\mu_0$ is a constant. Using the area you found in part (b) and enclosed current you found in part (c), calculate a value for $\mu_0$. Does your number agree with the value for $\mu_0$ given in the lab manual?