73. Letting the current in solenoid 1 be i, we calculate the flux linkage in solenoid 2. The mutual inductance, then, is this flux linkage divided by i. The magnetic field inside solenoid 1 is parallel to the axis and has uniform magnitude $B = \mu_0 i n_1$, where n_1 is the number of turns per unit length of the solenoid. The cross-sectional area of the solenoid is πR_1^2. Since $\vec{B}$ is normal to the cross section, the flux here is

$$\Phi = AB = \pi R_1^2 \mu_0 n_1 i \ .$$

Since the magnetic field is zero outside the solenoid, this is also the flux through a cross section of solenoid 2. The number of turns in a length ℓ of solenoid 2 is $N_2 = n_2 \ell$, and the flux linkage is

$$N_2 \Phi = n_2 \ell \pi R_1^2 \mu_0 n_1 i \ .$$

The mutual inductance is

$$M = \frac{N_2 \Phi}{i} = \pi R_1^2 \ell \mu_0 n_1 n_2 \ .$$

M does not depend on R_2 because there is no magnetic field in the region between the solenoids. Changing R_2 does not change the flux through solenoid 2, but changing R_1 does.