Reading assignment
Paul, Whites, and Nasar, 4.2 -> 4.4 (emphasis on 4.4)

Software
div_curl_example.m

Problem 1 - Magnetic field properties
Run div_curl_example.m. Which of the fields shown are possible magnetic fields? Which are possible electrostatic fields?

Problem 2 - Symmetry
Three standard geometries for analytical magnetostatic calculations are shown below.

a. Use the right hand rule (thumb along the current direction, fingers for B) and determine the direction of B in each case.
b. All 3 geometries can best be analyzed in cylindrical coordinates. For each, determine whether B is a function of r, φ, and/or z.
(Example from electric fields, E of cylindrically symmetric charge is only a function of r.)

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Coaxial cable
I is in z direction

Solenoid
I is in φ direction

Toroid
I wraps around core
Problem 3 - Ampere's Law

A long solenoid has a current density of \( J = J_0 a \phi \) for \( a < r < b \) and is 0 everywhere else. Ignore end effects.

a. Find the magnetic flux density, \( B \) for \( r < a \). Be sure to sketch the line integral paths you use. Assume \( B = 0 \) for \( r > b \).

b. Check your answer to part a. by evaluating \( \nabla \cdot B \) and \( \nabla \times B \).

c. Find \( B \) for \( a < r < b \). Sketch the line integral path you use.

d. Check your answer to part c. by evaluating \( \nabla \cdot B \) and \( \nabla \times B \).

e. Plot \( B_z \) vs \( r \).

f. Show that \( B = 0 \) for \( r > b \).