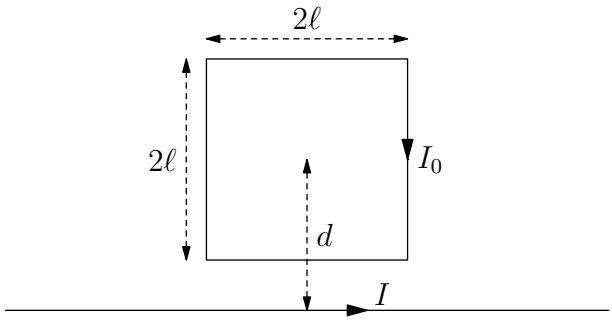
M06E.2 - Superconducting Loop

Problem

A current I_0 flows in a superconducting square loop of side 2ℓ and self-inductance L. An infinite wire, initially carrying no current, is in the plane of the loop at a distance $d > \ell$ from its center. When a current I is switched on in the wire, in the direction as indicated in the figure, a force between the loop and wire results.



a) Find the range of values of I for which the force is attractive.

b) For which value of I is the attractive force a maximum?

c) Calculate the maximum attractive force.