Subject : Physics

Class : XI

Kannada

Thermodynamics

First law of thermodynamics

$\Delta Q = \Delta U + \Delta W$

Work Done

$\Delta W = P\Delta W$

$\therefore \Delta Q = \Delta U + P\Delta V$

Relation between specific heats for a gas

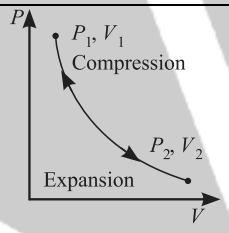
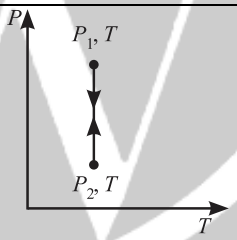
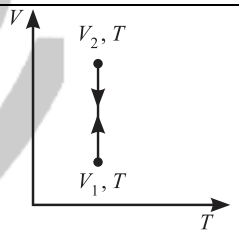
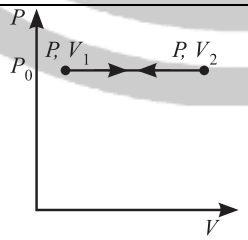
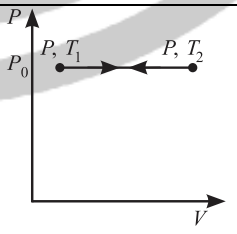
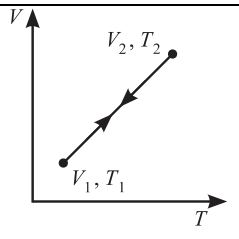
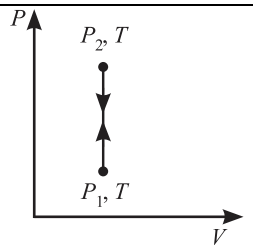
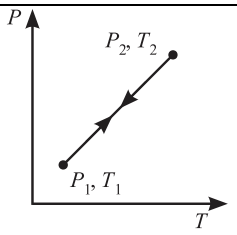
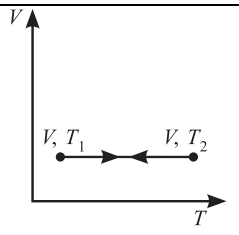
$C_P - C_v = R$

Polytropic Process

It is a thermodynamic process that can be expressed as follows:

PV^x = Constant

x (Polytropic exponent)	Type of standard process	Expression
0	Isobaric ($dP = 0$)	P = Constant
1	Isothermal ($dT = 0$)	PV = Constant
γ	Adiabatic ($dQ = 0$)	PV^γ = Constant
∞	Isochoric ($dV = 0$)	V = Constant

Process	Defination	*P-V* graph	*P-T* graph	*V-T* graph
Isothermal	Temperature constant			
Isobaric	Pressure constant			
Isocharic	Volume constant			

For any General Process

$$\Delta Q = \Delta U + W$$

$$\Rightarrow nC\Delta T = \frac{f}{2}nR\Delta T + \frac{nR\Delta T}{1-x}$$ [$\because$ Work done in a general polytorpic process = [n$R\Delta T$/(1 – x)]

$$\Rightarrow C = \frac{f}{2}R + \frac{R}{1-x}$$

For infinitesimal changes in Q, U, and W, we ca write,

$dQ = dU + dW$

$$\Rightarrow nCdT = \frac{f}{2}nRdT + PdV$$

$$\Rightarrow \quad C = \frac{f}{2}R + \frac{P}{n}\frac{dV}{dT}$$

Porcess	**voLFkk dk lehdj.k**	***W***	Δ***U***
Isobaric (dP = 0)	$\frac{V}{T} = c$	$P(V_f - V_i) = nR(T_f - T_i)$	$\frac{f}{2}nR(T_f - T_i) = \frac{f}{2}P(V_f - V_i)$
Isochoric (dV = 0)	$\frac{P}{T} = c$	0	$\frac{f}{2}nR(T_f - T_i) = \frac{f}{2}V(P_f - P_i)$
Isothermal (dT = 0)	$PV = c$	$nRT\ln\left(\frac{V_f}{V_i}\right) = nRT\ln\left(\frac{P_i}{P_f}\right)$	0
Adiabatic (dQ = 0)	$PV^{\gamma} = c$	$\frac{f}{2}nR(T_i - T_f)$ $= \frac{f}{2}(P_iT_i - P_fT_f)$	$\frac{f}{2}nR(T_f - T_i)$

Process	**ΔQ**
Isobaric (dP = 0)	$\left(\frac{f}{2}+1\right)nR\Delta T = \left(\frac{f}{2}+1\right)P(V_f - V_i)$
Isochoric(dV = 0)	$\frac{f}{2}nR(T_f - T_i) = \frac{f}{2}V(P_f - P_i)$
Isothermal (dT = 0)	$nRT\ln\left(\frac{V_f}{V_i}\right) = nRT\ln\left(\frac{P_i}{P_f}\right)$
Adiabatic (dQ = 0)	0

Slope of adiabatic = γ (slope of isotherm)

Carnot engine

$$\eta = 1 - \frac{Q_2}{Q_1} = 1 - \frac{T_2}{T_1}$$

$$\frac{Q_1}{Q_2}=\frac{T_1}{T_2}$$

$$W=Q_1-Q_2 \text{ (efficiency) } \eta=\frac{W}{Q_1}$$

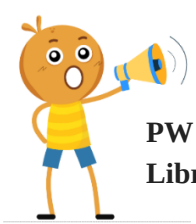
Refrigerator

Coefficient of performance is β

$$\beta=\frac{Q_2}{Q_1-Q_2}=\frac{Q_2}{W};\beta=\frac{1-\eta}{\eta}$$

Heat pump

$$\alpha=\frac{Q_1}{W}=\frac{Q_1}{Q_1-Q_2}=\frac{1}{\eta}$$



PW Web/App - https://smart.link/7wwosivoicgd4
Library- https://smart.link/sdfez8ejd80if