Homework: 3   Submission Date: 30/1/2024

The hand written solutions must be submitted at the start of the tutorial.

1. Argue well with a bit of mathematics that work done in a gravitational field is exact differential as opposed to the case in a gas-piston system discussed in the class.

2. For adiabatic transformation of a van der Waals' gas, find the relation like $f(T, V) = K$ where K is a constant, and f is a function of volume and temperature. It is given $\left(\frac{\partial U}{\partial V}\right)_T = a/V^2$, and $p = \frac{RT}{V-b} - \frac{a}{V^2}$. Now, find the work done for one mole of this gas when its volume is changed from V_1 to V_2 and pressure from p_1 to p_2.

3. 32 Kg of oxygen gas kept at a pressure of 5 atm and 27^0C is made to under a cycle of changes. It is first heated at constant volume till such time that its pressure increases by a factor of 3. In the second step, it is allowed to expand isothermally till it regains the initial pressure. Finally, it is cooled isobarically to the original temperature. Calculate the change in its internal energy and work done in each step. Use atomic weight of oxygen atom as 16 and $R = 8314$ Jkmol$^{-1}K^{-1}$. Assume the gas as an ideal gas.