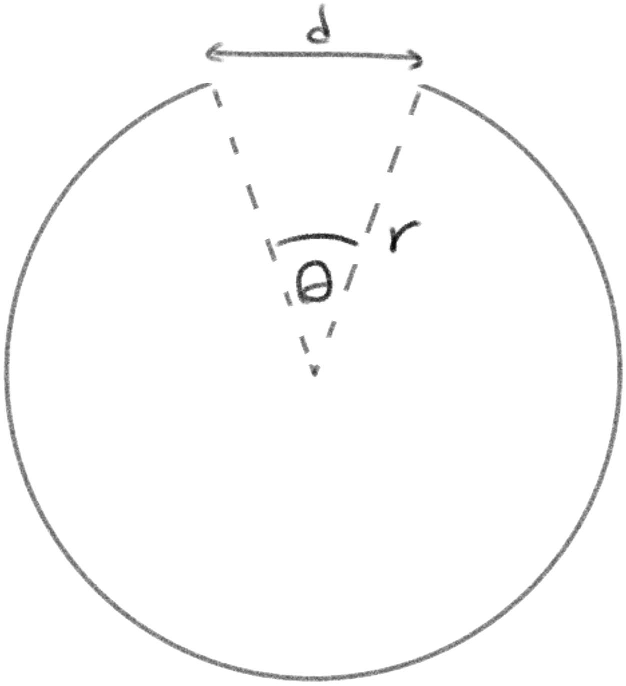
Task 2:



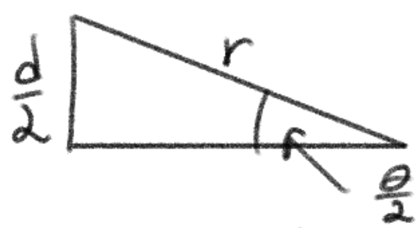
γ - the metal wire's coefficient expansion

r - the ring's radius

L = the wire's intial length

$$\Delta L = L_f - L$$

$$\Delta L = L \cdot \gamma \cdot \Delta T \qquad (1)$$



$$\frac{d}{2r} = \sin\left(\frac{\theta}{2}\right) \implies \theta = 2\sin^{-1}\left(\frac{d}{2r}\right)$$

let's assume that the radius doesn't change as a result of heating the wire, ($r_f \approx r$).

$$\frac{d_f}{2r} = \sin\left(\frac{\theta_f}{2}\right)$$

$$\Delta d = d_f - d$$

$$\Rightarrow \quad \Delta d = 2r\left[\sin\left(\frac{\theta_f}{2}\right) - \sin\left(\frac{\theta}{2}\right)\right] \quad (2)$$

$$L = 2\pi r - \frac{\theta}{2\pi}(2\pi r) \Longrightarrow \quad L = 2\pi r - \theta r$$

$$L = r(2\pi - \theta)$$

hence: $L_f = r(2\pi - \theta_f)$

$$\Longrightarrow \quad \Delta L = r(\theta - \theta_f) \quad (3)$$

$$L \gamma \Delta T = r(\theta - \theta_f) \qquad (1) = (3)$$

$$r(2\pi - \theta)\gamma\Delta T = r(\theta - \theta_f)$$

$$\theta_f = \theta - (2\pi - \theta)\gamma\Delta T \quad (4)$$

$$\theta(1 + \gamma\Delta T) - 2\pi\gamma\Delta T$$

Assuming that r, d, γ are known the expression of Δd:

$$\begin{cases} \Delta d = 2r\left[\sin\left(\frac{\theta_f}{2}\right) - \sin\left(\frac{\theta}{2}\right)\right] \\ \Delta T = 100 - 20 = 80 \; [K] \\ \theta = 2\sin^{-1}\left(\frac{d}{2r}\right) \\ \theta_f = \theta - (2\pi - \theta)\gamma \Delta T \end{cases}$$

$$\theta(1 + \gamma\Delta T) - 2\pi$$