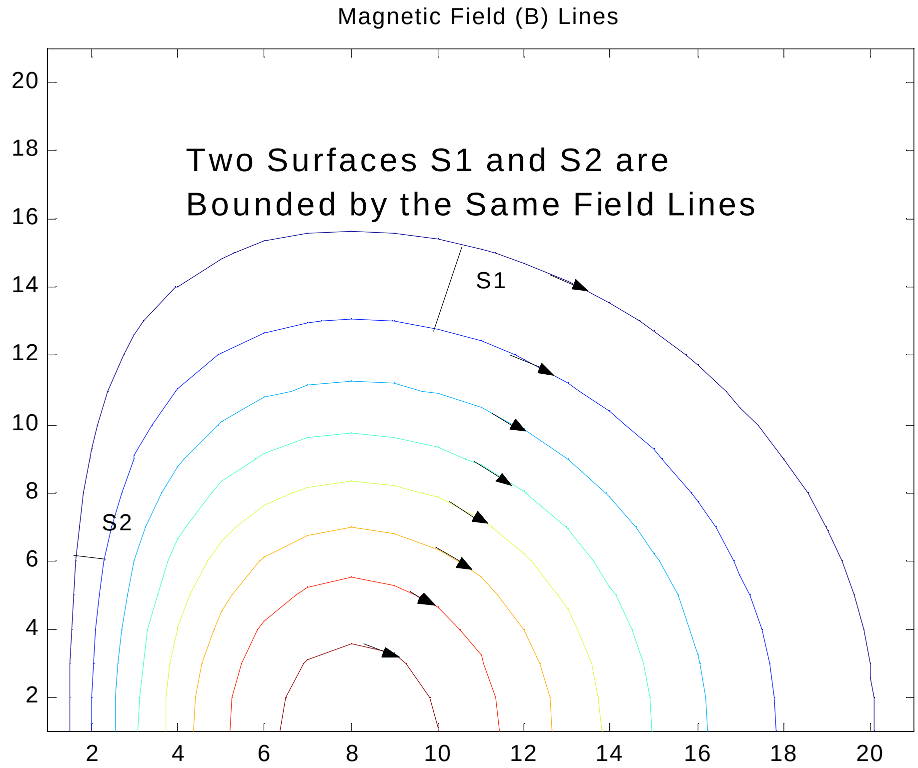
Flux and magnetic vector potential, **A**

Reading assignment

Popović and Popović, 12.4 – 19.8 (through Eqn. 19.52)
Connor and Salon VI-13 → VI-17, VII-19 → VII-21

Problem 1 - Flux

If the flux through surface S_1 in the figure below is 10^{-5} Webers, what is the flux through surface S_2?



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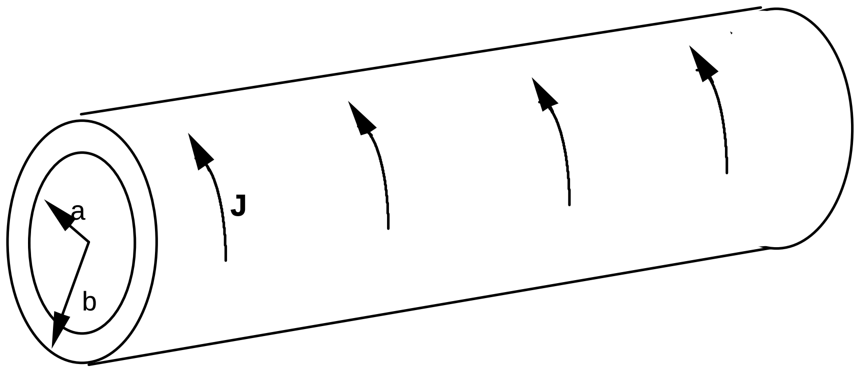
Problem 2 - Flux and magnetic vector potential

Take the same solenoid as used last class. The current density, $\mathbf{J} = J_0\, \mathbf{a}_\varphi$ for $a < r < b$ and is 0 everywhere else. In the previous class, we found that

$$\mathbf{B} = \begin{cases} \mu_0 J_0 (b - a)\, \mathbf{a}_z & \text{for } r \le a \\ \mu_0 J_0 (b - r)\, \mathbf{a}_z & \text{for } a \le r \le b \\ 0 & \text{for } b \le r. \end{cases}$$



a. Calculate the flux of **B** through a circle of radius a using $\psi = \int \mathbf{B} \bullet \mathbf{ds}$.

b. Show that $\mathbf{B} = \nabla \times \mathbf{A}$ if the magnetic vector potential, **A** is given by:

$$\mathbf{A} = \begin{cases} \mu_0 J_0 (b - a)\, r / 2\, \mathbf{a}_\varphi & \text{for } r \le a \\ \mu_0 J_0 (r\, b/2 - r^2/3 - a^3/6r)\, \mathbf{a}_\varphi & \text{for } a \le r \le b \\ \mu_0 J_0 (b^3 - a^3)/ 6r\, \mathbf{a}_\varphi & \text{for } b \le r \end{cases}$$

c. Calculate $\oint \mathbf{A} \bullet \mathbf{dl}$ around a circle of radius a.
Compare your answer with part a.