

Chapter 19 Tutorial

Thermodynamics-III

Chapter 19 : The First Law of Thermodynamics

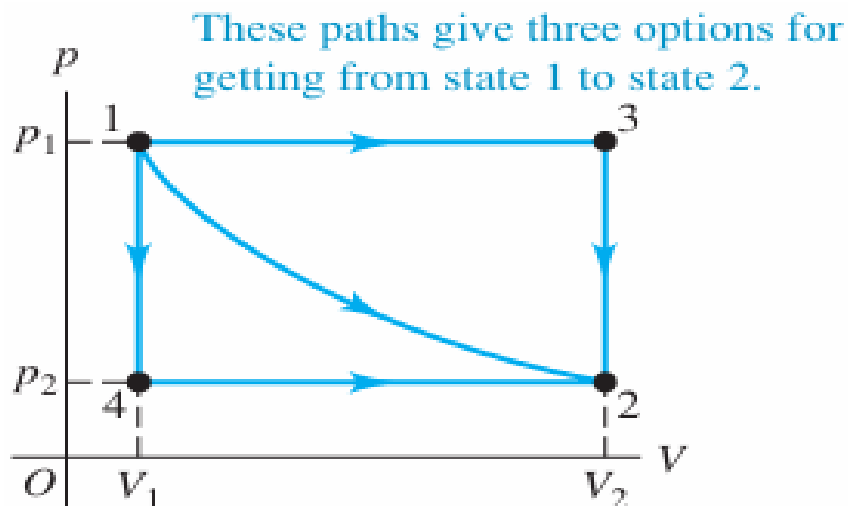
Question 1:

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

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

Question 2:

- (a) In figure shown below consider the closed loop $1 \rightarrow 3 \rightarrow 2 \rightarrow 4 \rightarrow 1$. This is a cyclic process in which the initial and final states are the same. Find the total work done by the system in this cyclic process, and show that it is equal to the area enclosed by the loop.
- (b) How is the work done for the process in part (a) related to the work done if the loop is traversed in the opposite direction, $1 \rightarrow 4 \rightarrow 2 \rightarrow 3 \rightarrow 1$? Explain.



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 $1.65 \times 10^5 \text{ Pa}$ during the expansion. The total heat added is $1.15 \times 10^5 \text{ J}$.

- (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:

During an isothermal compression of an ideal gas, 335 J of heat must be removed from the gas to maintain constant temperature. How much work is done by the gas during the process?

Question 5:

A cylinder contains 0.250 mol of carbon dioxide (CO_2) gas at a temperature of 27.0°C . The cylinder is provided with a frictionless piston, which maintains a constant pressure of 1.00 atm on the gas. The gas is heated until its temperature increases to 127°C . Assume that the CO_2 may be treated as an ideal gas. ($C_v = 28.46 \text{ J/mol} \cdot \text{K}$)

- (a) Draw a pV-diagram for this process.
- (b) How much work is done by the gas in this process?
- (c) On what is this work done?
- (d) What is the change in internal energy of the gas?
- (e) How much heat was supplied to the gas?
- (f) How much work would have been done if the pressure had been 0.50 atm?