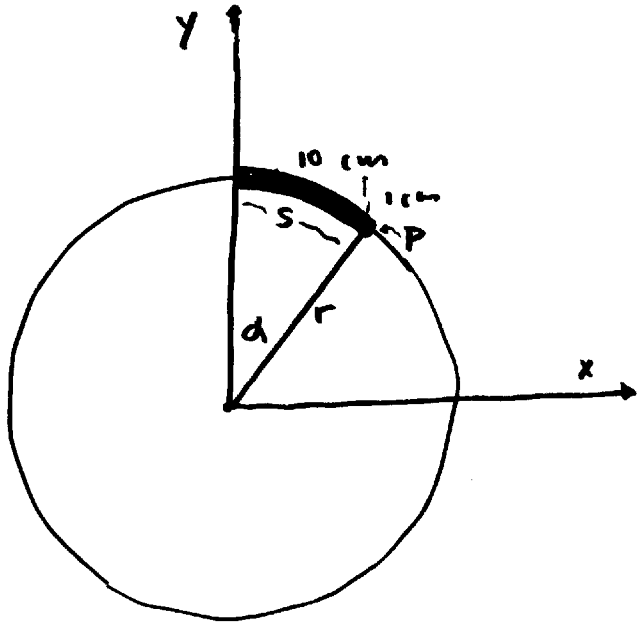
3



- what is r ? Assum the sensor does not change length significantly L= 10 cm

circle description :

$x = r \sin(\alpha)$

$y = r \cos(\alpha)$

$S = \alpha \cdot r$

In point P :

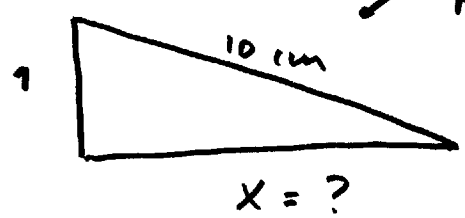
→ $S = 10$ cm ⟹ ① $\alpha_p r = 10 \Rightarrow \alpha_p = \frac{10}{r}$

→ $y = r-1$ ② $(r-1) = r \cos(\alpha_p)$

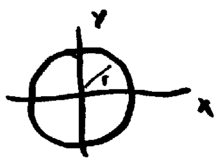
$(r-1) = r \cos\left(\frac{10}{r}\right)$

$\Rightarrow \boxed{r = 49.832 \text{ cm}}$

Alternative calculation (for whom doesn't have a fancy calculator to solve Equation ②) approximation



Pythagoras : $x = \sqrt{99}$



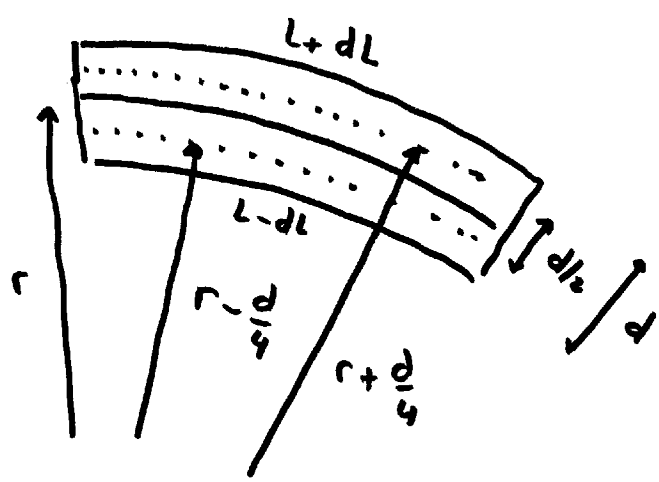
circle description :

$$x^2 + y^2 = r^2$$

$$x = \sqrt{99} \;,\; y = (r-1) \Rightarrow r = 50 \text{ cm}$$

$$r = 49.832 \text{ cm}$$

$$\alpha_p = \frac{10 \text{ cm}}{49.832 \text{ cm}} \text{ rad} = 0.20067251 \text{ rad}$$



$$\left.\begin{aligned} L + dL &= \left(r + \frac{d}{4}\right) \cdot \alpha_p \\ L - dL &= \left(r - \frac{d}{4}\right) \cdot \alpha_p \end{aligned}\right\} \quad dL = \frac{d}{4}\,\alpha_p = \frac{2 \text{ mm}}{4} \cdot 0.20067251$$

$$= 0.100336 \text{ mm}$$

$$\frac{dL}{L} = \frac{0.100336 \text{ mm}}{100 \text{ mm}} = 1.00 \ 10^{-6}$$

$$\left.\begin{aligned} \alpha_{AL} &= 22.2 \ 10^{-6} /k \\ \alpha_{W} &= 4.3 \ 10^{-6} /k \end{aligned}\right) \text{ approximation :}$$

$$\alpha_{I} = +9.05 \ 10^{-6} /k \qquad \left(\frac{22.2 - 4.3}{2} \cdot 10^{-6} \right)$$

$$\alpha_{II} = -9.05 \ 10^{-6} /k \qquad \left(- \frac{22.2 - 4.3}{2} \cdot 10^{-6} \right)$$

$$\Delta T \cdot \alpha_{I} = 1.00 \ 10^{-6}$$

$$\Delta T = \frac{1.00 \ 10^{-6}}{9.05 \ 10^{-6} /k} = 0.11 \text{ K}$$

(very small, but this is the calculation)