(1)

GIVEN

Piston-cylinder w/ CO(g) has 3-processes

process 1-2 : Isobar @ $P_1 = P_2 = 5$ bar $= 5\times10^5$ Pa, $V_1 = 0.2\ m^3 \rightarrow V_2 = 1\ m^3$

" 2-3 : Isovol to $P_3 = 1$ bar $= 1\times10^5$ Pa

" 3-1 : Isothermal to state 1

>> $R = 8.314\ J K^{-1} mol^{-1}$

FIND

(a) p-V diagram

(b) work $\equiv \bar{W}$ for each process (kJ)

EQUATION

$\Delta U = Q - \bar{W}$

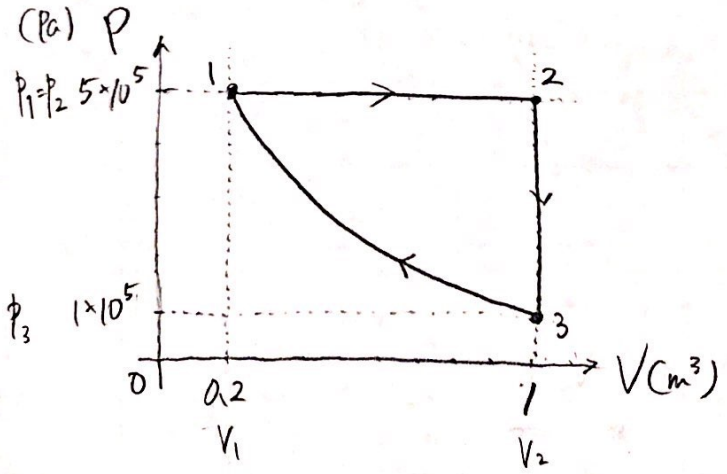
$PV = nRT$

ASSUMPTION

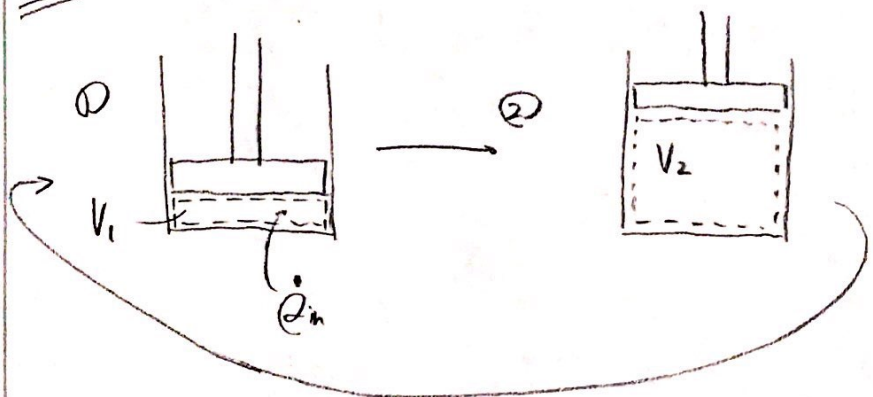
- ideal gas
- steady state
- quasi equilibrium
- closed system

SOLN

(a)



FFD



(b)

$$W_{12} = \int_{V_1}^{V_2} P_1 dV = P_1(V_2 - V_1) = (5\times10^5\,Pa)(1\,m^3 - 0.2\,m^3) = 4\times10^5\,J$$

$$W_{23} = 0 \quad \because \Delta V = 0$$

$T_1 = T_3$ & $dQ_{12} = dU_{12} + W_{12}$

$P_1V_1 = nRT_1$ $\quad nC_p dT = nC_v dT + W_{12}$

$P_2V_2 = nRT_2$ $\quad nR dT = W_{12}$

$P_3V_2 = nRT_3$ $\quad nR(T_2 - T_1) = 4\times10^5$

$$T_2 - T_1 = \frac{4\times10^5}{nR} \quad \cdots ①$$

$$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2} \Leftrightarrow T_1 = \frac{P_1V_1}{P_2V_2}T_2 = \frac{1\times10^5}{5\times10^5}T_2 = \frac{1}{5}T_2 \quad \cdots ②$$

$\because$ ① & ② $\quad 5T_1 - T_1 = \frac{4\times10^5}{nR}$

$$T_1 = \frac{1\times10^5}{nR}$$

$$W_{31} = \int_{V_2}^{V_1} \frac{nRT_1}{V} dV$$

$$= 1\times10^5 [\ln V]_{V_2}^{V_1} = 1\times10^5 \ln\frac{V_1}{V_2}$$

$$= \ln(0.2)\times10^5$$

$$\fallingdotseq -160943\,J$$

$W_{12} = 400\,kJ$

$W_{23} = 0\,kJ$

$W_{31} = -161\,kJ$

P8 11

GIVEN

10V battery supply, constant current at 0.5 A to a resistor (x Ω) for 30 min

FIND

(a) resistance x

(b) Energy transfer by Work in kJ

EQUATION

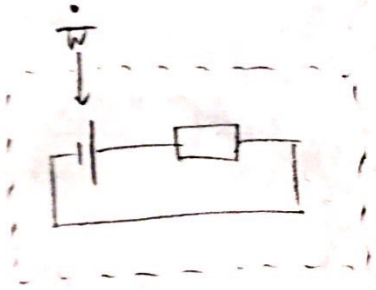
$V = IR$ $W = Pt$ t = time

$P = VI$ P = power W = work

ASSUMPTION

closed system

FBD



SOLN

(a) $x = \frac{V}{I} = \frac{10\,V}{0.5\,A} = \boxed{20\,\Omega}$

(b) $W = (60 \times 30\,s)(10\,V)(0.5\,A)$

$= 9000\,J$

$= \boxed{9\,kJ}$