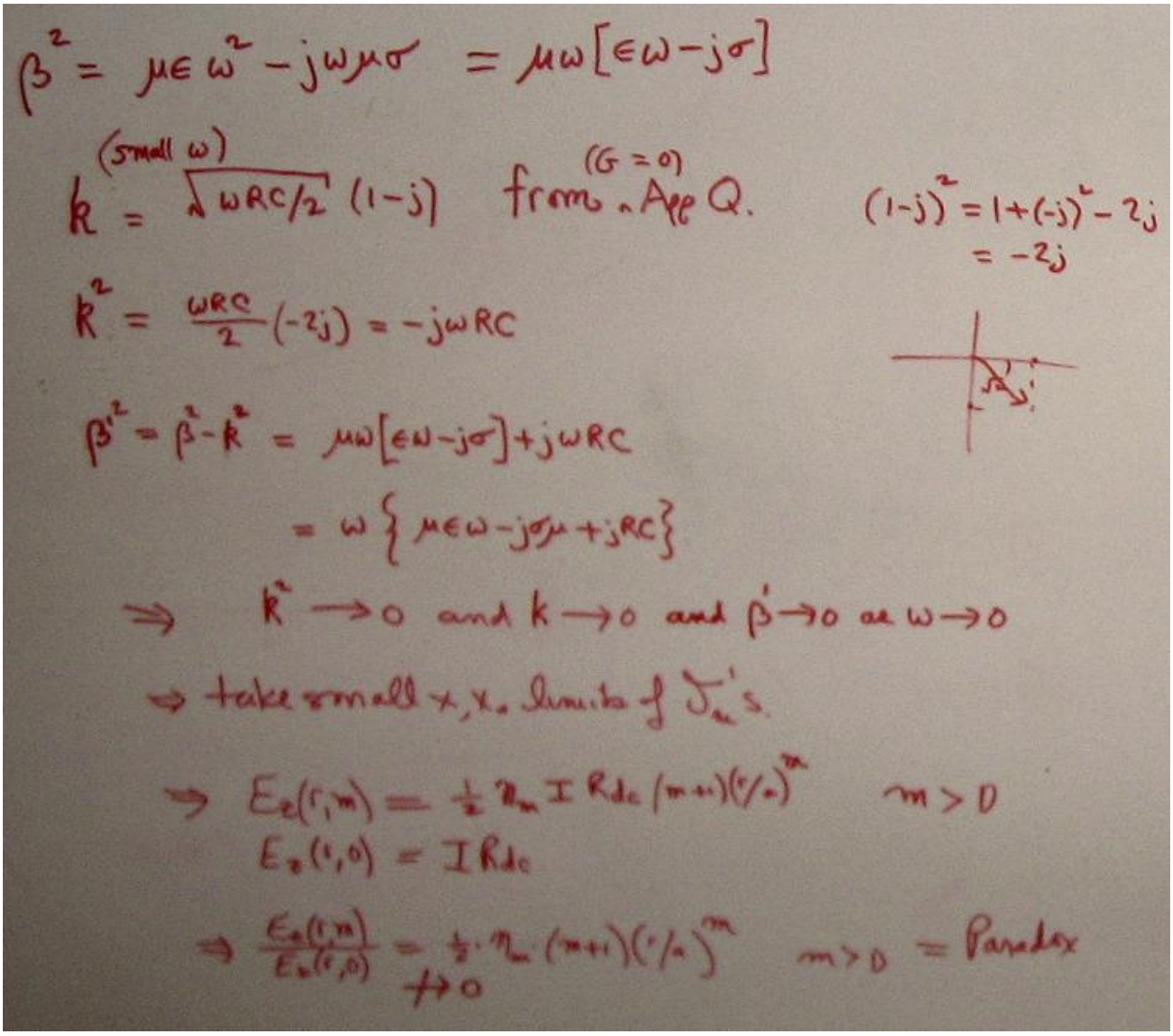
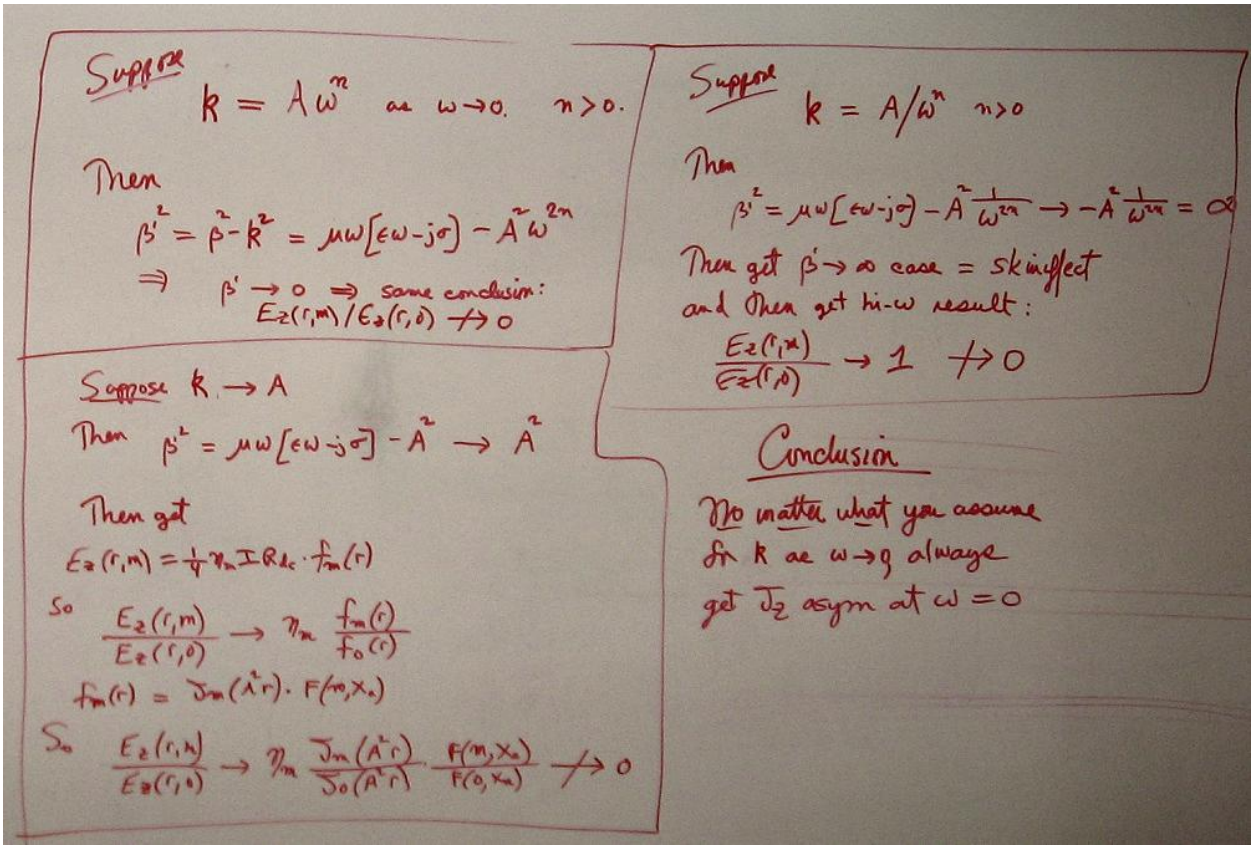
Whiteboard Regarding Asymmetry of J_z PhL photo 8.6.14

First part is this: (left side of photo) // an earlier whiteboard display.



This shows with standard form for k that as ω→0, all three objects β,k,β' → 0. Since β'→0, we use the small arg limits of the Bessel functions in f_m and we end up with the ratio on the bottom not approaching 0, and this is our anomaly or paradox. It means the E_z and J_z current distribution is asymmetric even when ω = 0, and we think this strange since we expect naively that J_z should be a constant at ω = 0.

Next, we make different assumptions about what happens to k as ω → 0. The assumptions here are different power possibilities:



Correction: on top right, should say $\to \eta_m$ instead of $\to 1$, but conclusion is the same.

I show three different possibilities. In each case, however, one finds again that that ratio does not $\to 0$ and we end up with J_z asymmetry. In the first case above, we again get $\beta' \to 0$ so can use the Bessel function limits as previously. In the last two cases, we are stuck with ratios of f_m as shown, but in general these ratios also do not $\to 0$, so the conclusion remains as stated on the lower right.

The point is this: regardless of how k behaves near $\omega = 0$, we always get J_z asymmetry.

Having written D.11 on this limit, I am less concerned about it now. If G = 0, the current charges the caps along the line, and as $\omega \to 0$, the caps are still there and still need charging and discharging. Since $n(\theta)$ is asym, so is J_r to charge and discharge, and then through div E = 0 we find J_z is also asym. It just happens that once ω is small enough, the shape of the asym becomes constant, as shown in D.11. I originally through that this shape should gradually approach a constant, but that is not what happens! Also, this is not the eddy current problem with two cylinders with a short and one end.

// However, I later constructed this shorted two-cylinder problem (see "Plan C Revised") and it too has this same asymmetry of J_z.