26、热力学基础（二）

1. A

2. D. 绝热：$Q_1 = \Delta E + W_1 = 0 \Rightarrow \Delta E = -W_1$

W_1 ↓ 看面积

I II III：$Q_2 = \Delta E + W_2 = W_2 - W_1 < 0$

放热

$Q_2 < 0$，$\Delta E < 0$

3. D. 净功 = 所围面积，$S_{ab'c'da} > S_{abcda}$

$\eta = 1 - \frac{T_2}{T_1}$ ← 不变

5. 净功 W = Q 净吸热

= 循环曲线所围面积

= $20 \times 1.013 \times 10^5 \times 8 \times 10^{-3} = 1.6208 \times 10^4$ J

6. AB 等温：$Q_{AB} = W_{AB} = 100$ J，$\Delta E = 0$

BC 等压：$Q_{BC} = \Delta E_{BC} + W_{BC} = -126$ J

CA 等体：$W_{CA} = 0$，$Q_{CA} = \Delta E_{CA} = \Delta E_{CB}$

$= -\Delta E_{BC} = 84$ J

ABCA：$Q = Q_{AB} + Q_{BC} + Q_{CA} = 58$ J

$W = W_{AB} + W_{BC} + W_{CA} = 58$ J

$\Delta E = 0$

$\eta = \frac{W}{Q_1} = \frac{58}{100 + 84} = 31.5\%$

7. 1). A|B: $Q_{A|B}=800J$, $W_{A|B}=500J$

$\Delta E_{AB}=E_B-E_A=800J-500J=300J$

2) B2A: $W_{B2A}=-300J$.

$\Delta E_{BA}=-300J$

$Q_{B2A}=\Delta E_{BA}+W_{B2A}=-600J$

3) $Q_1=Q_{A|B}$, $Q_2=Q_{B2A}$

$\eta=1-\frac{|Q_2|}{Q_1}=25\%$

8. 注意：求净功和净交换热量.

$P_1V_1=\frac{1}{4}P_1V_c \Rightarrow V_c=4V_1$

$Q=W=W_{ab}+W_{bc}+W_{ca}$

$=0+\frac{1}{4}P_1(V_c-V_b)+\nu RT_c\ln(\frac{V_a}{V_c})$

$\Rightarrow Q=W=\frac{1}{4}P_1(4V_1-V_1)+P_1V_1\ln(\frac{V_1}{4V_1})$

$=P_1V_1(\frac{3}{4}-\ln 4)<0$

9. $\nu = 1mol$, $T_1 = 400K$, $T_2 = 300K$

$V_1 = 0.001\ m^3$

$V_2 = 0.005\ m^3$

1) $Q_1 = \nu R T_1 \ln \frac{V_2}{V_1} = 1 \times 8.31 \times 400 \times \ln 5$

$= 5350J$

2) $\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{300}{400} = 0.25$

$\eta = \frac{W}{Q_1} \Rightarrow W = Q_1 \eta = 1338J$

3) $\eta = 1 - \frac{|Q_2|}{Q_1} = 0.25$

$\Rightarrow |Q_2| = 4012J$

或：$W = Q_1 - |Q_2| \Rightarrow |Q_2| = Q_1 - W$

10. $\nu = 1mol$, $i = 3$

a: $P_0 V_0 = R T_0$. b: $9 P_0 V_0 = R T_b \Rightarrow \underline{T_b = 9 T_0}$

C: $P_c = 9 P_0$, $P_c = P_0 \frac{V_c^2}{V_0^2} \Rightarrow \underline{\underline{V_c = 3 V_0}}$ $P_c V_c = R T_c$

$\Rightarrow \underline{T_c = 27 T_0}$

1) ab: $Q_{ab} = \nu C_V (T_b - T_a) = \frac{3}{2} R \times 8 T_0 = 12 R T_0 > 0$, 吸

bC: $Q_{bc} = \nu C_p (T_c - T_b) = \frac{5}{2} R \times 18 T_0 = 45 R T_0 > 0$, 吸

Ca: $Q_{ca} = \Delta E + W_{ca}$

$\Delta E = \nu \cdot \frac{i}{2} R (T_a - T_c) = -39 R T_0$

$W_{ca} = \int_{V_c}^{V_a} P dV = \frac{P_0}{V_0^2} \int_{3V_0}^{V_0} V^2 dV = -\frac{26}{3} P_0 V_0 = -\frac{26}{3} R T_0$

$Q_{ca} = -47.7 R T_0 < 0$, 放

2) $Q_1 = Q_{ab} + Q_{bc}$, $Q_2 = Q_{ca}$, $\eta = 1 - \frac{|Q_2|}{Q_1} = 16.4\%$