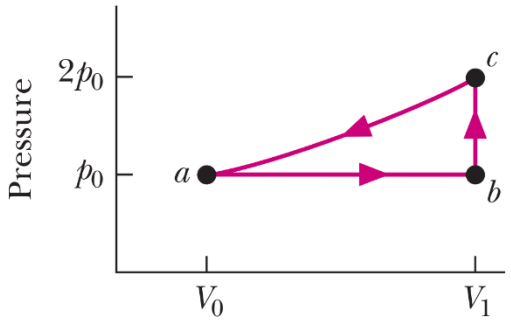
CHAPTER 20 | Entropy

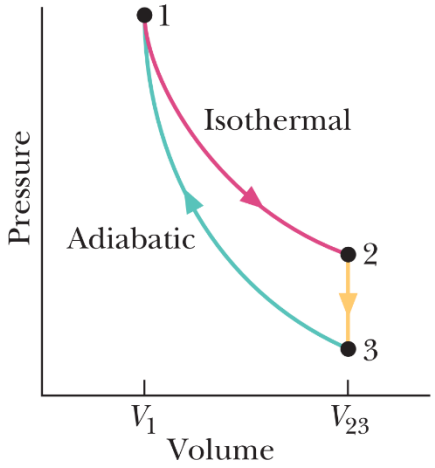
1 | An ideal gas undergoes a reversible isothermal expansion at 77.0℃, increasing its volume from 1.30 L to 3.40 L. The entropy change of the gas is 22.0 J/K. How many moles of gas are present? $(Ans: 2.75\ mol)$

2 | By absorbing heat, 250 g of ice in melting point has turned into 250 g water at 30℃. What has been the total change in entropy? $(Ans: 414\ J/K)$

3 | (a) For 1.0 mol of a monatomic ideal gas taken through the cycle in the figure in front, where $V_1 = 4.00V_0$, what is W/p_0V_0 as the gas goes from state a to state c along path abc? $(Ans: 3)$
What is $\Delta E_{int}/p_0V_0$ in going
(b) from b to c $(Ans: 6)$ and
(c) through one full cycle? $(Ans: 0)$
What is ΔS in going
(d) from b to c $(Ans: 8.64\ J/K)$ and
(e) through one full cycle? $(Ans: 0)$



4 | In the figure given, where $V_{23} = 3.00V_1$, n moles of a diatomic ideal gas are taken through the cycle with the molecules rotating but not oscillating.
(a) What are p_2/p_1, p_3/p_1, and T_3/T_1?
$(Ans: 0.333, 0.215, and\ 0.644)$
(b) For paths $1 \to 2$, $2 \to 3$, and $3 \to 1$, what are W/nRT_1, Q/nRT_1, $\Delta E_{int}/nRT_1$ and $\Delta S/nR$?

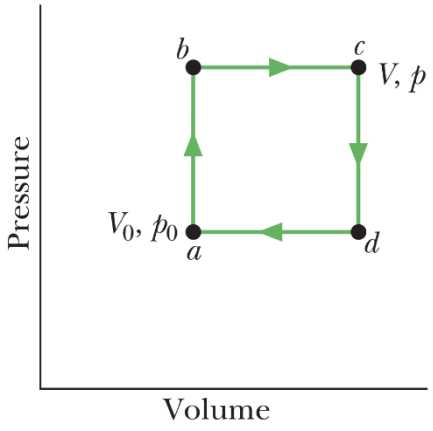


	W/nRT_1	Q/nRT_1	$\Delta E_{int}/nRT_1$	$\Delta S/nR$
$1 \to 2$	1.1	1.1	0	1.1
$2 \to 3$	0	−0.889	−0.889	−1.1
$3 \to 1$	−0.889	0	0.889	0

CHAPTER 20 | Entropy in the Real World: Engines

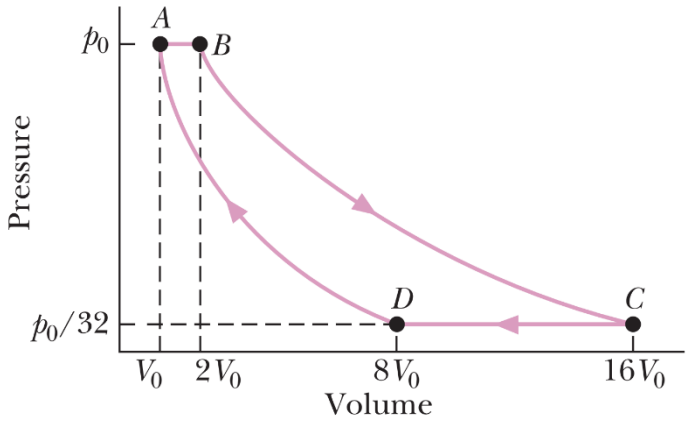
1 | A Carnot engine whose low-temperature reservoir is at 17°C has an efficiency of 40%. By how much should the temperature of the high-temperature reservoir be increased to increase the efficiency to 50%? $(Ans: 97\ K)$

2 | The figure shows a reversible cycle through which $1.00\ mol$ of a monatomic ideal gas is taken. Assume that $p = 2p_0$, $V = 2V_0$, $p_0 = 1.01 \times 10^5\ Pa$, and $V_0 = 0.0225\ m^3$. Calculate



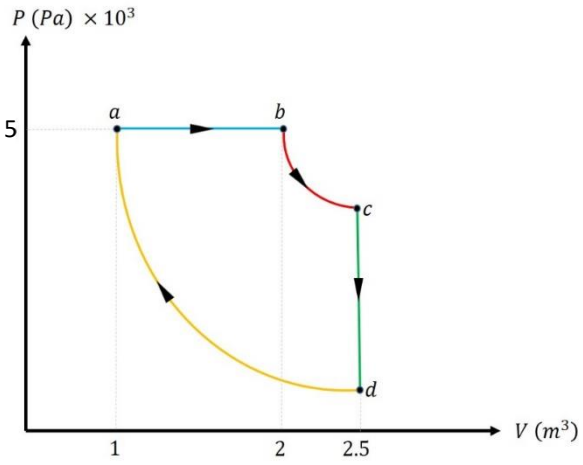
(a) the work done during the cycle $(Ans: 2.27\ kJ)$,
(b) the energy added as heat during stroke abc $(Ans: 14.8\ kJ)$, and
(c) the efficiency of the cycle $(Ans: 15.4\%)$.
(d) What is the efficiency of a Carnot engine operating between the highest and lowest temperatures that occur in the cycle? $(Ans: 75\%)$
(e) Is this greater than or less than the efficiency calculated in (c)? $(Ans: greater)$

3 | An ideal gas $(1.0\ mol)$ is the working substance in an engine that operates on the cycle shown in the figure. Processes BC and DA are reversible and adiabatic.



(a) Is the gas monatomic, diatomic, or polyatomic? $(Ans: monatomic)$
(b) What is the engine efficiency? $(Ans: 75\%)$

4 | In the figure below, 3 moles of an ideal diatomic gas undergoes different processes in a thermal-engine. Starting from point a, it goes through an isobaric process to point b, and having an isothermal process to point c, it reaches to point d via an isovolumetric process, and finally completes the cycle experiencing an adiabatic process.



(a) Find pressure at points c and d, and temprature at points a, b, c, and d.
(b) Find the work done by the gas during each process.
(c) Find the transferred heat into the engine during each process.
(d) Find the net work, net transferred heat, and change in internal energy ΔE_{int} for the cycle. Does the gained value for ΔE_{int} makes sense to you. Why?
(e) Find the efficiency and the Carnot efficiency of the engine.
(f) Find the change in entropy for each process.
(g) Find the total change in entropy for the whole cycle. What can be stated from its value?

Ans:

	$Volume\ (m^3)$	$Presure\ (Pa)$	$Temprature\ (K)$
a	1.00	5000	200.47
b	2.00	5000	400.93
c	2.50	4000	400.93
d	2.50	1386	138.92

	$Work\ (J)$	$Heat\ (J)$	$Entropy\ (J/K)$
$a \to b$	5000	17500	60.51
$b \to c$	2231	2231	5.56
$c \to d$	0	-16338	-66.09
$d \to a$	-3836	0	0
	$W_{total} \cong 3395$	$Q_{total} \cong 3393$	$S_{total} \cong 0$

$$\varepsilon = 17\%$$
$$\varepsilon_c = 65\%$$