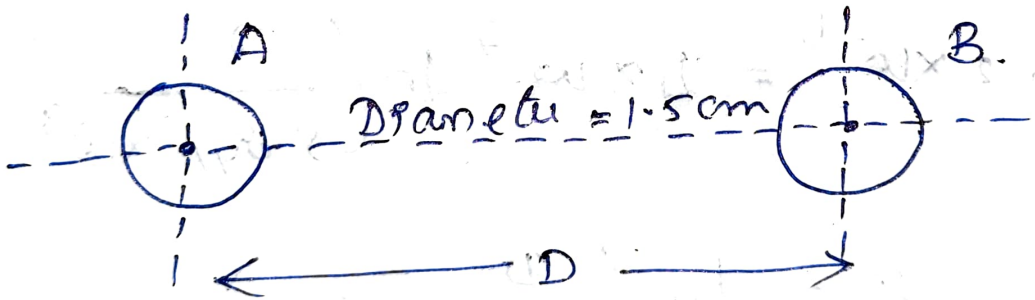
Problems.

1) A single phase overhead line 25 km long is to be constructed of conductor 1.5 cm diameter. Calculate the maximum spacing b/w the conductors in order that the loop inductance of conductor is not more than 0.08 H.



loop inductance / line $= 4 \times 10^{-7} \ln \frac{D}{r}$

Length of Tr. line = 25 km

= 25000 m.

loop inductance / metre of a Tr. line Conductor A $= \frac{0.08}{25000}$

$= 3.2 \times 10^{-6}$ H

Diameter of Conductor = 1.5 cm

Radius of Conductor = 0.75 cm

$r' = 0.7788 \times$ Radius of Conductor

$= 0.7788 \times 0.75$

$= 0.5841$ cm

$= 5.841 \times 10^{-3}$ m.

loop inductance / metre of the line

$= 4 \times 10^{-7} \ln \frac{D}{r'}$

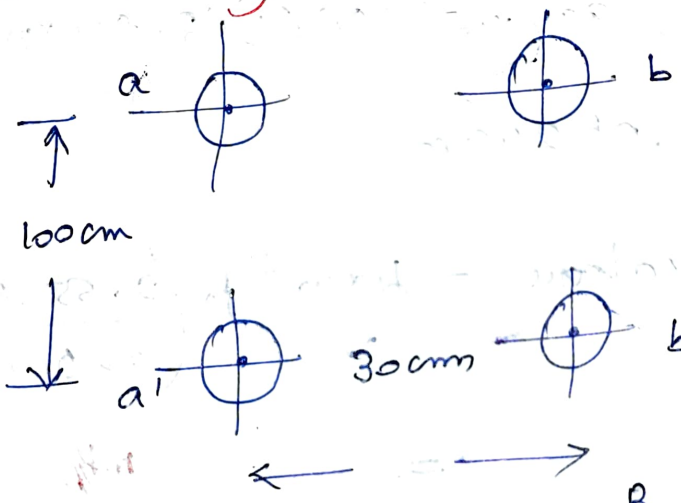
$3.2 \times 10^{-6} = 4 \times 10^{-7} \ln \frac{D}{r'}$

$3.2 \times 10^{-6} = 4 \times 10^{-7} \ln \left(\frac{D}{5.841 \times 10^{-3}} \right)$

$8 = \ln \left(\frac{D}{5.841 \times 10^{-3}} \right)$

$D = 17.41$ m

(2) Two conductors of a single phase line, each of 1cm diameter are arranged in a vertical plane with one conductor mounted 1m above the other. A second identical line is mounted at the same height as the first and spaced horizontally 30cm apart from it. The upper & lower conductors are connected in parallel. Determine inductance per km of the resulting double circuit.



$$\text{Loop inductance} = 4 \times 10^{-7} \ln\left(\frac{D_M}{D_S}\right) \text{H/m}$$

$$D_m = \sqrt[4]{D_{ab}\, D_{ab'}\, D_{ba'}\, D_{ba}}$$

$$D_s = \sqrt[4]{D_{aa}\, D_{aa'}\, D_{a'a}\, D_{a'a'}}$$

$D_{ab} = 30\text{cm}$,

$D_{aa'} = D_{a'a} = 100\text{cm} = 1\text{m}$

$D_{bb'} D_{b'b} = 100\text{cm} = 1\text{m}$

$D_{ab} = D_{ba} = D_{a'b'} = D_{b'a'} = 30\,cm$

$= 0.03\,m.$

$D_{ab} \perp D_{ba'} = \sqrt{(100)^2 + (30)^2}$

$= 104.40\,cm = 1.04\,m.$

$D_m = \sqrt[4]{(0.3)(1.0440)(1.0440)(0.3)}$

$= 0.5596\,m.$

$D_s = \sqrt[4]{(3.894 \times 10^{-3})(1)(1)(3.894 \times 10^{-3})}$

$= 0.06240\,m.$

loop inductance $= 4 \times 10^{-7} \ln\left(\frac{0.5596}{0.06240}\right)$

$=$ mH.