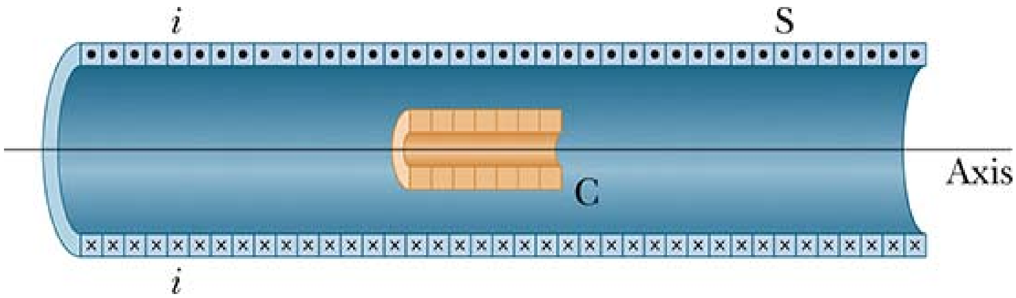
Phyx 135-2, Fall 2016, Quiz #5 **Name** ________________________________
Section 01 (10 am)



1) The schematic at right shows a small solenoid C which is inside a larger solenoid S. You may assume that S has an infinite length. Solenoid S has a radius of 5 cm, and has 4000 turns of wire per meter. Solenoid C has a radius of 2 cm, and 3000 turns of wire per meter. Solenoid C is one meter long.

1a) (3 points) If I send a constant current of 10 amps through the wire for solenoid S, what is the strength of the magnetic field at any point outside the cylinder?

Answer: Zero, because the B field outside an infinite solenoid is always zero.

1b) (3 points) What is the strength of the magnetic field at any point inside cylinder S?

Answer: $B = \mu_o in = (4\pi \text{ x } 10^{-7})(10)(4000) =$ 0.05 T

1c) (3 points) What is the magnitude of the magnetic flux through solenoid C?

Answer: $\Phi = BA = (0.05)\pi(0.02)^2 =$ $6.3 \text{ x } 10^{-5}$ T m^2

1d) (3 points) What is the magnitude of the induced emf in solenoid C?

Answer: Zero, because the magnetic flux is not changing in this case.

2) Suppose I have the same arrangement of cylinders as in Problem 1. Then, I suddenly begin changing the current running through solenoid S at a constant rate of 10 amps per second.

2a) (4 points) What is the inductance per meter of solenoid S?

Answer: $L / l = \mu_o n^2 A = (4\pi \text{ x } 10^{-7})(4000)^2 \pi(0.05)^2 =$ 0.158 henry/m

2b) (4 points) What is the magnitude of the induced emf in solenoid C?

Answer: $\mathcal{E} = N\, d\Phi/dt = N\, d(BA)/dt = N\, d(\mu_o in\, A)/dt = N\, \mu_o nA(di/dt) =$
$(3000)(4\pi \text{ x } 10^{-7})(4000)\pi(0.02)^2(10) =$ 0.19 volt