Assignment # 5

Thermodynamics-III

Chapter. 19: The First Law of Thermodynamics

Important Concepts and Formulas:

W = $\int_{V1}^{V2} P.dV$

dU = dQ – dW (First law of thermodynamics)

$C_p = C_v + R$

$\gamma = \frac{C_P}{C_V}$

W = $\frac{C_V}{R}$. $(P_1 V_1 – P_2 V_2) = \frac{1}{\gamma - 1} (P_1 V_1 – P_2 V_2)$

Question 1:

Two moles of an ideal gas are heated at constant pressure from T = 27°C to T = 107°C

(a) Draw a PV-diagram for this process.
(b) Calculate the work done by the gas.

Question 2:

A gas undergoes two processes. In the first, the volume remains constant at 0.200 m^3 and the pressure increases from 2×10^5 Pa to 5×10^5 Pa. The second process is a compression to a volume of 0.120 m^3at a constant pressure of 5×10^5 Pa.

(a) In a PV-diagram, show both processes.
(b) Find the total work done by the gas during both processes.

Question 3:

A gas in a cylinder expands from a volume of 0.110 m^3 to 0.320 m^3 . Heat flows into the gas just rapidly enough to keep the pressure constant at 1.65×10^5 Pa during the expansion. The total heat added is 1.15 $\times 10^5$ J.

(a) Find the work done by the gas.
(b) Find the change in internal energy of the gas.
(c) Does it matter whether the gas is ideal? Why or why not?

Question 4:

Propane gas (C_3H_8) behaves like an ideal gas with γ = 1.127 Determine the molar heat capacity at constant volume and the molar heat capacity at constant pressure.

Question 5:

The compression ratio of a diesel engine is 15.0 to 1; that is, air in a cylinder iis compressed to $\frac{1}{15.0}$ of its initial volume.

(a) If the initial pressure is 1.01×10^5 Pa and the initial temperature is 27^o C, find the final pressure and the temperature after adiabatic compression.
(b) How much work does the gas do during the compression if the initial volume of the cylinder is 1.00 L = 1.00×10^{-3} m^3 ? (let C_V = 20.8 J/mol.K and γ 1.400 for air)