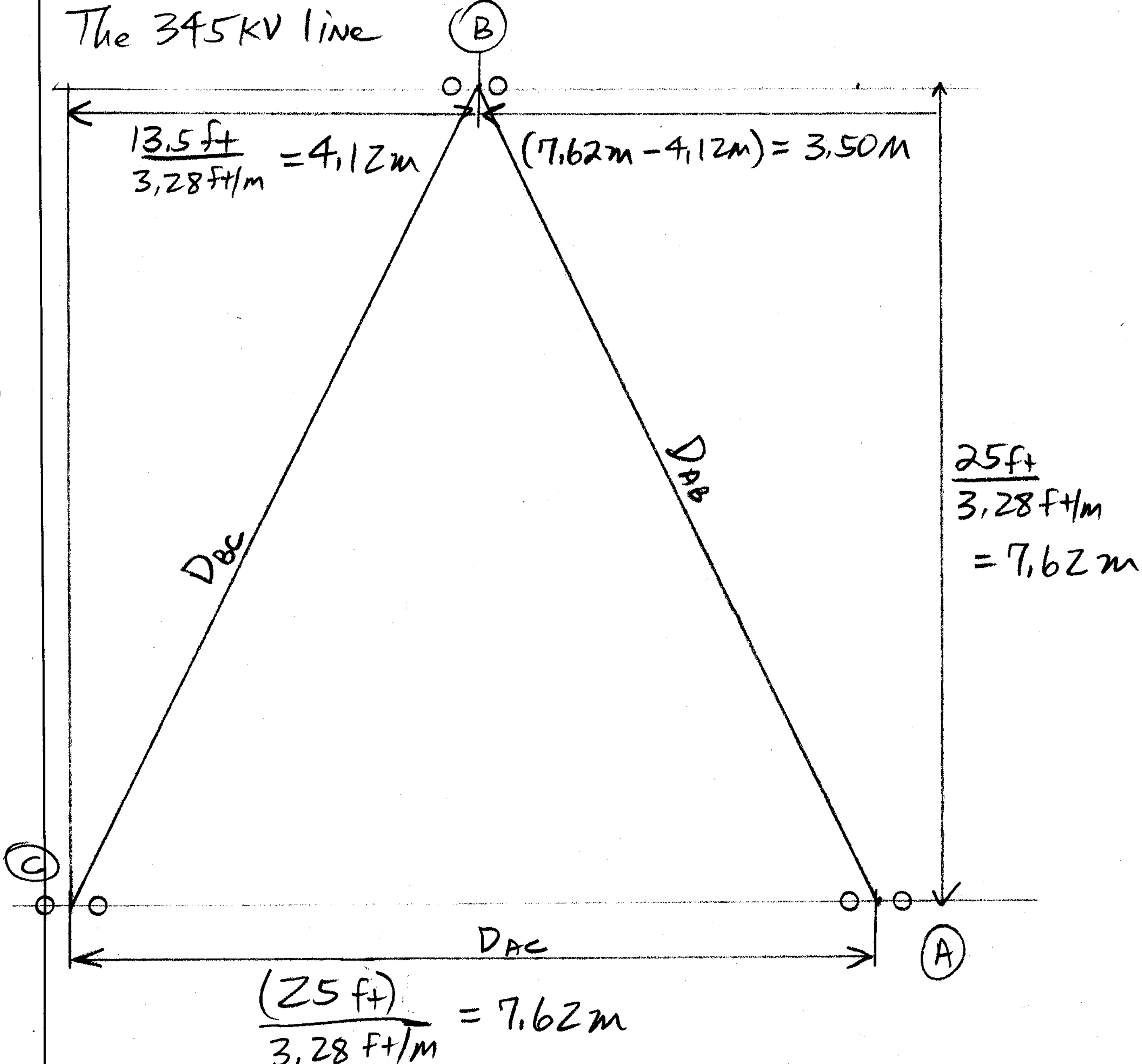
HW#3

The 345KV line

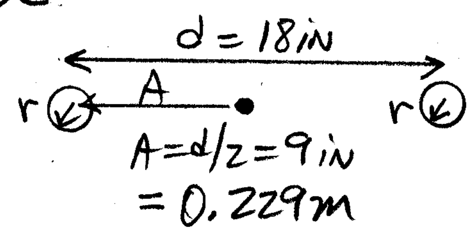


$D_{AC} = 7.62m$, $D_{BC} = \sqrt{4.12^2 + 7.62^2} = 8.66m$

$D_{AB} = \sqrt{7.62^2 + 3.50^2} = 8.39m$. $GMD_{+/-} = \sqrt[3]{D_{AB} D_{AC} D_{BC}}$

$GMD_{+/-} = \sqrt[3]{(7.62)(8.66)(8.39)} = 8.21\ m$

Now, the phase bundles



$r = 1.407cm$

$r_{gmr} = 1.137cm$

$$GMR_{C+/-} = \sqrt[2]{2rA^{2-1}} = \sqrt[2]{(2)(0.01407)(0.229)} = 0.0803\,m$$

$$C_{+/-} = \frac{2\pi\epsilon_0}{\ln\frac{GMD_{+/-}}{GMR_{C+/-}}} = \frac{2\pi(8.854)}{\ln\frac{8.21}{0.0803}} = \boxed{12.02\ pF/m}$$

$$\ln\frac{8.21}{0.0803} = 4.63$$

For $R_{+/-}$, we have two conductors per phase,

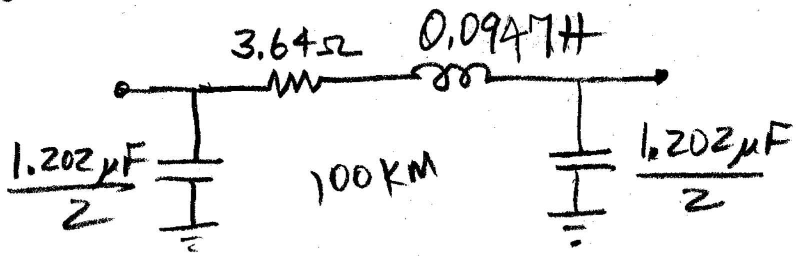
so $$R_{+/-} = \frac{0.0728\,\Omega/km}{2} = 0.0364\,\Omega/km = \boxed{3.64\times10^{-5}\,\Omega/m}$$

For $L_{+/-}$, use $L_{+/-} = \frac{\mu_0}{2\pi}\ln\frac{GMD}{GMR_{L+/-}}$

$$L_{+/-} = \frac{4\pi\times10^{-7}}{2\pi}\ln\frac{8.21}{\sqrt[2]{(2)(r_{gmr})(A)}} = 0.2\ln\frac{8.21}{\sqrt[2]{(2)(0.01137)(0.229)}}\ \mu H/m$$

$$\boxed{L_{+/-} = 0.947\ \mu H/m}$$

So, the +/- lumped parameter for a 100 km line ($10^5\,m$) would be



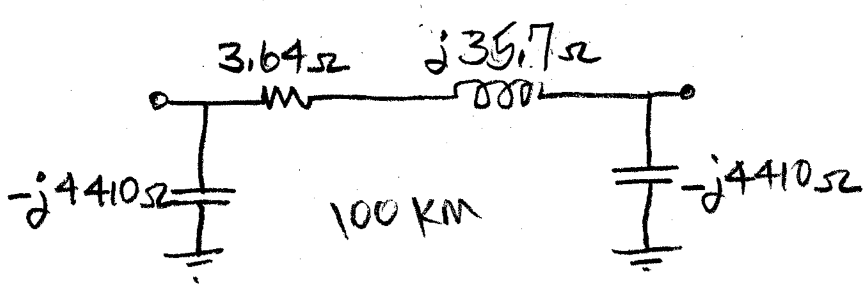
Note –

$C_{+/-} \simeq 10pF/m$

$L_{+/-} \simeq 1\mu H/m$

$\frac{X_{L60}}{R} \simeq 10$

At 60 Hz, we have



$$\frac{1}{\sqrt{L_{+/-}C_{+/-}}} = 2.96\times10^8\ m/s$$

OK