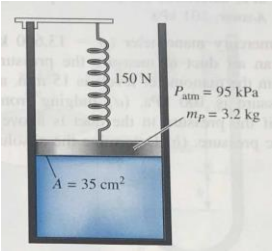
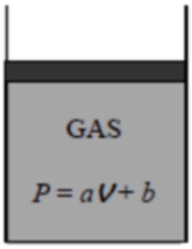
ÇANKAYA UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
ME211 THERMODYNAMICS I
Homework #1

1) A closed system consists of **0.2 kmol** of ammonia occupying a volume of 0.3 m^3. Determine:
   a) The weight of the system in N
   b) The specific volume in m^3/kmol and m^3/kg. Note: g=9.81 m/s^2.

2) A gas is contained in a vertical, frictionless piston-cylinder device. The piston has a mass of **3.2 kg** and a cross-sectional area of **35 cm²**. A compressed spring above the piston exerts a force of **150 N** on the piston. If atmospheric pressure is **95 kPa**, determine the pressure inside the cylinder.



3) A gas is compressed from an initial volume 0f **0.42 m³** to a final volume of **0.12 m³**. During the quasi-equilibrium process, the pressure changes with volume according to the relation **P=aV+b**, where **a=-1200 kPa/m³** and **b= 600 kPa**. Calculate the work done during this process;
   a) By plotting the process on P-V diagram and finding the area under the process curve.
   b) By performing the necessary integration.



4) a vertical piston–cylinder assembly by a piston with a face area of **80 cm²** and weight of **4450 N** contains a gas. The atmosphere exerts a pressure of **101.1 kPa** on top of the piston. An electrical resistor transfers energy to the gas in the amount of **6 kJ** as the elevation of the piston increases by **0.7 m**. The piston and cylinder are poor thermal conductors, and friction between them can be neglected. Determine the change in internal energy of the gas, in **KJ**.

5) A gas within a piston–cylinder assembly undergoes a thermodynamic cycle consisting of three processes (There are no significant changes in kinetic or potential energy):
   Process 1–2: Constant volume, V =0.028 m^3, U_2 - U_1= 26.4 kJ.
   Process 2–3: Expansion with pV= constant, U_3 =U_2.
   Process 3–1: Constant pressure, p = 1.4 bar, W_{31} = -10.5 kJ.
   (a) Sketch the cycle on a p–V diagram.
   (b) Calculate the net work for the cycle, in kJ.
   (c) Calculate the heat transfer for process 2–3, in kJ.
   (d) Calculate the heat transfer for process 3–1, in kJ.
   (e) Is this a power cycle or a refrigeration cycle?

6) A power cycle shown Fig. has the thermal efficiency of **30%**, and **Q_{out}** is **20 kJ**. Determine the net work developed and the heat transfer **Q_{in}** in kJ.