

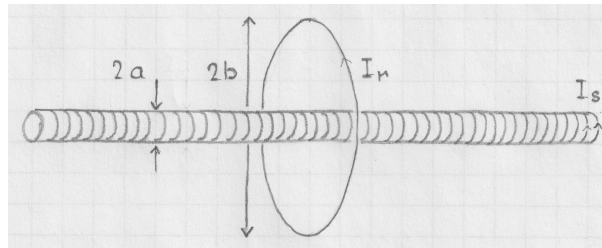
[lex86] Mutual inductance of solenoid and ring

Consider a very long solenoid of radius a and a winding wire with n turns per unit length positioned at the center of a conducting ring of radius b and oriented perpendicular to the plane of the ring as shown.

(a) Calculate the mutual inductance $M_{rs} \doteq \Phi_B^{(rs)}/I_s$, where $\Phi_B^{(rs)}$ is the magnetic flux through the ring caused by a current I_s in the solenoid.

(b) Calculate the mutual inductance $M_{sr} \doteq \Phi_B^{(sr)}/I_r$, where $\Phi_B^{(sr)}$ is the sum of magnetic flux through all turns of the solenoid caused by a current I_r in the ring.

Assumptions: (i) the radius of the ring is much larger than the radius of the solenoid, $b \gg a$; (ii) the length l of the solenoid is much larger than the radius of the ring, $l \gg b$. Consistent approximations will maintain the exact symmetry, $M_{rs} = M_{sr}$.



Solution: