THERMO HW #1

1.3 a) $310\,^\circ K$ b) $373\,^\circ K$ c) $255\,^\circ K$

d) $77\,^\circ K$ e) $600\,^\circ K$

1.8 a) $\Delta T = 100\,^\circ F - 0\,^\circ F = 56\,^\circ K$

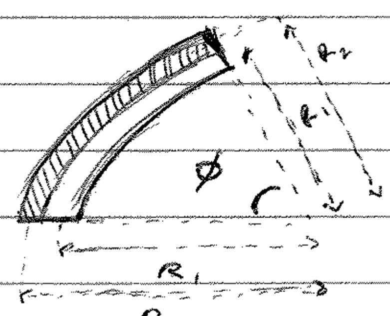
$$\Delta L = \alpha \Delta T \, L = 62E{-}5 \cdot 1E3m$$
$$= .62 m$$

$$\left[x E y \equiv x \cdot 10^{y} \right]$$

b) IF THE TWO METALS ARE BONDED STRONGLY TOGETHER, THEN THEY WILL PREFER TO BEND IN SUCH A WAY THAT EACH OF THE TWO STRIPS INCREASES / DECREASES BY THE AMOUNT DICTATED BY

$$\Delta L = \alpha \Delta T \, L$$

i.e.



▨ = METAL A

▭ = METAL B

BUT $R_2 - R_1 \equiv w$

IS FIXED BY THE THICKNESS OF THE BIMETALLIC STRIP, SO

FOR SOME RADIUS OF CURVATURE
$R \equiv [R_1 + R_2] / 2$ AND SUBTENDED
ANGLE ϕ WE HAVE:

$$\phi R_1 = L[1 + \alpha_1 \Delta T]$$

$$\phi R_2 = L[1 + \alpha_2 \Delta T]$$

OR:

$$\phi[R - \omega/2] = L(1 + \alpha_1 \Delta T]$$

$$\phi[R + \omega/2] = L(1 + \alpha_2 \Delta T]$$

WE FIND:

$$\phi = \frac{L}{\omega}(\alpha_2 - \alpha_1)\Delta T$$

AND $$R = \omega \Big/ \left[\frac{1 + \bar{\alpha}\Delta T}{\Delta\alpha\,\Delta T}\right]$$

WHERE $\bar{\alpha} \equiv (\alpha_2 + \alpha_1)/2$

& $\Delta\alpha = \alpha_2 - \alpha_1$

SO BY KNOWLEDGE OF R, ω, α_1, & α_2
WE CAN DETERMINE ΔT.

c) $\beta = \frac{dV}{dT} \Big/ V$

$= \frac{d}{dT} \left(\ln V \right]$

$= \frac{d}{dT} \left[\ln \left[L_x L_y L_z \right] \right]$

$= \frac{d}{dT} \left[\ln L_x + \ln L_y + \ln L_x \right]$

$= \frac{d}{dT} \ln L_x + \ldots$

$= \frac{d}{dT} L_x \Big/ L_x + \ldots$

$= \alpha_x + \alpha_y + \alpha_z$