Section B. Thermodynamics and Statistical Mechanics

1. Carnot Engine

A Carnot engine uses n moles of an ideal gas as its working substance. The absolute temperatures of its hot and cold reservoirs are denoted by T_H and T_C respectively. The net work performed by the engine in one cycle of operation is W. An investigator is asked to check the values of the reservoir temperatures, but unfortunately she is not provided with a thermometer. However she is able to measure W, and also the following volumes:

V_{H1} = volume of working substance when first contacted with the hot reservoir
V_{H2} = volume of working substance after extracting heat from the hot reservoir
V_{C1} = volume of working substance when first contacted with the cold reservoir
V_{C2} = volume of working substance after giving up heat to the cold reservoir

Derive expressions for the unknown temperatures T_H and T_C in terms of n, W, the ratios of the above volumes, the molar gas constant R and the ratio γ of the constant pressure and constant volume specific heats for the gas.