



5. (10 points)

A sample of  $n$  moles of an ideal gas, originally at a pressure  $P_1$  and volume  $V_1$ , undergoes the three processes shown on the  $PV$  diagram above:

Process 1  $\rightarrow$  2: The volume is halved while the pressure remains constant.

Process 2  $\rightarrow$  3: The pressure is increased while the volume remains constant until the temperature reaches its original value.

Process 3  $\rightarrow$  1: The volume is increased while the temperature remains constant until the volume reaches its original value.

(a) Determine expressions for each of the following in terms of  $P_1$ ,  $V_1$ ,  $n$ , and fundamental constants.

i. The temperature of the gas in state 1

ii. The pressure of the gas in state 3

iii. The total work done on the gas during processes 1  $\rightarrow$  2 and 2  $\rightarrow$  3

(b) Indicate below whether heat is added to the gas, removed from the gas, or neither during the process 2  $\rightarrow$  3.

\_\_\_ Added to    \_\_\_ Removed from    \_\_\_ Neither added to nor removed from

Justify your answer.

(c) Indicate below whether heat is added to the gas, removed from the gas, or neither during the process 3  $\rightarrow$  1.

\_\_\_ Added to    \_\_\_ Removed from    \_\_\_ Neither added to nor removed from

Justify your answer.

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