PHYS 301
Thermodynamics and Statistical Mechanics

Problems #14

Wednesday, 04/29/2026

Question 1.

In absorption refrigerators the energy driving the process is supplied not as work, but as heat from a gas flame at a temperature $T_{hh} > T_h$. Mobile home and cabin refrigerators may be of this type, with propane as a fuel.

(a) Draw an energy-entropy flow diagram for such a refrigerator, involving no work at all, but with energy and entropy flows at the three temperatures $T_{hh} > T_h > T_l$.

(b) Assuming reversible operation, compute the ratio Q_l/Q_{hh} for the heat extracted at $T = T_l$, where Q_{hh} is the heat input at $T = T_{hh}$.

Question 2.

It has been proposed to use the thermal gradient of the ocean to drive a heat engine. Suppose that at a certain location the water temperature is 22°C at the ocean surface and 4°C at the ocean floor.

(a) What is the maximum possible efficiency of an engine operating between these two temperatures?

(b) If the engine is to produce 1 Gigawatt of electrical power, what minimum volume of water must be processed (to suck out the heat) in every second? The density of water is $\rho \approx 1000$ kg/m^3 and its specific heat capacity is $c_V = 4186$ J kg^{-1} K^{-1}.