

PHYSICS 140A : STATISTICAL PHYSICS
HW ASSIGNMENT #6

(1) A substance obeys the thermodynamic relation $E = aS^4/VN^2$.

- (a) Compute the heat capacity $C_{V,N}$ in terms of N , V , and T .
- (b) Compute the equation of state relating p , V , N , and T .
- (c) Compute the ratio $C_{\varphi,N}/C_{V,N}$, where $C_{\varphi,N}$ is the heat capacity at constant φ and N , with $\varphi = V^2/T$.

(2) Consider an engine cycle which follows the thermodynamic path in Fig. 1. The work material is ν moles of a diatomic ideal gas. BC is an isobar ($dp = 0$), CA is an isochore ($dV = 0$), and along AB one has

$$p(V) = p_B + (p_A - p_B) \cdot \sqrt{\frac{V_B - V}{V_B - V_A}}.$$

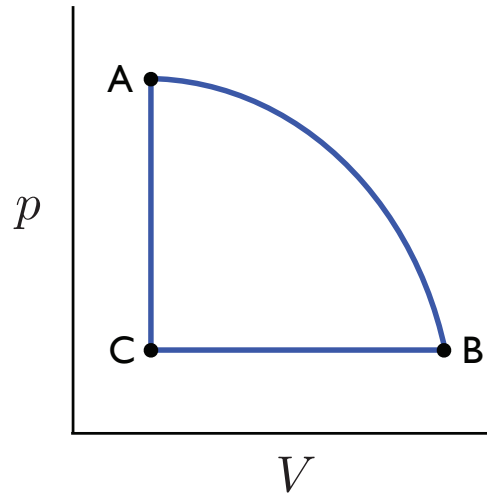


Figure 1: Thermodynamic path for problem 2.

- (a) Find the heat acquired Q_{AB} and the work done W_{AB} .
- (b) Find the heat acquired Q_{BC} and the work done W_{BC} .
- (c) Find the heat acquired Q_{CA} and the work done W_{CA} .
- (d) Find the work W done per cycle.

(3) For each of the following differentials, determine whether it is exact or inexact. If it is exact, find the function whose differential it represents.

(a) $xy^2 dx + x^2y dy$

(b) $z dx + x dy + y dz$

(c) $x^{-2} dx - 2x^{-3} dy$

(d) $e^x dx + \ln(y) dy$