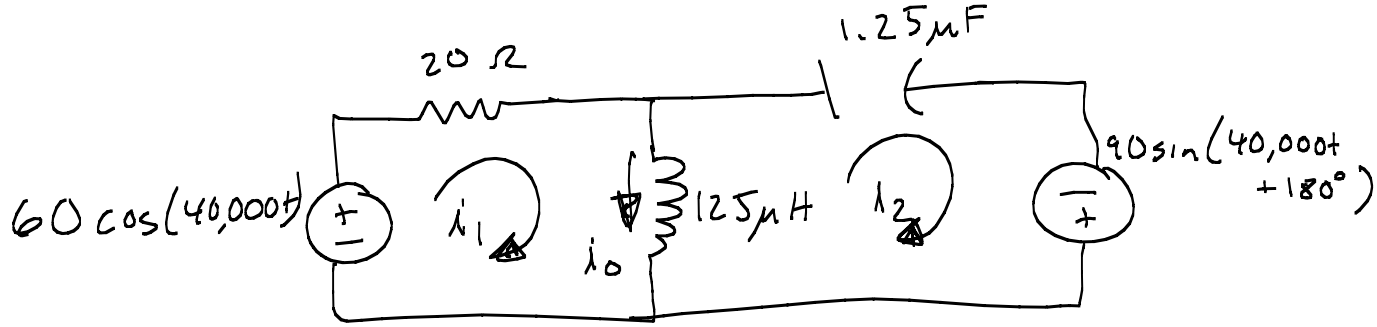
Problem 2

Determine i_o



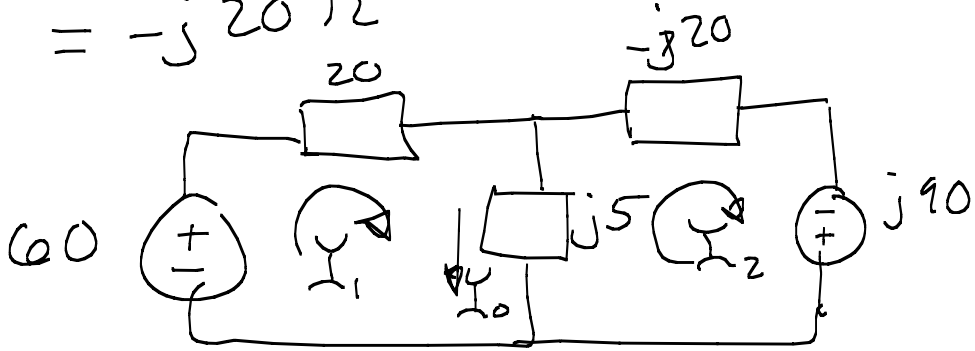
$$60\angle 0^\circ = 60 + j0$$

$$90\sin(40{,}000t + 180) = 90\cos(40{,}000t + 90^\circ)$$

$$90\angle 90^\circ = j90$$

$$Z_L = j\omega L = j(40{,}000)(125\times10^{-6}) = j5\,\Omega$$

$$Z_C = \frac{-j}{\omega C} = \frac{-j}{(40{,}000)(1.25\times10^{-6})} = -j20\,\Omega$$



Mesh 1

$$-60 + 20I_1 + j5(I_1 - I_2) = 0$$

$$\boxed{I_1(20 + j5) - j5I_2 = 60}$$

Mesh 2

$$j5(I_2 - I_1) - j20(I_2) - j90 = 0$$

$$j5I_2 - j5I_1 - j20I_2 - j90 = 0$$

$$\boxed{I_1 = -(18 + 3I_2)}$$

$$-(18 + 3I_2)(20 + j5) - j5I_2 = 60$$

$$I_2 = \frac{-420 - j90}{60 + j120}$$

$$\boxed{I_2 = -6.75 + j0.75 \text{ A}}$$

$$I_1 = -(18 + 3I_2) = \boxed{2.25 - j2.25}$$

$$I_0 = I_1 - I_2 = 9 - j3 = 9.49 \angle -18.43^\circ \text{ A}$$

$$\boxed{i_0 = 9.49 \cos(40{,}000t - 18.43^\circ) \text{ A}}$$