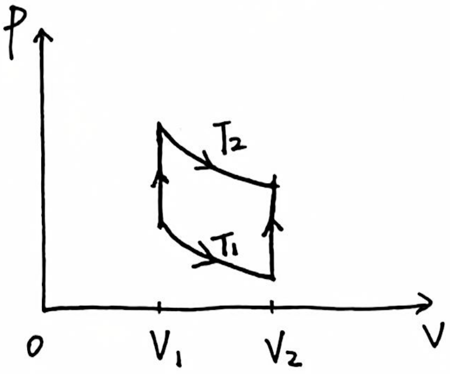
浙江大学
ZHEJIANG UNIVERSITY

大学物理第十四周作业

T8-15



1mol H_2 双原子分子 $i=5$

(1). $\Delta E = \nu C_V \Delta T = \frac{5}{2}R(T_2-T_1)$

$= 1.25\times10^3 J$

$A_1 = RT_2\ln\frac{V_2}{V_1} = 2.03\times10^3 J$

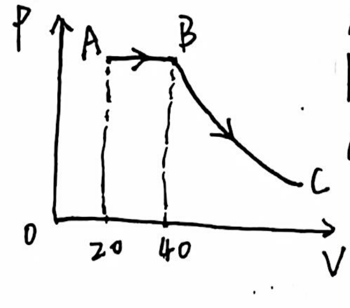
$Q_1 = \Delta E + A_1 = 3.28\times10^3 J$

(2). $\Delta E = 1.25\times10^3 J$

$A_2 = RT_1\ln\frac{V_2}{V_1} = 1.69\times10^3 J$

$Q_2 = \Delta E + A_2 = 2.94\times10^3 J$

T8-19.



$A(P_1, V_1, T_1)$

$B(P_2, V_2, T_2)$

$C(P_3, V_3, T_3)$

(2). $T_2 = \frac{V_2}{V_1}T_1 = 600K$

$Q = \nu C_p(T_2-T_1) = \nu\cdot\frac{5}{2}R(T_2-T_1)$

$= 1.25\times10^4 J$

(3). $\Delta E = 0$ 回复初温，T未变

(4). $A = Q - \Delta E = 1.25\times10^4 J$

(5). $\gamma = \frac{C_p}{C_V} = \frac{5}{3}$

$V_3 = \left(\frac{T_2}{T_1}\right)^{\frac{1}{\gamma-1}} V_2 = 113L$

T8-28

(1). $A_{ab} = 0$

$Q_{ab} = \Delta E_{ab} = \nu C_V(T_b-T_a) = \nu\cdot\frac{3}{2}R\cdot(T_b-T_a) = \frac{3}{2}(P_bV_b-P_aV_a) = 75J$

而 $P_b V_b = P_c V_c$

故 $T_b = T_c \quad \Delta E_{bc} = 0$

$A_{bc} = \frac{1}{2}(P_b + P_c)\cdot(V_c - V_b) = 200J$

$Q_{bc} = A_{bc} + \Delta E_{bc} = 200J$

(2). $\Delta E_{abc} = \Delta E_{ab} + \Delta E_{bc} = 75J$

T8-29. 等温膨胀 $a \to b$ 等压压缩 $b \to c$ 等体升压 $c \to a$

$T_b = T_a = \frac{P_a V_a}{\nu R} = 386K$

$T_c = T_b \cdot \frac{V_c}{V_b} = 193K$

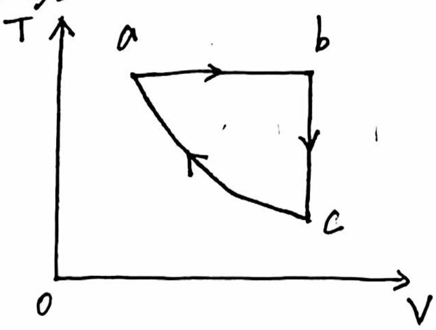
$Q_{ab} = \nu R T_a \ln \frac{V_b}{V_a} = 222J$

$Q_{bc} = \nu C_p (T_c - T_b) = \nu \cdot \frac{5}{2} R \cdot (T_c - T_b) = -401J$

$Q_{ca} = \nu C_v \cdot (T_a - T_c) = \nu \frac{3}{2} R \cdot (T_a - T_c) = 241J$

$$\eta = \frac{Q_{ab} + Q_{ca} - |Q_{bc}|}{Q_{ab} + Q_{ca}} \times 100\% = 13.4\%$$

T8-32



(1). ab过程 等温

$Q_{ab} = \nu R T_1 \ln \frac{V_2}{V_1} > 0$ 吸热

bc过程 等体

$Q_{bc} = \nu C_V (T_c - T_1) < 0$ 放热

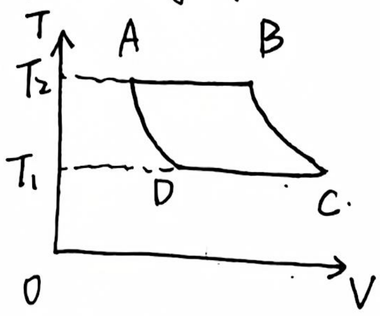
(2). $V_2^{\gamma-1} T_c = V_1^{\gamma-1} T_1$

$T_c = T_1 \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

$V_c = V_2$ 故 $P_c = \frac{\nu R T_c}{V_c} = \nu R T_1 \frac{V_1^{\gamma-1}}{V_2^{\gamma}}$

(3). 不是卡诺循环

T-V 图中



(4).

$$Q_1 = Q_{ab} = A = \nu R T_1 \ln \frac{V_2}{V_1}$$

$$Q_2 = |Q_{bc}| = \nu C_V (T_1 - T_c)$$

$$\eta = 1 - \frac{Q_2}{Q_1} = 1 - \frac{C_V(T_1 - T_c)}{R T_1 \ln \frac{V_2}{V_1}} = 1 - \frac{1 - \frac{T_2}{T_1}}{(\gamma-1)\ln \frac{V_2}{V_1}}$$

T8-36.

(1). $Q_2 = \lambda m = 1.68 \times 10^7 J$

$$w_c = \frac{Q_2}{|A|} = \frac{T_2}{T_1 - T_2} = 10.1$$

$$|A| = \frac{Q_2}{w_c} = 1.66 \times 10^6 J$$

(2). 放热.

$$|Q_1| = |A| + Q_2 = 1.84 \times 10^7 J$$

(3). $w_c' = \frac{Q_2}{|A'|} = \frac{T_2'}{T_1 - T_2'} = 7.11$

$$|A'| = \frac{Q_2}{w_c'} = 2.36 \times 10^6 J$$

$|A'| - |A| = 7 \times 10^5 J$ 多做的功

T8-41.

(1). $A = \frac{1}{2}(P_a + P_b)\cdot(V_b - V_a) + \frac{1}{2}(P_b + P_c)\cdot(V_c - V_b)$

$= 1.3 \times 10^3 J$

(2). $\Delta E = \nu C_V(T_c - T_a) = \nu \cdot \frac{5}{2}R \cdot \left(\frac{P_c V_c}{\nu R} - \frac{P_a V_a}{\nu R}\right) = 1.5 \times 10^3 J$

$Q = \Delta E + A = 2.8 \times 10^3 J$

(3). ~~ΔE~~ ~~$\Delta S = \nu C_p \ln \frac{T_a}{}$~~

以等压可逆过程 ad 与等体可逆过程 dc 连接始末态

$$\Delta S = \nu C_p \ln \frac{T_d}{T_a} + \nu C_v \ln \frac{T_c}{T_d}$$

$$= \nu \frac{7}{2} R \ln \frac{V_d}{V_a} + \cancel{\nu \frac{5}{2} R \ln \frac{V_c}{V_d}} \ \nu \cdot \frac{5}{2} R \cdot \ln \frac{P_c}{P_d}$$

$$= 23.5\ J/K$$

T8-43

$$\begin{matrix} 1mol \\ P_n \\ 273K \\ 冰 \end{matrix} \xrightarrow[\Delta S_1]{} \begin{matrix} 1mol \\ P_n \\ 273K \\ 水 \end{matrix}$$ 等温等压可逆相变化

$$\Delta S_1 = \frac{Q}{T_1} = \frac{\lambda M}{T_1} = 22.0 J/K$$

$$\begin{matrix} 1mol \\ P_n \\ 273K \\ 水 \end{matrix} \xrightarrow[\Delta S_2]{} \begin{matrix} 1mol \\ P_n \\ 333K \\ 水 \end{matrix}$$ 等压可逆

$$\Delta S_2 = \int \frac{dQ}{T} = \int_{T_1}^{T_2} \frac{cMdT}{T} = cM \ln \frac{T_2}{T_1} = 15 J/K$$

$$\Delta S = \Delta S_1 + \Delta S_2 = 37 J/K$$

T8-44 甲气体摩尔质量为M_1，令乙气体为M_2

$$\Delta S_甲 = \frac{m_1}{M_1} R \ln 2 \qquad \Delta S_乙 = \frac{m_2}{M_2} R \ln 2$$

而 $\frac{m_1}{M_1} = \frac{m_2}{M_2} = \frac{PV_0}{RT}$

$$\Delta S = \Delta S_甲 + \Delta S_乙 = 2 \frac{m_1}{M_1} R \ln 2$$