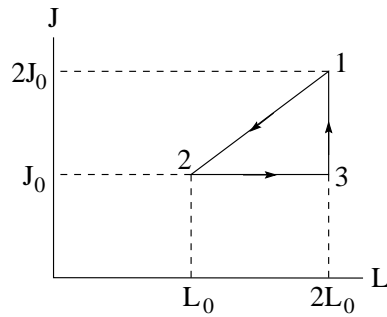


[tex39] Rubber band heat engine

Consider a heat engine that uses a rubber band in the three-step cycle shown. The equation of state $J = \alpha LT$ with $\alpha = \text{const}$ relates the tension J in the band to the length L of the band and to the absolute temperature T . The heat capacity of the band at constant length is $C_L = \text{const}$. Calculate the heat transfer ΔQ and the work performance ΔW in each of the three steps in the cyclic process shown:

- 1 \rightarrow 2 relaxation at $T = \text{const}$,
- 2 \rightarrow 3 expansion at $J = \text{const}$,
- 3 \rightarrow 1 heating up at $L = \text{const}$.

From these results calculate the efficiency η of the rubber band heat engine. Compare η with the efficiency of a Carnot engine operating between the same temperatures.



Solution: