Week 4, Meeting 2 Problems

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9/13

1 Cycle Through the Cycles

This problem will develop a useful reference: a list of all quantities associated with thermodynamic processes of ideal gases. Suppose that there are N molecules of an ideal gas with d degrees of freedom (use $\gamma = \frac{d+2}{d}$ where it is more convenient). Suppose the gas starts at (P_0, V_0). Then $T_0 = P_0V_0/(Nk)$. Complete the following table and *draw each process on a P-V diagram.*

Table 1: This table is also available in the workbook on pg. 153.

Quantity	**Isochoric**	**Isovolumetric**	**Isothermal**	**Adiabatic**
P_f		P_f		
V_f	V_f		V_f	
T_f				T_f
ΔE				
Q				
W				
ΔS				

Source: Physics 7B Workbook pg. 153

2 Problems

2.1 Heat from the Ocean

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^oC at the ocean surface and 4^oC 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 GW of electrical power, what minimum volume of water must be processed (to suck out the heat) in every second?

Source: Schroeder - Thermal Physics problem 4.4

2.2 Challenge: Adiabatic Atmosphere

In an adiabatic atmosphere, $P\rho^{-\gamma}$ is a constant. Show that temperature falls off at a constant rate with height above the earth, and find the rate of this decrease.

Source: some Feynman physics book problem