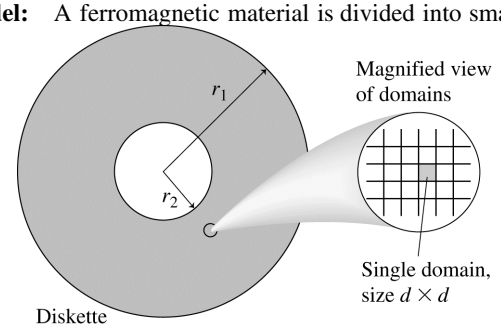
32.77. Model: A ferromagnetic material is divided into small regions called magnetic domains.

Visualize:



Solve: A diskette is measured with a ruler and found to have an outer radius $r_1 \approx 4.5$ cm and an inner radius $r_2 \approx 2.0$ cm. The area of one surface is

$$A_{\text{surface}} = \pi\left(r_1^2 - r_2^2\right) \approx 51 \text{ cm}^2 = 5.1 \times 10^{-3} \text{ m}^2$$

Each side stores ≈ 500,000 bytes, each of 8 bits. This is $N = 4 \times 10^6$ bits of data. Each bit needs one magnetic domain, so the area of each domain is

$$A_{\text{bit}} = \frac{A_{\text{surface}}}{N} = \frac{5.1 \times 10^{-3} \text{ m}^2}{4 \times 10^6} \approx 1.3 \times 10^{-9} \text{ m}^2$$

If each domain is square and of size $d \times d$, then

$$A_{\text{bit}} = d \times d \Rightarrow d = \sqrt{A_{\text{bit}}} \approx 3.6 \times 10^{-5} \text{ m} = 0.036 \text{ mm}$$

Assess: Your answer may differ somewhat, depending on the assumptions you made, and it will depend on the distance between the domains. This result is consistent with the estimate of 0.1 mm for the size of domains given in Section 32.10.