NO.

DATE / /

熱力學

机二甲

1014010005

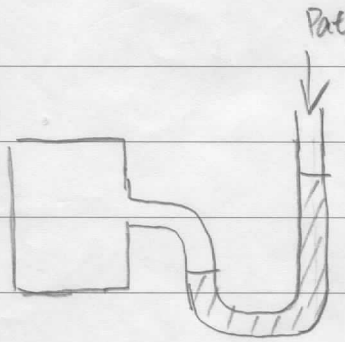
許冠维

A+

熱力学

NO.

DATE / /



$\Delta P = \rho_{水} \cdot g \cdot h$

$[\frac{kg}{m^3}][\frac{m}{s^2}][m]$

$= 1000 \times 9.8 \times 0.1$

$= 980 \frac{N}{m^2} = Pa$

$P_{abs} = P_{atm} + 980Pa$

$\fallingdotseq 10^5 Pa + 980Pa$

$\rho_{水} = 1000 \frac{kg}{m^3}$

比容 $= v_{水} = \frac{1}{1000} \frac{m^3}{kg}$

3-1

吸熱 → +

放熱 ⇒ −

(膨脹)系統对外界作功 ⇒ +

(圧縮)外界对系統作功 ⇒ −

$W = (P \cdot A) \times S$

$= F \times S$

進 圧 煙 排

作業

$Q_{net} = W_{net}$

$q_{net} = w_{net}$

壓縮 −:W

膨脹 +:W

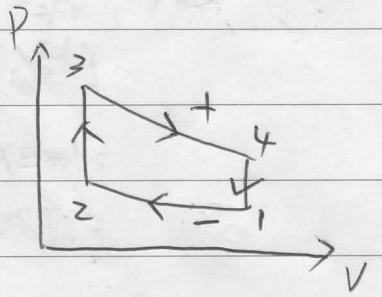
NO.

DATE / /

$|W_{12}| = 100\ kJ/kg$.

$|q_{23}| = 500\ kJ/kg$.

$|W_{34}| = 400\ kJ/kg$.



請問

$|q_{41}| = ?\ kJ/kg$.

$W_{23} = W_{41} = 0$.

$W_{12} = -100\ kJ/kg$ $W_{34} = 400\ kJ/kg$.

$W_{23} = W_{41} = 0$.

$q_{net} = W_{net}$

$q_{23} + q_{41} = W_{12} + W_{34}$

$500 + q_{41} = (-100) + 400$.

$= 300$

$q_{41} = -200\ kJ/kg$ ※.

$\therefore W_{net} = W_{12} + W_{23} + W_{34} + W_{41}$

$= -100 + 400$

$= 300\ kJ/kg$ ※

功 力 位移

$W = F \cdot \Delta S$

$= P \cdot (A \cdot \Delta S) = \boxed{P \cdot \Delta V}$

壓力 作用面積 體積變化量

NO.

DATE / /

有一活塞汽缸裝置

其內部盛裝3kg空氣

若活塞在等壓過程下膨脹

壓力為100kpa

膨脹前空氣比容為 $0.8\frac{m^3}{kg}$

：後 ： $1.0\frac{m^3}{kg}$

請問系統做功多少？

$[Pa]\cdot[m^3]=[J]$

$[kpa]\cdot[m^3]=[kJ]$

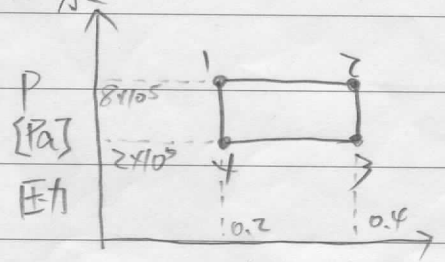
$[kpa]\cdot[\frac{m^3}{kg}]=[\frac{kJ}{kg}]$

$W=\int_1^2 P\,dV$ = 曲線下面積

$=P(V_2-V_1)$

$=500(0.5-0.1)=200\ kJ/kg$

作業



1→2 等壓過程

2→3 等容過程

3→4 等壓

4→1 等容

工作流體 2kg

請計算

此循環下

$W_{12}=?$ ∴ $W_{12}=P_{12}\cdot(V_2-V_1)=(8\times10^5 Pa)(V_2-V_1)m$

$=(8\times10^5)(0.4-0.2)\cdot 2=3.2\times10^5\ J$

$W_{34}=?$ ∴ $W_{34}=P_{34}\cdot(V_4-V_3)=(2\times10^5 Pa)\cdot(0.2-0.4)-2$

$=-0.8\times10^5 J$

W_{net} 淨功=?J $W_{12}+W_{23}+W_{34}+W_{41}=(3.2\times10^5)+(-0.8\times10^5)$

$=2.4\times10^5 J=Q_{net}$

Q_{net} 淨熱量=?J

NO.

DATE / /

$(q-w)+(p_1V_1+u_1+\frac{1}{2}V_1^2+gz_1)-(p_2V_2+u_2+\frac{1}{2}V_2^2+gz_2)=0$

$\Rightarrow 85000\left[\frac{J}{kg}\right]+(10^5\times0.83+u_1+\frac{1}{2}9.46^2)-(10^5\times1.074+u_2+\frac{1}{2}75^2)=$

PS. ① u代表內能，它是溫度的函數。

② $u_1-u_2=C_v(T_1-T_2)=1007(32+20)$

$=(1007)(88)\left[\frac{J}{kg}\right]$.

1234;

69 封閉系統

如果

$U_1=50$ kJ

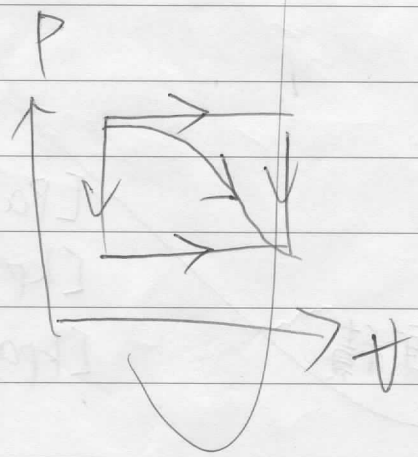
1→2 = 吸熱10 kJ

2→3 = 放熱20 kJ

1→2 做功 $|W_{12}|=15$ kJ

請問 $U_2=?$

$U_3=?$



$Q_{12}-W_{12}=U_2-U_1$

$10-15=U_2-50$

$-5=U_2-50$

$U_2=45$ kJ

$Q_{23}-W_{23}=U_3-U_2$

$-20-0=U_3-45$

$U_3=25$ kJ

NO.

DATE / /

請問 若 $|W_{34}| = 10$ kJ

而 $U_4 = 40$ kJ

請問 $Q_{34} = ?$

$Q_{41} = ?$

$Q_{34} - W_{34} = U_4 - U_3$

$Q_{34} - (-10) = 40 - 75$.

$Q_{34} = 5$ kJ

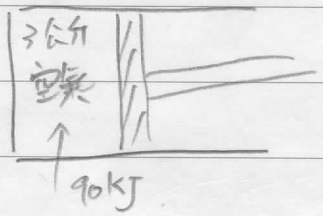
$Q_{41} - W_{41} = U_1 - U_4$

$Q_{41} - 0 = 50 - 40$

$Q_{41} = 10$ kJ

★作業.

活塞膨脹作功 20 kJ/kg



閉密氣體內能改變量?

公式: $Q - W = \Delta U$(內能) $+ \Delta K.E. + \Delta P.E.$

動能 位能

$\Rightarrow Q - W = \Delta u = u_2 - u_1$

比熱的定容量

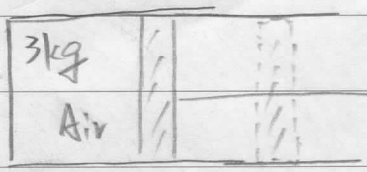
$90\text{kJ} - 20\frac{\text{kJ}}{\text{kg}} \times 3 = \Delta U = 30$ kJ

$\Delta U = \frac{\Delta U}{m} = \frac{30\text{kJ}}{3\text{kg}} = 10$ kJ/kg.

NO.

DATE / /

作業一



等壓膨脹

壓力 $P = 100 kPa$

$v_1 = 0.8 \frac{m^3}{kg}$

$v_2 = 1.0 \frac{m^3}{kg}$

$W = P \cdot \Delta V$

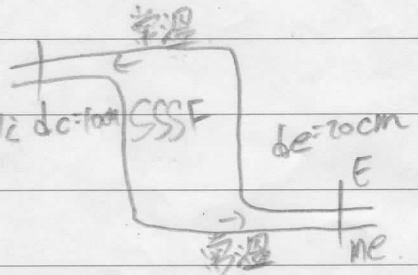
$= P(V_2 - V_1)$

$= (100 kPa)(V_2 - V_1) \cdot m$

$= (100)(1 - 0.8) \cdot 3$

$= 60 kJ$

作業二



$\dot{m}_i = 10 \frac{kg}{s}$

求 ① 入口之 V_i ? $\frac{m}{s}$

② 出口之 V_e = ? $\frac{m^3}{s}$

SSSF = $\begin{cases} (i) \dot{m}_i = \dot{m}_e \\ (ii) \frac{\partial}{\partial t} = 0 \end{cases}$

$[\frac{kg}{s}] [\frac{m^3}{kg}] [m^2] [\frac{m}{s}]$

$\dot{m} = \rho \cdot A \cdot V$

$\dot{m}$ 質量流率　ρ 密度　A 通過截面積　V 流體速度

NO.

DATE / /

$\dot{m}_i = 10\frac{kg}{s}$

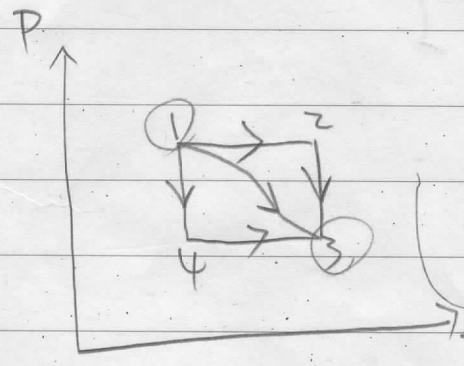
$= \rho_* (\frac{\pi}{4} 0.1^2] \cdot V_i$

$= 1000\frac{kg}{m^3} (\frac{\pi}{4} 0.1^2] V_i$

② $\dot{m}_o = \dot{m}_i = 10\frac{kg}{s}$

$= \rho_* \cdot v_e$

$= 1000\frac{kg}{m^3} \cdot v_e$



沿 1→2→3 过程下

吸热 47.5 kJ

作功 30 kJ

求 1→4→3 过程时且其作功为 15kJ 系统之热传量?

$Q_{13} - W_{13} = \Delta U = U_3 - U_1$

$Q_{123} - W_{123} = U_3 - U_1 = 47.5 - 30 = 17.5\ kJ$

$Q_{143} - W_{143} = U_3 - U_1 = Q_{143} - 15 = 17.5\ kJ$

$\therefore Q_{143} = 32.5\ kJ$ ※

NO.

DATE / /

100kg之Air在 - closed system

$P_1 = 100\,kpa$, $V = 86.1\,m^3$

$P_2 = 1500\,kpa$, $P_1V_1^{1.3} = P_2V_2^{1.3} = C$

如果压缩过程: $PV^{1.3} = C$.

求作功 = ? kJ ↳ $P = V^{-1.3} \cdot C$

Ans: $W = \int_1^2 P \cdot dV$

$= C \int_1^2 V^{-1.3} \cdot dV$

$= (100kpa)(86.1m^3) \cdot \left[\frac{1}{-1.3+1}\right]\left[V_2^{-1.3+1} - V_1^{-1.3+1}\right]$

$= (100kpa)(86.1m^3)\left(-\frac{1}{0.3}\right)\left(V_2^{-0.3} - V_1^{-0.3}\right]$

$P_1V_1^{1.3} = P_2V_2^{1.3}$

$\Rightarrow (100)(86.1)^{1.3} = (1500)(V_2)^{1.3}$.