O-I  (25)

$20° \longrightarrow 0°$

500 gm

ice

$$n C \Delta T = \frac{500}{18} \times 75.6 \times 20 = \frac{n \times 9}{18} \times 6000 \text{ J}$$

(24)

$$W = -P_{ext}(V_2 - V_1)$$

$$= -1 \ (3) \ atm. \ lit = -300 \ J = -0.3 \ kJ$$

$$\boxed{\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}}$$

$$\frac{10}{300} = \frac{20}{T} \implies \underline{T = 600}$$

$$Q = (nc) \Delta T$$

$$= 50 \times 300$$

$$= 15000 =$$

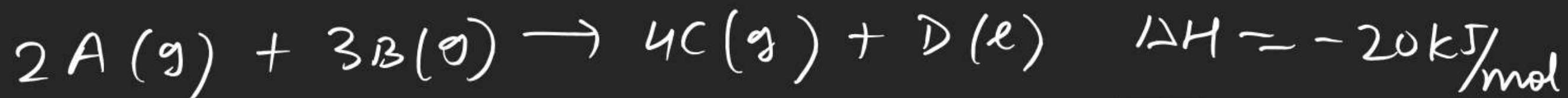$$= 15 kJ$$

$$\Delta U = Q + W$$

$$= 15 - 0.3 = 14.7$$

$$\Delta H = \Delta U + (P_2 V_2 - P_1 V_1)$$

S-I    Q.No 20    **THERMODYNAMICS**

$$2A(g) + 3B(\ell) \rightarrow 4C(g) + D(\ell) \qquad \Delta H = -20 \, kJ/mol$$

$$\Delta n_g = -1$$

$$-20 \, kJ = \Delta U + \frac{(-1) \times 8.3 \times 300}{1000}$$
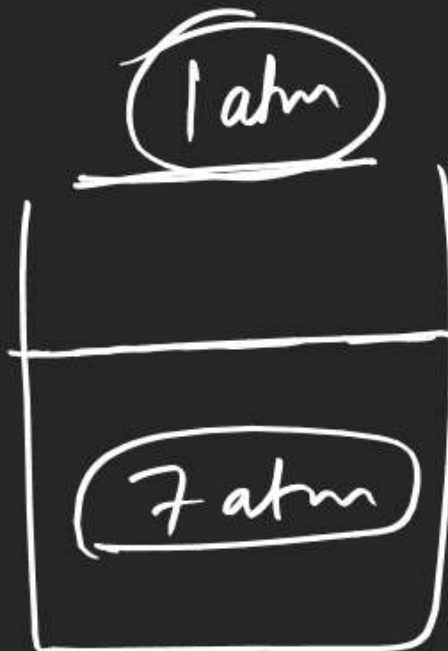
$$-20 + 2.49 = \Delta U$$

$$-17.51 = \Delta U$$

$$2 \longrightarrow -17.51$$

$$0.4 \longrightarrow \boxed{-\frac{17.51}{2} \times 0.4}$$

$(25)$

1 atm

7 atm

irrev

$$W = -1 \times (V_2 - V_1)$$

$$= -1 \times 6$$

$$W = -6 \text{ atm. lit}$$

Work done on the surround $= \underline{6 \text{ atm lit}}$

$$P_1 V_1 = P_2 V_2$$

$$7 \times 1 = 1 \times V$$

10 atm → 1 atm
expansion
T = 300 K

① $W_{rev} = \boxed{-690\,R}$

② $\boxed{W_{irr} = -270\,R}$

1 atm → 10 atm
compression
T = 300 K

① $\boxed{W = 690\,R}$

② $W = 2700\,R$

③ In a rev process
both system and surrounding
can be restored to their
original state simultaneously

Conclusion :— ① In case of expansion

$$|W_{rev}| \geq |W_{irr}|$$
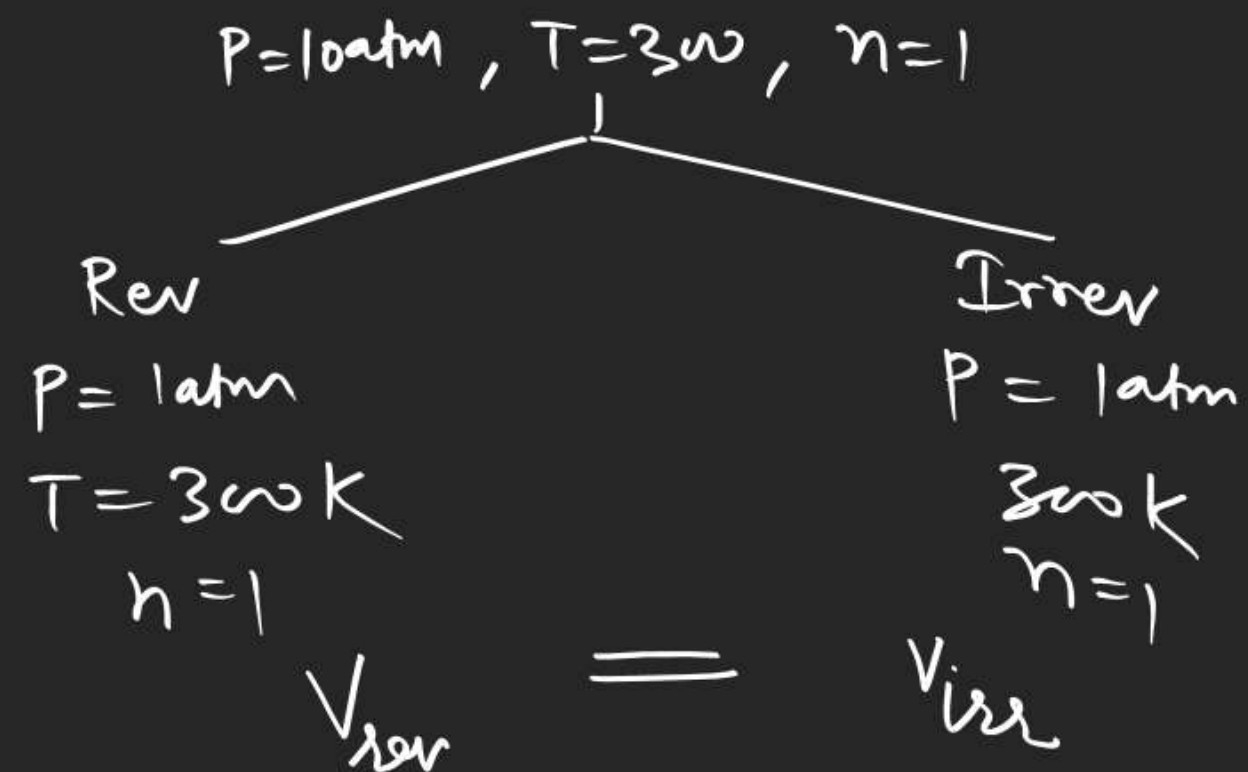
② In case of comp$^n$

$$|W_{rev}| \leq |W_{irr}|$$

but in an irreversible process both can be not restored to their original state simultaneously.

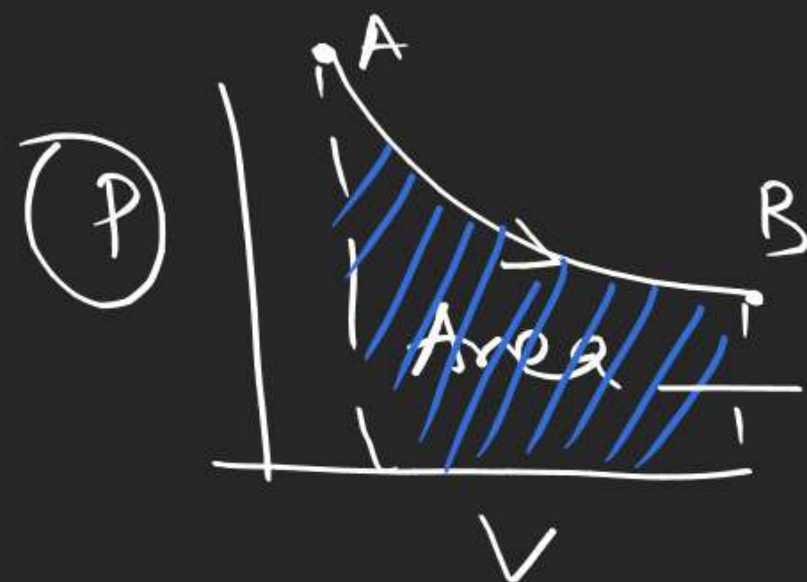④         Reversible process are more efficient than irrev process

⑤

$$P = 10 \text{ atm}, \quad T = 300, \quad n = 1$$

Rev
$P = 1 \text{ atm}$
$T = 300 K$
$n = 1$

$$V_{rev}$$

Irrev
$P = 1 \text{ atm}$
$300 K$
$n = 1$

$$V_{irr}$$

$$V_{rev} = V_{irr}$$

Isothermal reversible and irrev process end up at the same final state if carried out against same final pressure from same initial state.
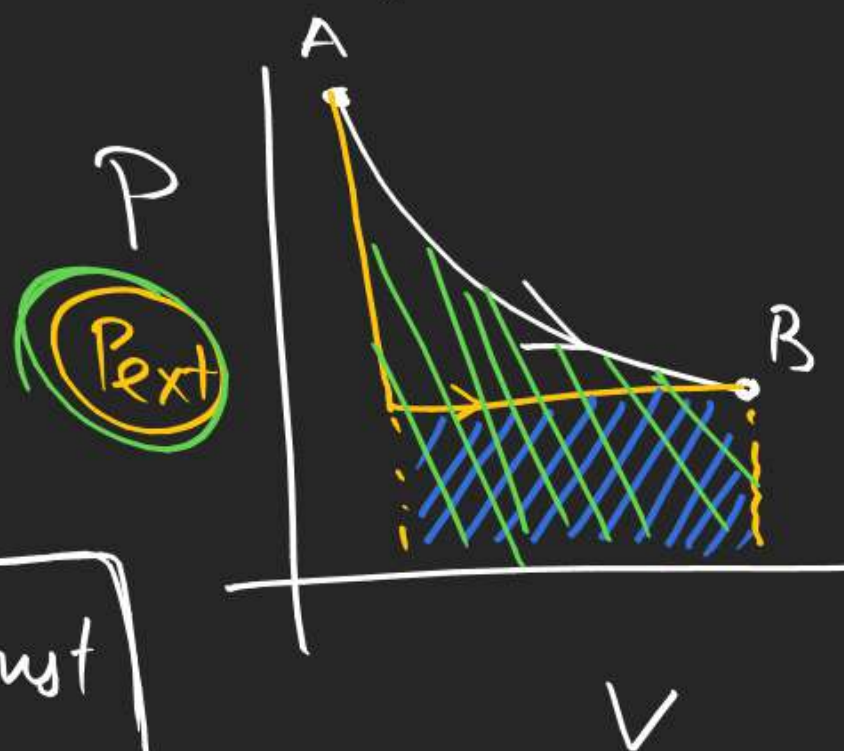
# THERMODYNAMICS

Graphical representation of work done
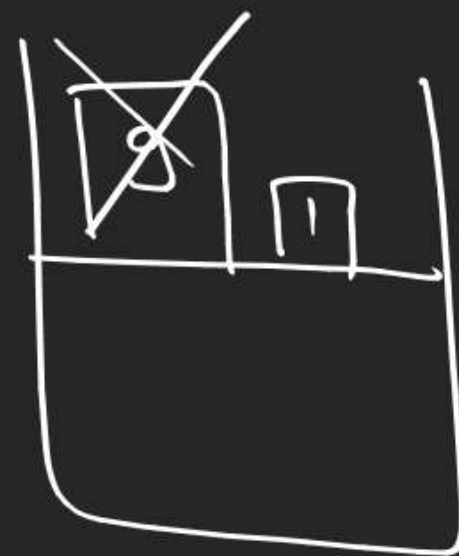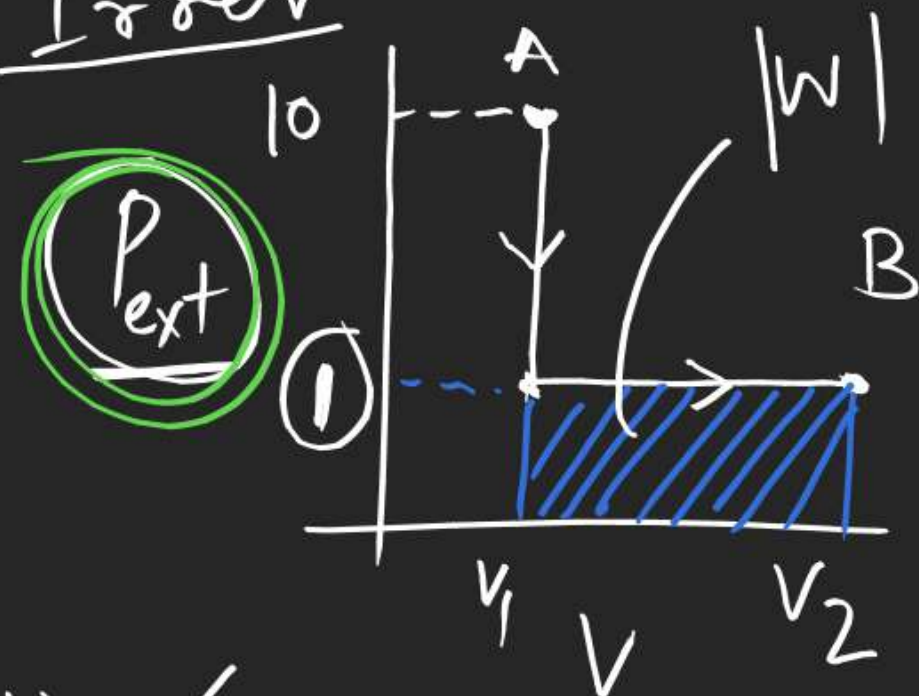
$$|W| = \boxed{P(V_2 - V_1)}$$

① Rev

Area $= \int P dV = |W|$



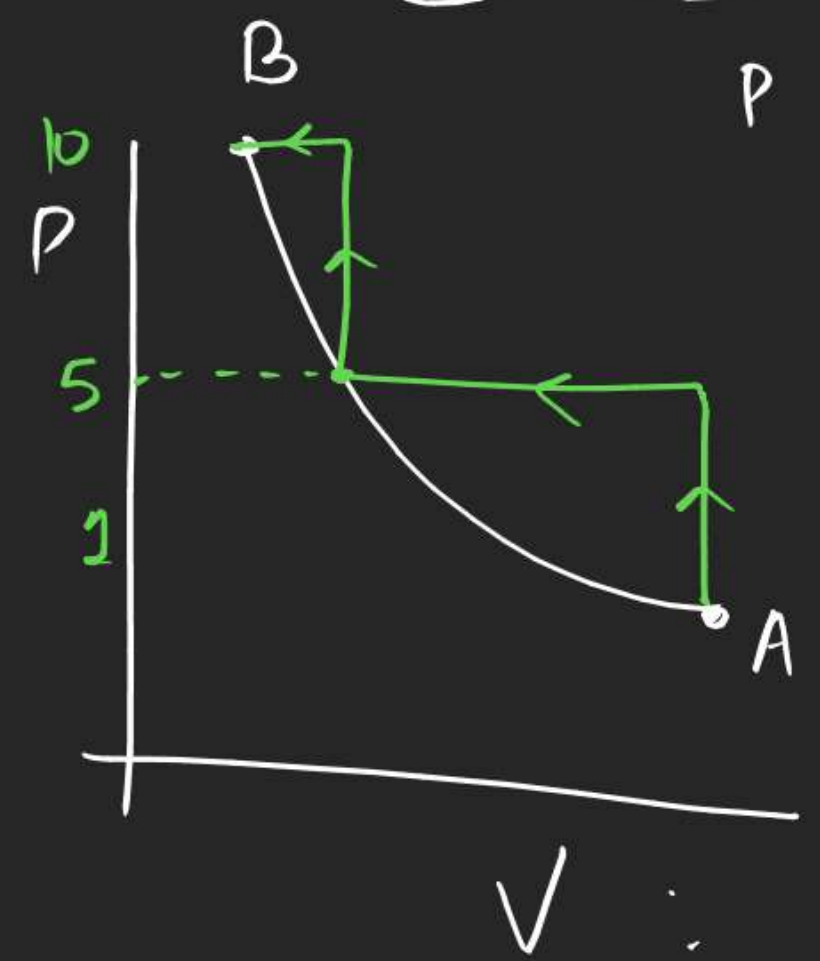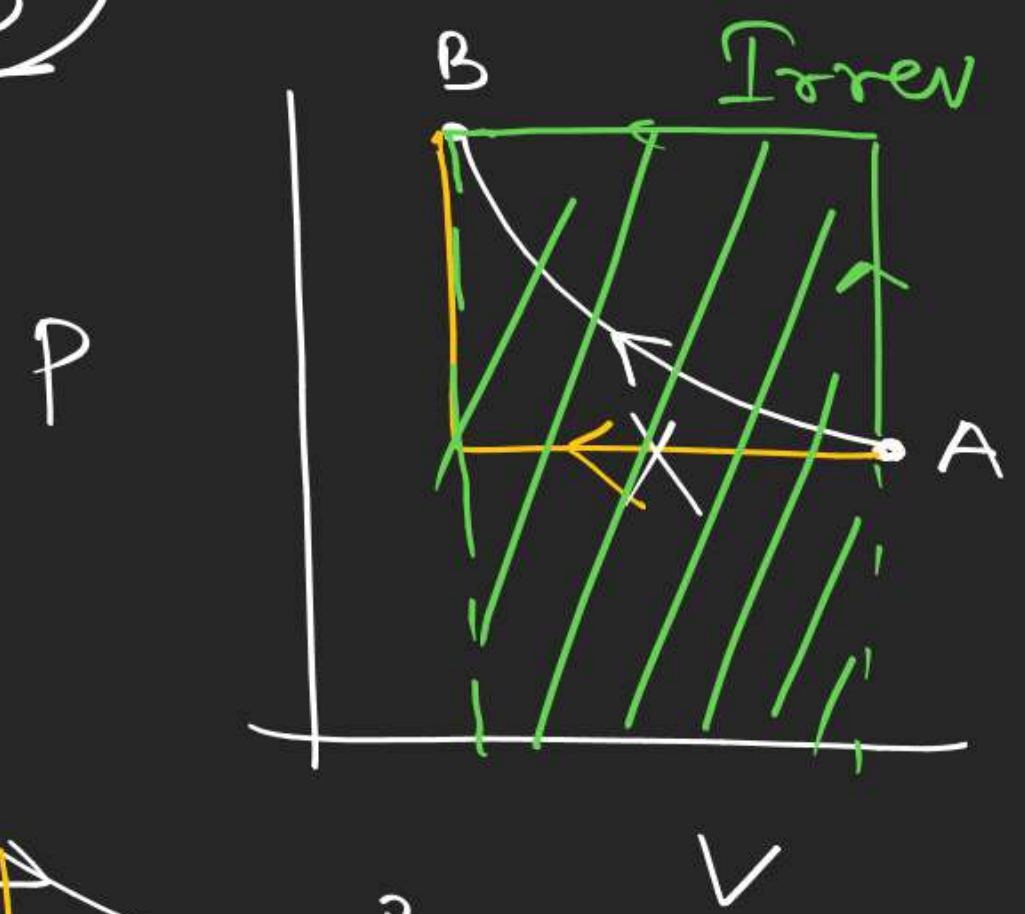② Irrev

$P_{ext}$

$$PV = nRT = Const$$

$$\boxed{Comp^n}$$

$$\boxed{PV} = \boxed{nRT}$$

**Irrev**

B

A

P

V

10
P
5
1

B

A

P

V

P

V

A

B

$P$

A

$\boxed{\text{hyperbola}}$

B

$P = \underline{nRT}\left(\dfrac{1}{V}\right)$

$V$

Isothermal

$P$

isothermal

Area $\neq |W|$

$\dfrac{1}{V}$

Isothermal
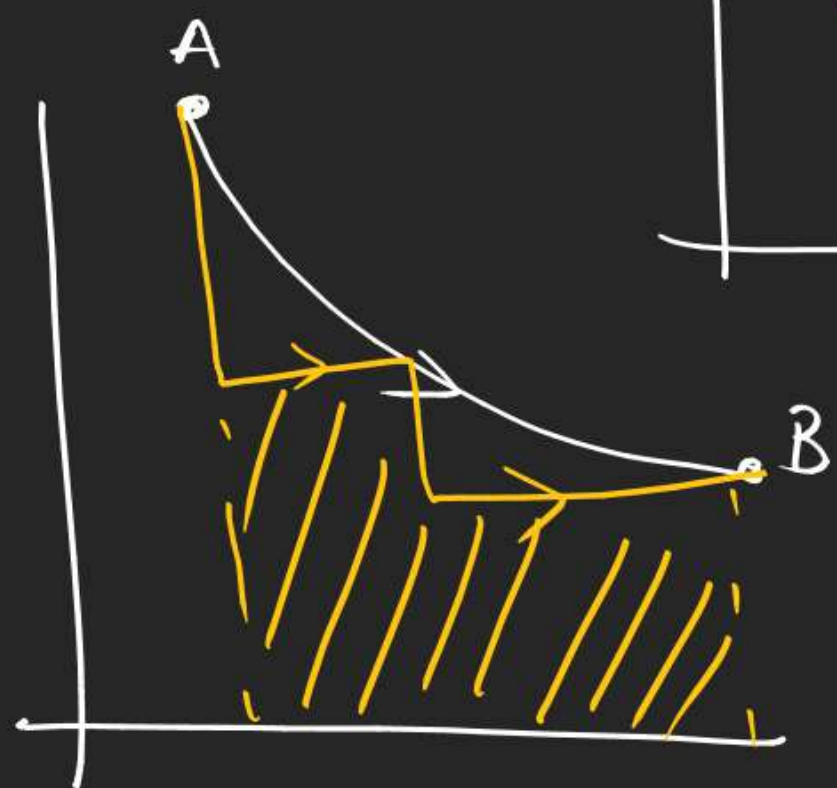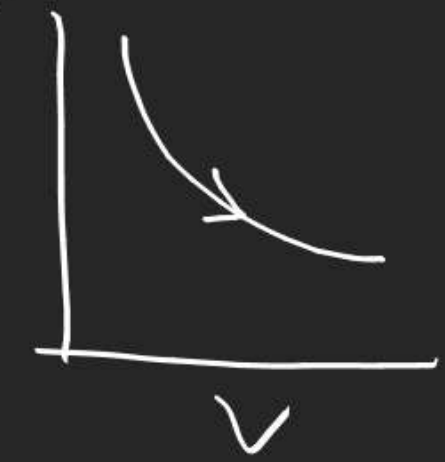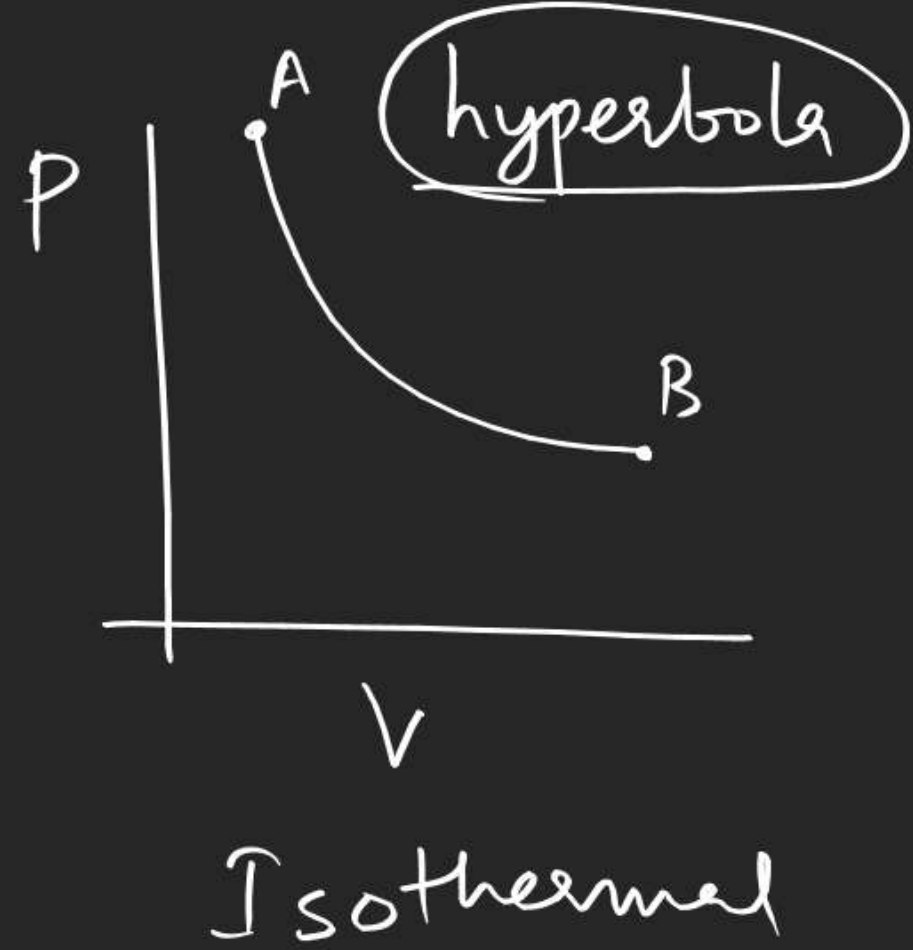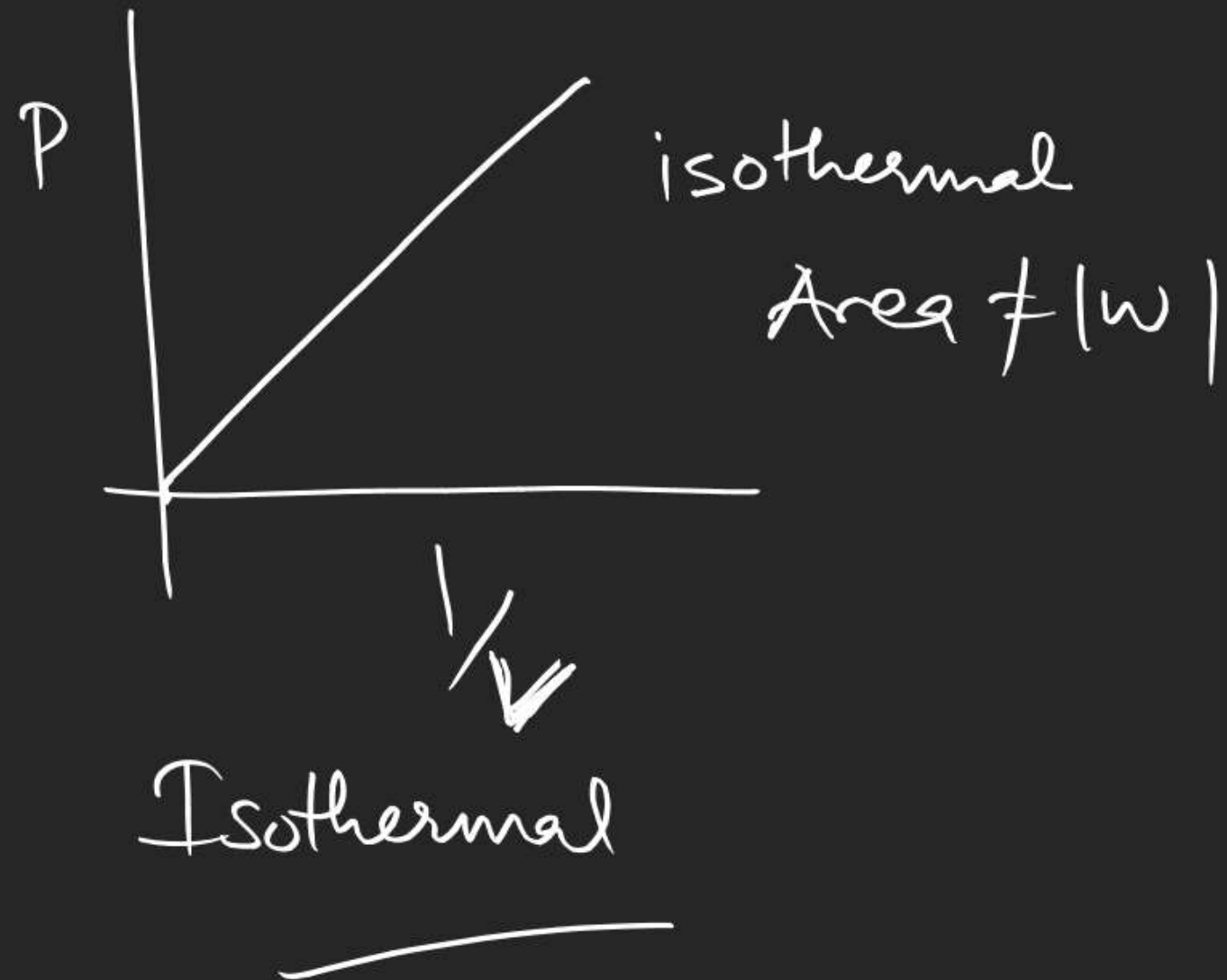
# THERMODYNAMICS

## Isochoric process

\#    $V = $ Const

\#    $W = 0$

\#    $\Delta U = Q_v = n C_v \Delta T$ $\underline{\left(\text{for any substance}\right)}$

\#    $\Delta H = n C_p \Delta T$ $\left(\text{for ideal gas, solid \& liq}\right)$

for real gas    $dH = n C_p dT + \left(\dfrac{\partial H}{\partial P}\right)_T dp$

or

$$\Delta H = \Delta U + \left(P_2 V_2 - P_1 V_1\right)$$

$P = \left(\dfrac{nR}{V}\right) T$
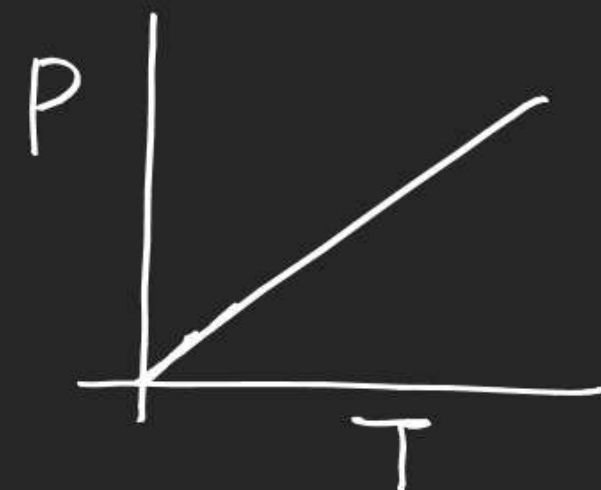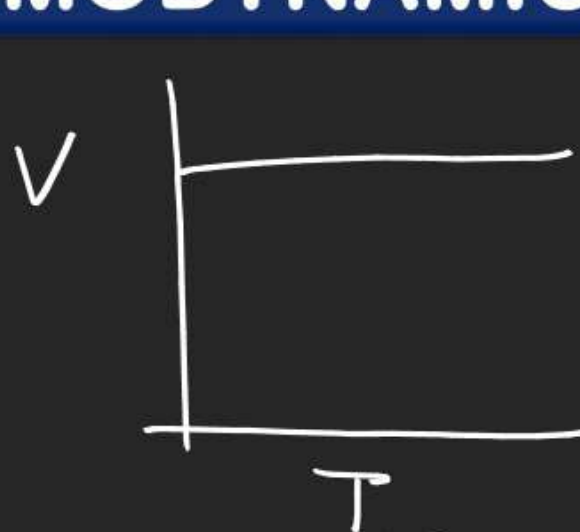
③ <u>Isobaric process</u>

\# $P = const$

\# $\Delta H = Q_p = n C_p \Delta T$ (for any substance)

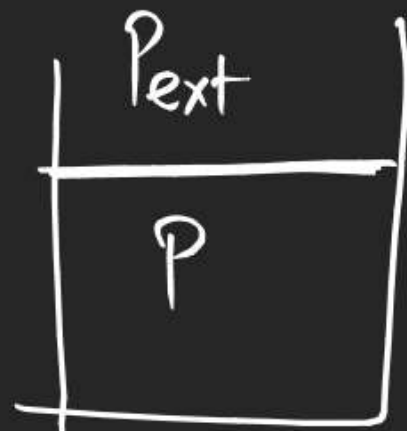\# $\Delta U = n C_v \Delta T$ (for ideal, solid & liq)

for real gas

$$dU = C_v dT + \left(\frac{\partial U}{\partial V}\right)_T dV$$

or

$$\Delta H = \Delta U + (P_2 V_2 - P_1 V_1)$$

**THERMODYNAMICS**

Work done

$$W = -\int P_{ext} \, dV$$

$P_{ext}$

$P$

for isobaric process  $P_{ext} = P = const$

$$\boxed{W = -P_{ext}(V_2 - V_1)} \longleftarrow \text{ for any change involving any substance}$$

@ for ideal gas not undergoing any chemical & phase

$$W = -\int P \, dV = -\int d(PV) = -\int d(nRT)$$

$$\boxed{W = -nR(T_2 - T_1)}$$

(b) for chemical & phase change

$$W = - \int d(PV)$$

$$= - \int d(nRT)$$

$$\boxed{W = - \Delta n_g RT}$$

$$\boxed{W = - P_{ext}(V_2 - V_1)}$$