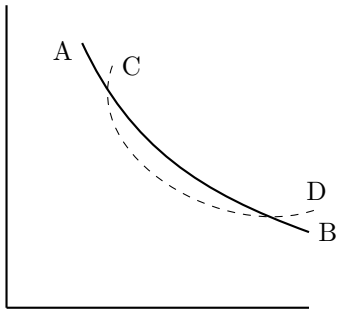
Thermal Physics

QUIZ 1

Each question carries 10 marks

20th October 2021

1. Consider a P-V diagram for a system as shown below



Assume the solid curve AB is isothermal (system in thermal contact with a reservoit at constat temperature) and the dashed curve CD is adiabatic. Show that they can not intersect at two points as shown.
(This is true for a general system, not just for a perfect gas.)

2. The equation of state of system is given by (in standard notation). The internal energy of the system is

$$P = \frac{aT^3}{V}$$

$$U = BT^n \ln(\frac{V}{V_0}) + f(T),$$

where $B\,, n$ and V_0 are all constants. $f(T)$ is a function of only T. Find n and a relation between a and B. (Use the fact that entropy is a perfect differential.)

3. A Carnot engine is made to operate as a refrigerator, operating at 0^o C and discharging heat at 20^oC. Find the minimum amount of work done by the refrigerator in converting one kilogram of water at 0^o into ice. (Assume latent heat to be $L = 3.35 \times 10^5 J/Kg$.)