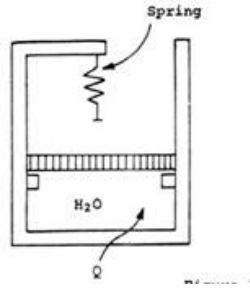


PH207: Year 2023
Problem Set-I
Instructor: **Subhradip Ghosh**

1. The tension in a wire is increased quasi-statically and isothermally from τ_i to τ_f . If the length L , cross-section area A and isothermal Young's Modulus Y remain constant, practically, show that the work done is $W = \frac{L}{2AY} (\tau_f^2 - \tau_i^2)$
2. Prove that the work done during a quasi-static isothermal change of state of a paramagnetic substance obeying Curie's law is $W = \frac{\mu_0 T}{2C} (m_f^2 - m_i^2) = \frac{\mu_0 C}{2T} (H_f^2 - H_i^2)$
 m, H, T, C are magnetization, magnetic field, temperature and Curie constant, respectively.
3. A liquid is compressed isothermally inside a chamber. Obtain an expression for the total amount of work required if the compression process is quasistatic and is given by the equation $\ln(V/V_0) = -A(p - p_0)$
 A, V_0, p_0 are constants
4. An elastic balloon filled with Hydrogen gas has a diameter of 0.3m and an internal pressure of 150 kPa. The gas is then heated to a diameter of 0.4m and a pressure of 200 kPa. During the process, the pressure is proportional to the balloon's diameter. Calculate (a) the work done by the gas during the process, (b) the work done by the balloon on the atmosphere. Assume atmospheric pressure to be 100 kPa.
5. The figure shows a container having 4kgs of saturated water at 35°C. It also has a frictionless piston with a cross sectional area of 0.06 m² initially resting on the stops enclosing a volume of 0.03 m³. To raise this piston against atmospheric pressure, a pressure of 300 kPa has to be applied. On moving the piston upwards, it will encounter a linear spring when the contained volume is 0.075 m³. To deflect this spring 1 m, the force required is 360 kN. If the final pressure is 7 MPa, determine the work done during the process.



6. Prove that the work required to stretch a wire of length l within the elastic region is given by the equation $W = 0.5AYl(e)^2$
 A is the cross sectional area of the wire, Y is the Young's Modulus, and e the unit strain.