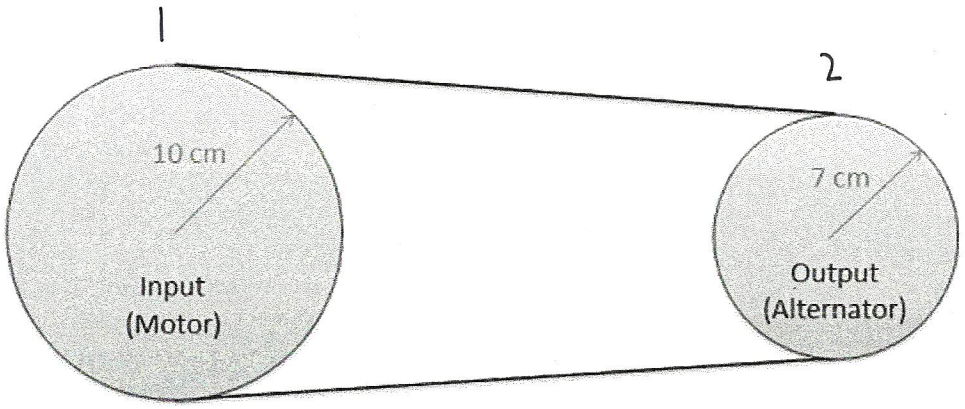
Question 3:

A flat belt is being used to transfer power from a motor to an alternator as shown in the diagram below. The coefficient of friction between the belt material and the pulley is .5. If we require a power of 100 Watts (Nm/s) while the input is rotating at a rate of 1000 rpm, what is the required resting tension in the belt? (Assume contact angles of approximately 180°)



output
1428.6 rpm

$P_1 = P_2 = 100 \text{ Nm/s}$

$\omega_1 = 1000 \text{ rpm} = 104.7 \text{ rad/s}$
$\omega_2 = 1428.6 \text{ rpm} = 149.6 \text{ rad/s}$

input pulley

$$P = M\omega$$

$$100 \frac{\text{Nm}}{\text{s}} = (M)(104.7 \text{ rad/s})$$

$$M = .955 \text{ Nm}$$

$$M = (T_{2max} - T_1)(r_1)$$

T_1 ↑ T_{rest} ; r_1 ↑ .1m

$$9.55 \text{ N} = T_{2max} - T_{rest}$$

input pulley

$$T_{2max} = T_{rest} e^{\mu_s \beta}$$

$$T_{2max} = T_{rest} e^{(.5)(\pi)}$$

$$T_{2max} = 4.81\, T_{rest}$$

$$9.55N = 4.81\, T_{rest} - T_{rest}$$

$$\boxed{T_{rest} = 2.51N}$$

output pulley

$$P = M\omega$$

$$100 \tfrac{Nm}{s} = (M)(149.6\ rad/s)$$

$$M = .668\ Nm$$

$$M = (T_{2max} - T_{rest})(r_2)$$

r_2 = .07m

$$9.55\ N = T_{2max} - T_{rest}$$

$$T_{2max} = T_{rest} e^{\mu_s \beta}$$

$$T_{2max} = T_{rest} e^{(.5)(\pi)}$$

$$T_{2max} = T_{rest} e$$

$$T_{2max} = 4.81\, T_{rest}$$

$$9.55N = 4.81\, T_{rest} - T_{rest}$$

$$\boxed{T_{rest} = 2.51\ N}$$

same in both locations