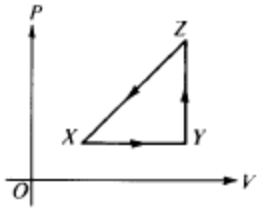
1st law of thermodynamics MCQ

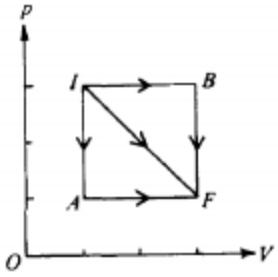
Questions 2-3



A thermodynamic system is taken from an initial state X along the path XYZX as shown in the PV-diagram.
2. For the process X → Y, ΔU is greater than zero and
(A) Q < 0 and W = 0 (B) Q < 0 and W > 0 (C) Q > 0 and W < 0 (D) Q > 0 and W > 0

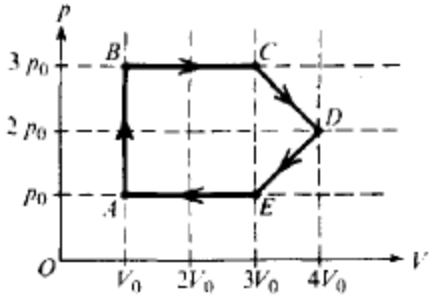
3. For the process Y → Z, Q is greater than zero and
(A) W < 0 & ΔU = 0 (B) W = 0 & ΔU < 0 (C) W = 0 & ΔU > 0 (D) W > 0 & ΔU > 0

x

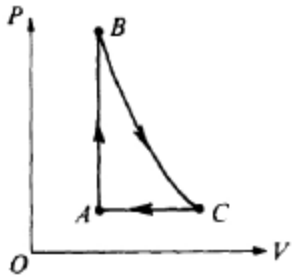


6. If three identical samples of an ideal gas are taken from initial state I to final state F along the paths IAF, IF, and IBF as shown in the P-V-diagram above, which of the following must be true?
(A) The heat absorbed by the gas is the same for all three paths.
(B) The change in internal energy of the gas is the same for all three paths.
(C) The expansion along path IF is adiabatic.
(D) The expansion along path IF is isothermal.

Questions 9-10

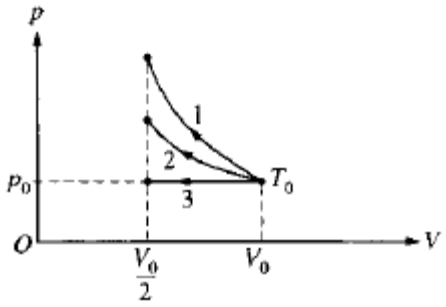


An ideal gas undergoes a cyclic process as shown on the graph above of pressure *p* versus volume V.
9. During which process is no work done on or by the gas?
(A) AB (B) BC (C) CD (D) EA
10. At which point is the gas at its highest temperature?
(A) A (B) B (C) C D) D



10. Gas in a chamber passes through the cycle ABCA as shown in the diagram above. In the process AB, 12 joules of heat is transferred to the gas. In the process BC, no heat is exchanged with the gas. For the complete cycle ABCA, the work done by the gas is 8 joules. How much heat is added to or removed from the gas during process CA?

(A) 20 J is removed. (B) 4 J is removed. (C) 4 J is added. (D) 20 J is added.



Questions 13-14

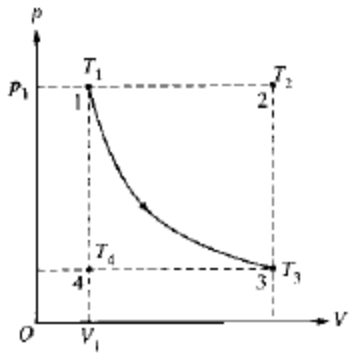
13. A certain quantity of an ideal gas initially at temperature T_0, pressure p_0, and volume V_0 is compressed to one-half its initial volume. As shown above, the process may be adiabatic (process 1), isothermal (process 2), or isobaric (process 3).

13. Which of the following is true of the mechanical work done on the gas?

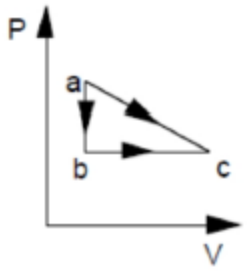
(A) It is greatest for process 1.
(B) It is greatest for process 2.
(C) It is greatest for process 3.
(D) It is the same for all three processes.

14. Which of the following is true of the final temperature of this gas?

(A) It is greatest for process 1. (B) It is greatest for process 2.
(C) It is greatest for process 3. (D) It is the same for all three processes.

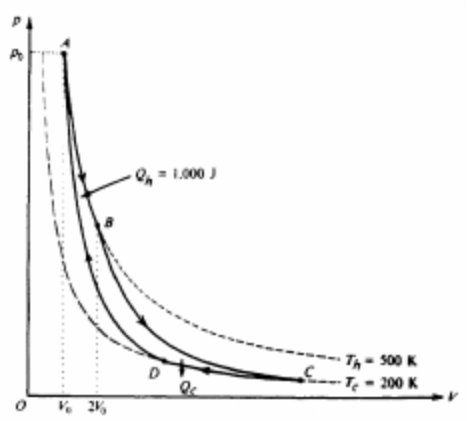


16. **Multiple Correct.** An ideal gas is initially in a state that corresponds to point 1 on the graph above, where it has pressure p_1, volume V_1, and temperature T_1. The gas undergoes an isothermal process represented by the curve shown, which takes it to a final state 3 at temperature T_3. If T_2 and T_4 are the temperatures the gas would have at points 2 and 4, respectively, which of the following relationships is true? Select two answers:
(A) $T_1 < T_3$ (B) $T_1 < T_2$ (C) $T_1 = T_3$ (D) $T_1 = T_4$



A gas can be taken from state a to c by two different reversible processes, $a \Rightarrow c$ or $a \Rightarrow b \Rightarrow c$. During the direct process $a \Rightarrow c$, 20.0 J of work are done by the system and 30.0 J of heat are added to the system. During the process $a \Rightarrow b \Rightarrow c$, 25.0 J of heat are added to the system. How much work is done by the system during $a \Rightarrow b \Rightarrow c$?
(A) 5.0 J (B) 10.0 J (C) 15.0 J (D) 20.0 J

1st law of thermodynamics FR



1983B4. The pV-diagram above represents the states of an ideal gas during one cycle of operation of a reversible heat engine. The cycle consists of the following four processes.

Process Nature of Process

AB Constant temperature (T_h = 500 K)

BC Adiabatic

CD Constant temperature (T_c = 200 K)

DA Adiabatic

During process A B, the volume of the gas increases from V_o to $2V_o$ and the gas absorbs 1,000 joules of heat.

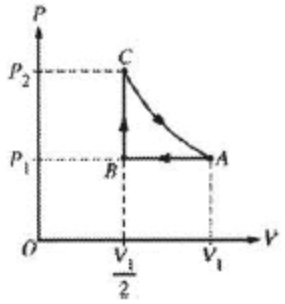
a. The pressure at A is p_o. Determine the pressure at B.

b. Using the first law of thermodynamics, determine the work performed on the gas during the process AB.

c. During the process AB, does the entropy of the gas increase, decrease, or remain unchanged? Justify your answer.

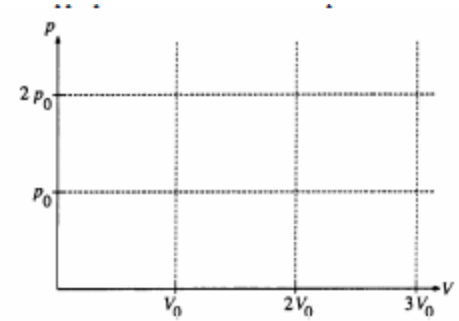
d. Calculate the heat Q_c given off by the gas in the process CD.

e. During the full cycle ABCDA is the total work the performed on the gas by its surroundings positive, negative, or zero? Justify your answer.



2004Bb5 One mole of an ideal gas is initially at pressure P_1, volume V_1, and temperature T_1, represented by point A on the PV diagram above. The gas is taken around cycle $ABCA$ shown. Process AB is isobaric, process BC is isochoric, and process CA is isothermal.
a. Calculate the temperature T_2 at the end of process AB in terms of temperature T_1.
b. Calculate the pressure P_2 at the end of process BC in terms of pressure P_1.
c. Calculate the net work done on the gas when it is taken from A to B to C. Express your answer in terms of P_1 and V_1.
d. Indicate below all of the processes that result in heat being added to the gas.
____ *AB* ____ *BC* ____*CA*
Justify your answer.

1989B4 (modified) An ideal gas initially has pressure p_o, volume V_o, and absolute temperature T_o. It then undergoes the following series of processes:
I. It is heated, at constant volume, until it reaches a pressure $2p_o$.
II. It is heated, at constant pressure, until it reaches a volume $3\ V_o$.
III. It is cooled, at constant volume, until it reaches a pressure p_o.
IV. It is cooled, at constant pressure, until it reaches a volume V_o.
a. On the axes below
i. draw the p-V diagram representing the series of processes;
ii. label each end point with the appropriate value of absolute temperature in terms of T_o.



b. For this series of processes, determine the following in terms of p_o and V_o.
i. The net work done on the gas
ii. The net change in internal energy
iii. The net heat absorbed
c. Determine the heat transferred during process 2 in terms of p_o and V_o.