

**CANKAYA UNIVERSITY
FACULTY OF ENGINEERING
MECHANICAL ENGINEERING DEPARTMENT**

**ME 211 THERMODYNAMICS I
Fall 2016
CHAPTER 2 EXAMPLES**

22) Air is located inside a cylinder, under a piston as shown. The cylinder has a cross sectional area of 0.008 m^2 . Initially, the air occupies a volume of 0.01 m^3 , and the pressure of the air is 150 kPa. A weight with a mass of 5 kg is placed on top of the piston, and the piston moves down, compressing the gas to a volume of 0.007 m^3 . Determine the amount of work done in the process.



23) An unknown gas is heated inside a balloon. Initially, the gas occupies a volume of 0.21 m^3 , and its pressure is 320 kPa. The gas is heated until the volume expands to 0.34 m^3 . During the expansion process, the pressure and volume are related through $pV^{1.2} = \text{Const}$. Find the moving boundary work done in the process.

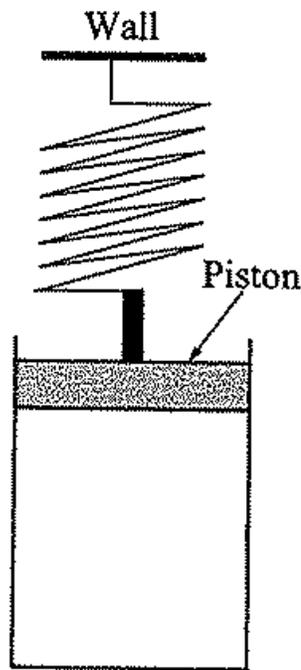
24) 10 kg of air undergoes a constant temperature expansion from a pressure of 1 MPa and a volume of 0.045 m^3 to a volume of 0.085 m^3 . The process follows a polytropic relationship of $pV = \text{const}$. Determine the final pressure and the work done by the air in the expansion process.

25) A sump pump in a home use 350 W of power. The pump is plugged into a standard 120 V outlet. What current is drawn while the pump is operating.

26) A steel rod (ID=100 mm and length 500 mm) is subjected to a tensile force applied along its axis whereupon it extends by a length of 10 mm. Young's modulus of steel is 200 GN/m^2

a) What is the stretching force applied ?
How much work has been done?

27) A gas is held in a cylinder by means of a frictionless and weightless piston which is linked to a wall with a coil spring that exerts a force proportional to a piston displacement. Initially the cylinder contains 0.05 m^3 of gas at 200 kPa , but the piston exerts no force on the spring (spring constant $k=150 \text{ kN/m}$). Now the gas is heated to expand its volume to 0.1 m^3 . Piston cross sectional area is 0.25 m^2 .



Determine

- a) The final pressure
- b) The work done by the gas

28) The drive shaft of a building's air handling fan is turned at 300 rpm by a belt running a 0.3 m diameter pulley. The net force applied by the belt on the pulley is 2000 N.

Determine the torque applied by the belt on the pulley, in N.m and the power transmitted in kW.