NAME :

Quiz 2

Philip Cherian

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(a) Consider a gaseous system that is taken along the following cycle from $A \to B \to A$: it is first taken from $A \to B$ along a parabola and is then brought back from $B \to A$ at constant pressure. This process is shown in Figure (1). For convenience, the internal energy at the two states (U_A and U_B) are given to you, and the equation of the parabola (in units of MPa and m^3) is $P = 0.1 + 10^3 (V - 0.02)^2$.

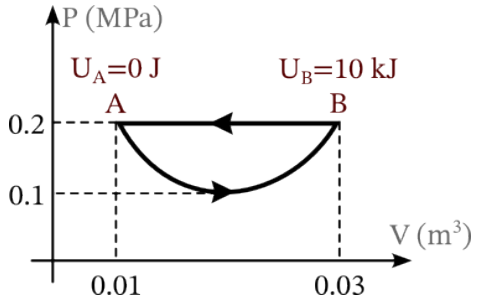

Figure 1: A thermodynamic system is taken along a process $A \to B \to A$. Note that 1MPa = 10^6 Pa.

Along each of the arms, compute (i) the work done, and (ii) the heat transferred. Indicate whether the heat is transferred into or out of the system. [7]

(b) Suppose you are given the infinitesimal form of the First Law of Thermodynamics

$$\mathrm{d}U = T\mathrm{d}S - P\mathrm{d}V + \mu\mathrm{d}N. \tag{1}$$

Use this to arrive at equations for T, P, and μ in terms of partial derivatives of U. Use your results to derive the three equations of state for the fundamental relation given below: [3]

$$U = k\left(\frac{S^3}{NV}\right). \tag{2}$$