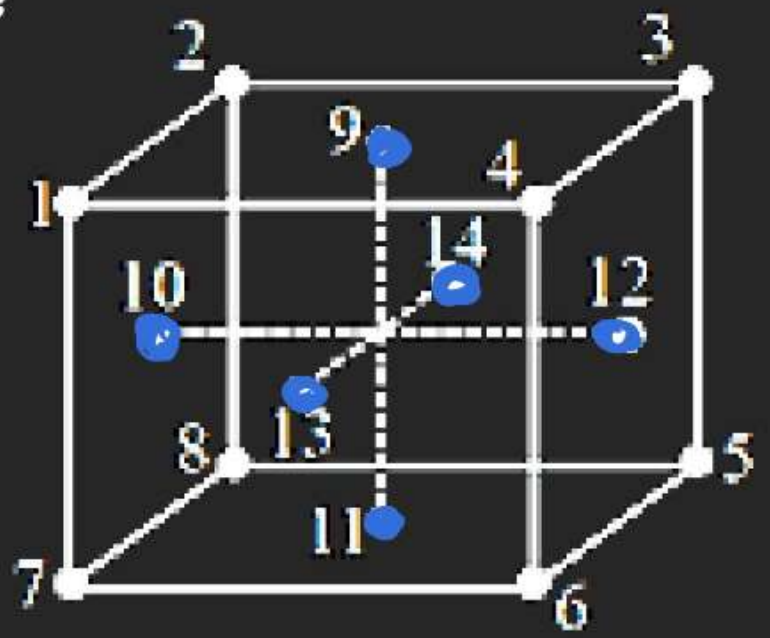
1. In FCC unit cell shown which of the following statements are correct –



(A) sphere 11 & 14 touch each other

(B) sphere 10 & 14 touch each other

(C) sphere 10 & 12 are at a distance of $2\sqrt{2}r$

(D) There are six  planes in the FCC unit cell having such arrangement of atoms

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<u>Ans</u> A B C — 4 Marks

A, or B, or C — 1

A C, or A B, or B C — 2

A D, A B D, B C D — -2

A B C D

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4. In a compound, A atoms are at FCC lattice positions, B atoms are in all tetrahedral voids and C atoms are in all octahedral voids of this lattice. Assume B and C are of appropriate size so that there is no distortion in FCC lattice. Find correct statement (s)

(A) formula of the compound is AB_2C

F (B) In this compound B atoms will be touching the C atoms.

(C) if atomic masses of A, B and C are 20, 30, and 40 respectively, then mass of unit cell is 480 amu

(D) if radius of A atoms is 200 pm edge length of unit cell is $4\sqrt{2}$Å

Paragraph for 1 to 3

In solids, the constituent particles are closed packed, leaving the minimum vacant space. The constituent particles are identical hard spheres and they build the three-dimensional structure. In ionic solids normally the bigger anions occupy the void spaces, depending on their relative size.

1. An ionic solid has some point defect but its experimental density is equal to its theoretical density. The type of defect is

   (A) Schottky defect ↓

   (B) Frenkel defect

   (C)Metal excess defect ↑

   (D) Metal deficient defect ↓

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2. The radius ration of P^{2+} and Q^{-} ions $\left(\frac{r_{P^{2+}}}{r_{Q^{-}}}\right)$ is 0.8. The unit cell of this ionic solid is

F (A) Simple cubic for Q^{-} ions and P^{2+} ions occupy all the cubic voids

(B) Face centred cubic for Q^{-} ions and P^{2+} ions occupy all the tetrahedral voids.

T (C) Face centred cubic for P^{2+} ions and Q^{-} ions occupy all the tetrahedral voids.

(D) Face centred cubic for Q^{-} ions and P^{2+} ions occupy 50% of octahedral voids.

PQ_2 CaF_2

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3. An ionic solid PQ crystallises in rock salt structure with density 4.0 gm/cm^3. If the radius of cation and anion is 83 and 167 pm respectively, then the molar mass of solid is [$N_A = 6 \times 10^{23}$]

(A) 75 gm/cm^3 (B) 50 gm/cm^3 (C) 25 gm/cm^3 (D) 150 gm/cm^3

INTEGER

1. An unknown solution [mol. wt. of solute = 250] is 20% (w/w). Molarity of solution is. [Given $d_{solution}$ = 1.25 g/ml]

100 gm solution contains 20 gm solute

$\frac{100}{1.25}$ ml solⁿ " " $\frac{20}{250}$ moles solute

$$M = \frac{20/250}{100/1.25} \times 1000 = 1$$

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4. Calculate % volume occupied by atoms in CsCl type structure assuming anion-anion contact.

[Given $\frac{r_+}{r_-} = 0.7$; ~~p = 3~~; $\sqrt{3} = 1.7$] $\pi = 3$

1. Select the correct statement -

(A) Frenkel defect is a non-stoichiometric defect

(B) F-centres are due to Frenkel defect

(C) ZnO shows yellow colour on heating due to metal excess defect

(D) Schottky defect is more probable if difference in radius of cation and anion are large.

4. Molality(m) of a sulphuric acid solution in which the mol fraction of water is 0.85 is :

(A) 4.9 (B) 9.8 (C) 19.6 (D) 14.7

H_2O H_2SO_4

0.85 0.15 mol

0.85 x 18 gm

$$m = \frac{0.15}{0.85 \times 18} \times 1000$$

7. Select the correct statements

F (A) System having non-permeable and adiabatic boundary must be isolated

T (B) Molarity, normality & molality all are intensive properties

F (C) DU = q + w can be used for any system.

T (D) Close system can transfer energy only.

10. Select CORRECT option about cubic crystal system-

(A) Packing fraction along body diagonal in PC (SC) is $\frac{1}{\sqrt{3}}$

/ (B) Packing fraction along edge in bcc is $\frac{\sqrt{3}}{2}$

F (C) Packing fraction along face diagonal in fcc is $\frac{1}{\sqrt{2}}$

T (D) 3-D packing fraction follows the order fcc > bcc > pc

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13. Combustion of glucose is given by reaction

$C_6H_{12}O_6(s) + 6O_2(g)$ ¾® $6CO_2(g) + 6H_2O(g)$; DH = –300 Kcal/mole

If 5 moles of glucose mixed with 20 moles of oxygen in a closed rigid container.

Amount of heat evolved (in kcal) at 500 K is : [R = 2 Cal/Mole-K]

$\Delta U = ?$

$$-300 = \Delta U + \frac{(6) \times 2 \times 500}{1000}$$

$$-306 = \Delta U$$

$$\frac{306}{6} \times 20$$

$$Q = \Delta U = -1020$$

heat evolved = 1020

1 lit

16. 2 moles of an ideal gas is compressed from (1 bar, 2L) to 2 bar isothermally.

Calculate magnitude of minimum possible work in the change (in Joules).

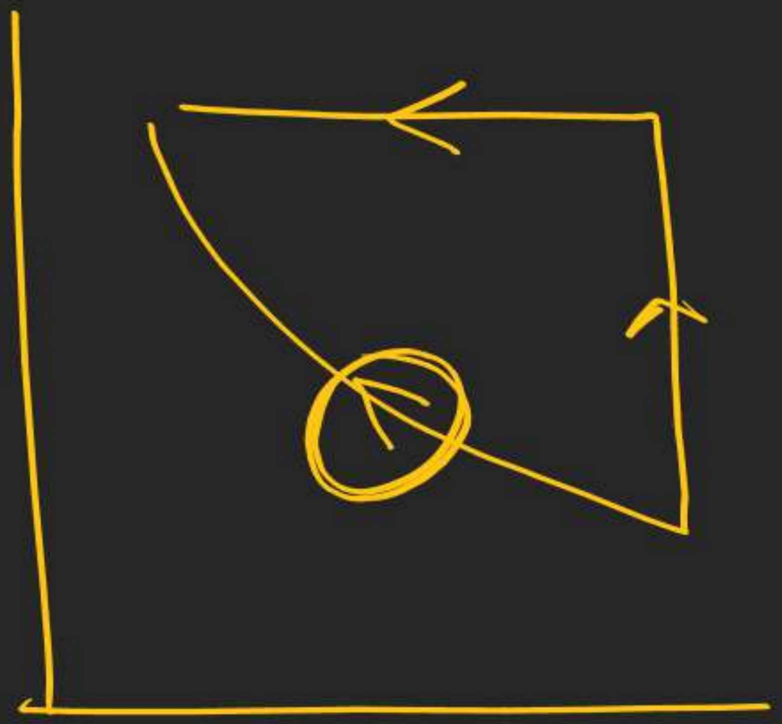
(Given: 1 bar L=100 J) (ln 2 = 0.7)

$$= -nRT \ln \frac{P_1}{P_2}$$

$$= -PV \ln \frac{P_1}{P_2}$$

$$= -1 \times 2 \ln \frac{1}{2}$$

$$= 2 \ln 2$$



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28 (i) (2 bar, 4 lit) (20 bar, 0.4)

$P_1V_1 = P_2V_2$

$\frac{2\times 4}{20} = P_2$

(ii)

(iii) (2 bar, 4 lit) → (10 bar, V) → (20 bar, 0.4 lit)

$= 0.8$ lit

$W = -10(0.8-4)$

$W = -20(0.4-0.8)$

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(32) $(2\,atm, 200K)$ to $(P, 250K)$ $\underline{n=3}$

$$\Delta U = nC_v\Delta T = W$$

$$\Delta H = nC_p\Delta T$$

$$= n(C_v + R)\Delta H$$

$$Q = 0$$

$$P^{1-\gamma}T^{\gamma} = Const$$

$$V = \frac{nRT}{P}$$

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THERMODYNAMICS

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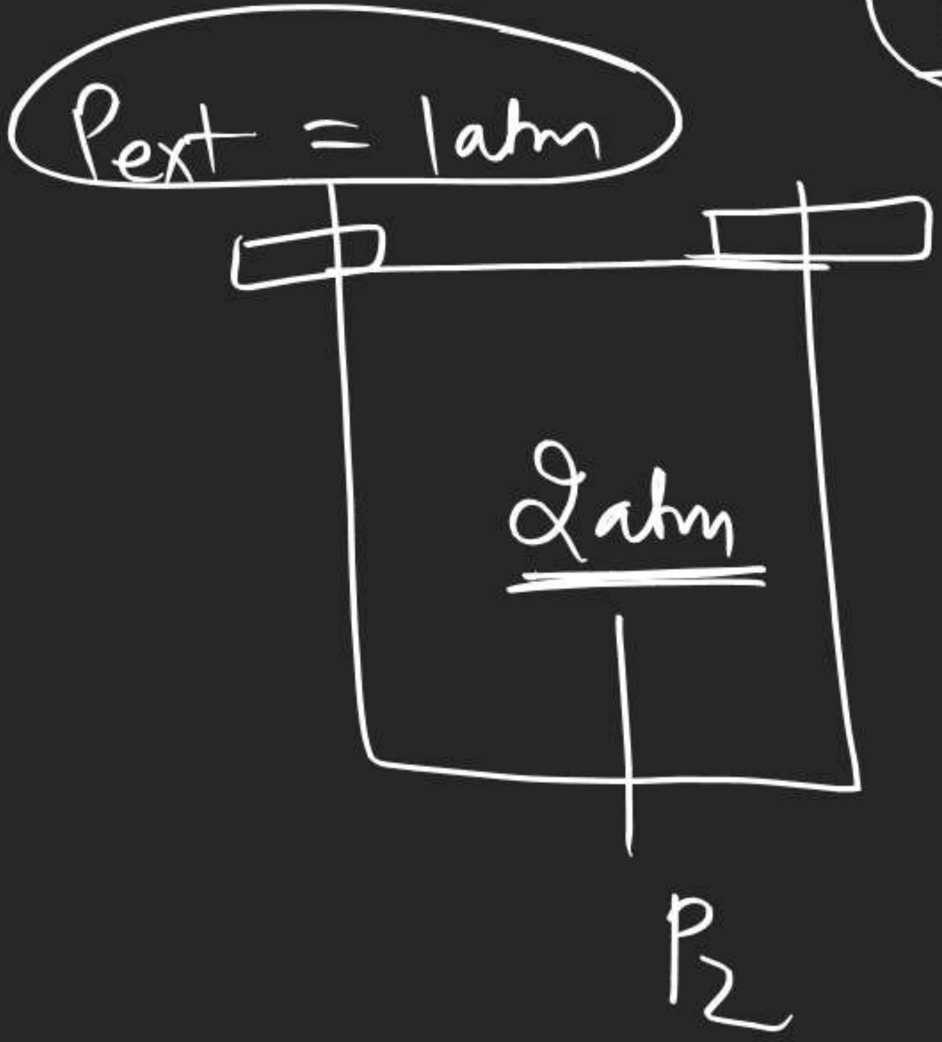
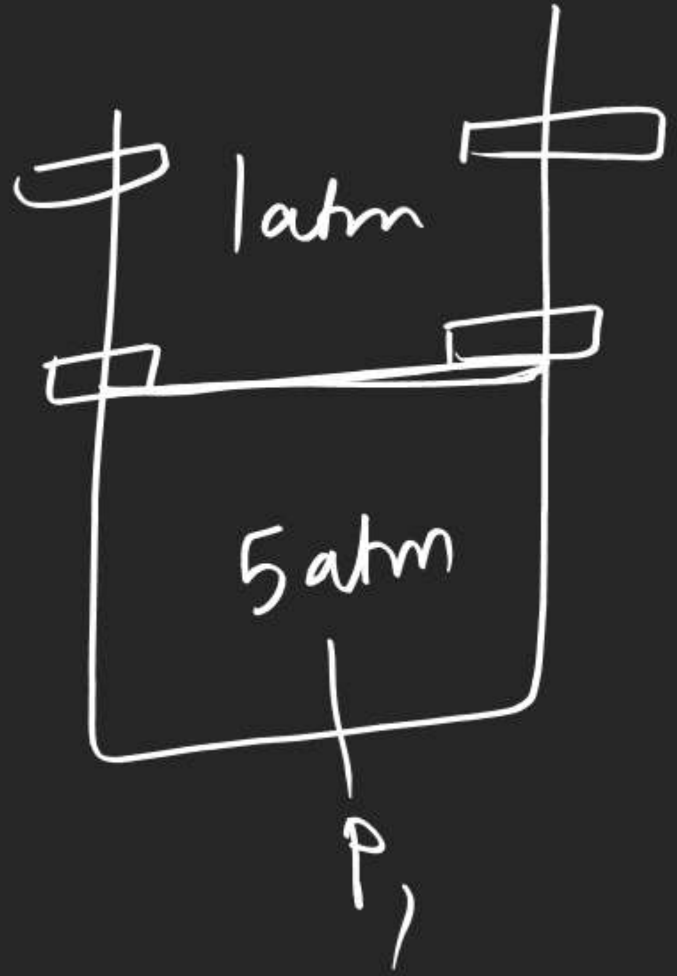
$(5\,atm,\ 300K)$ $\qquad$ $(2\,atm,\ T)$ $\qquad$ $1\,atm = P_{ext}$

P_1 $\qquad$ P_2





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$P_1 T_1$

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$\longrightarrow T_{rev} < T_{irr}$

for same final 'P' $\quad V_{rev} < V_{irr}$

for same final volume $\quad P_{rev} < P_{irr}$

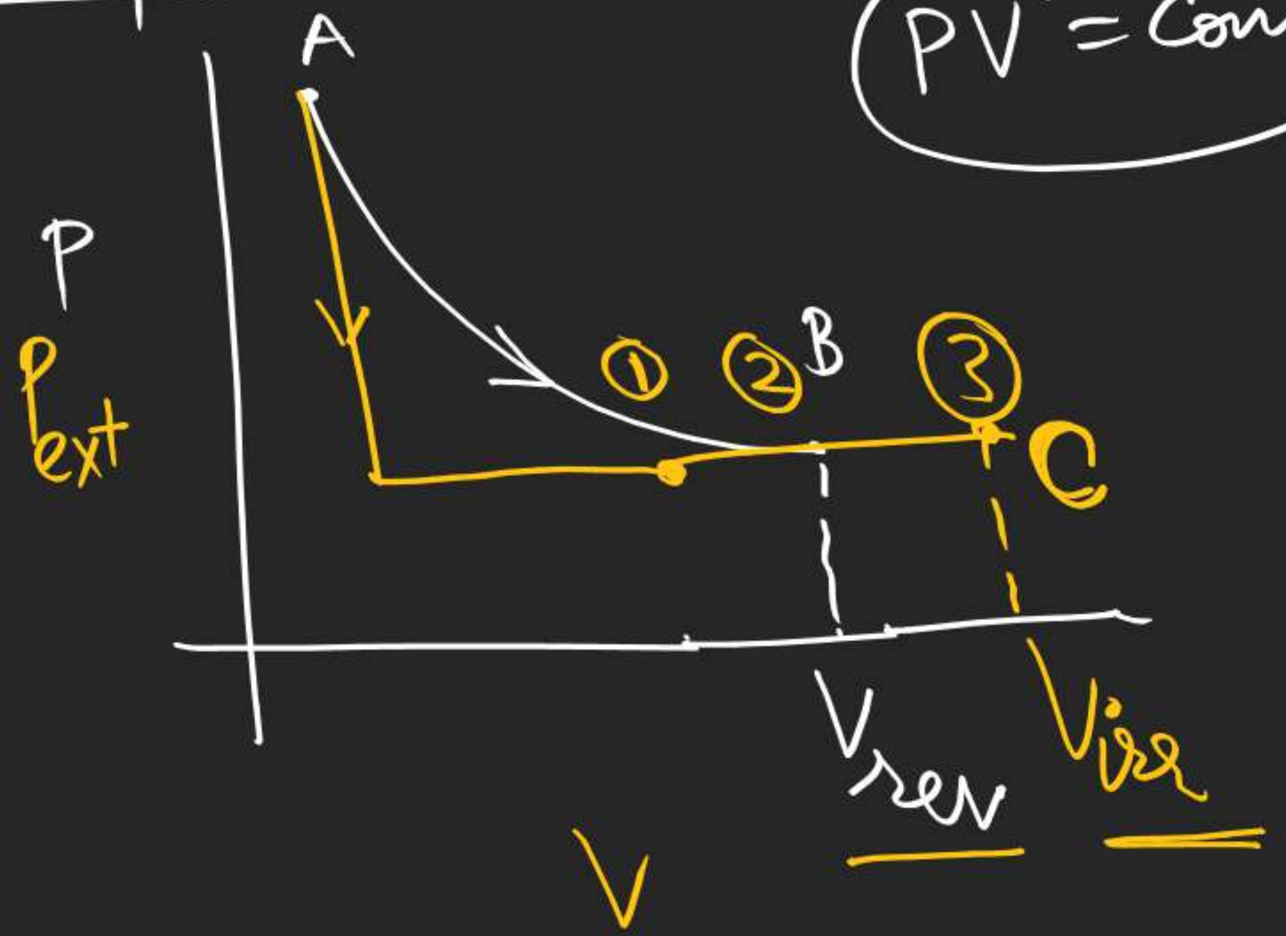
Adiabatic rev & irreversible process do not end up at the same final state if carried out against same final pressure from same initial state.

Graphical representation of work done

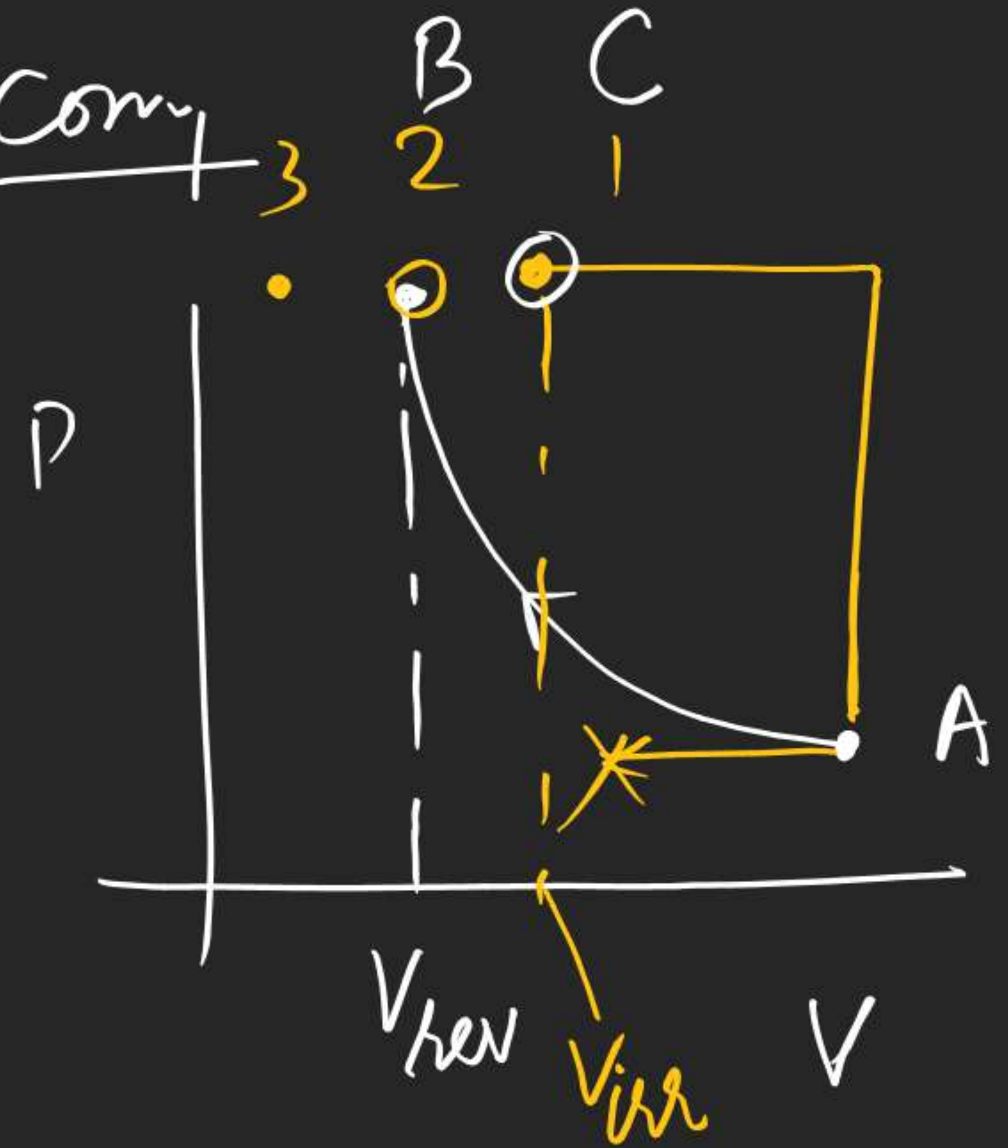
Case-I for same final pressure

(a) Expansion

$PV^{\gamma} = Const$



(b) Comp



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Case-II <u>for same final volume</u>

$P_{rev} < P_{irr}$

(I) <u>Exp</u>

(II)

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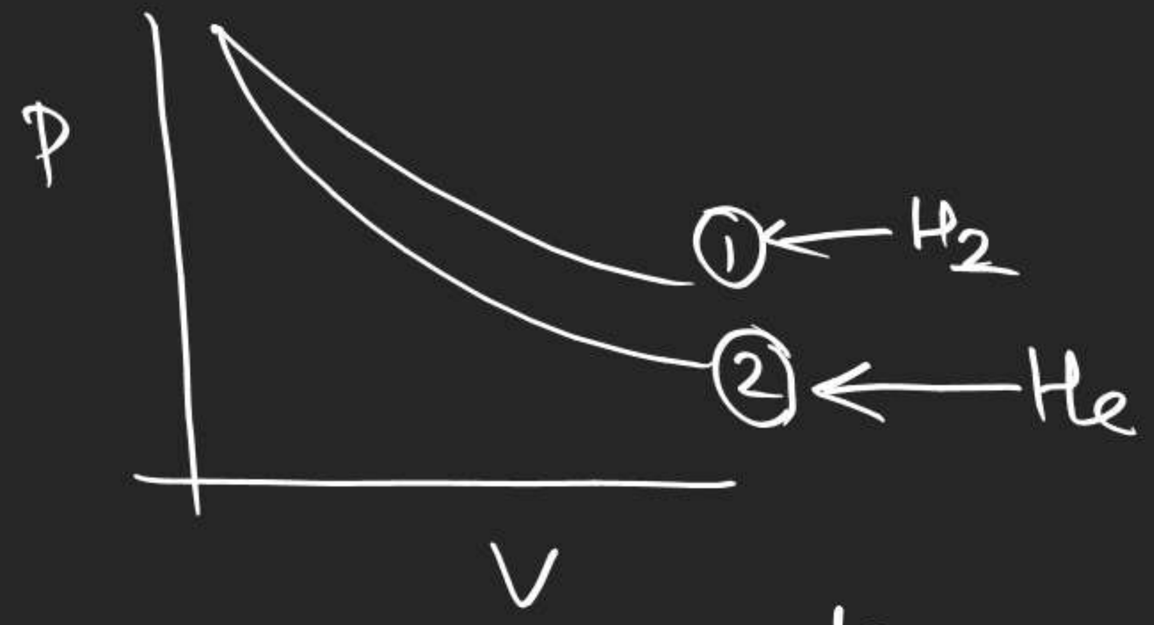
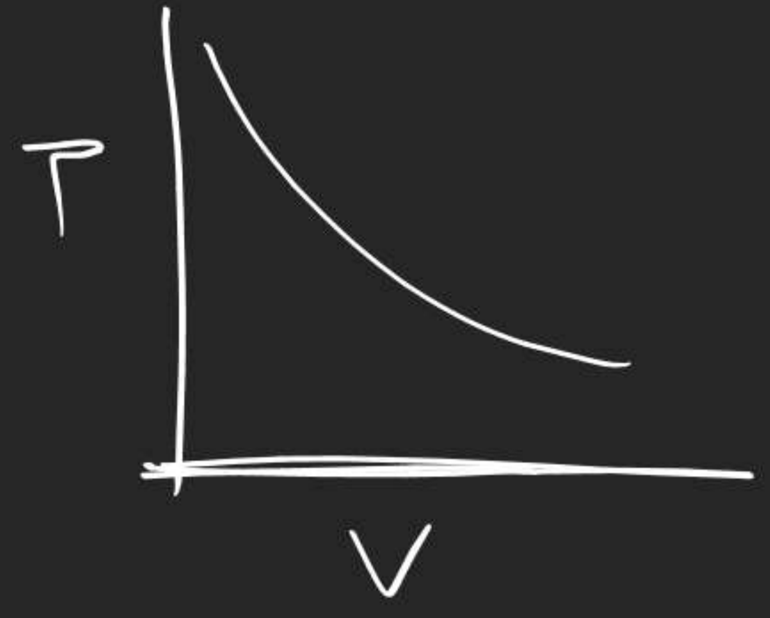
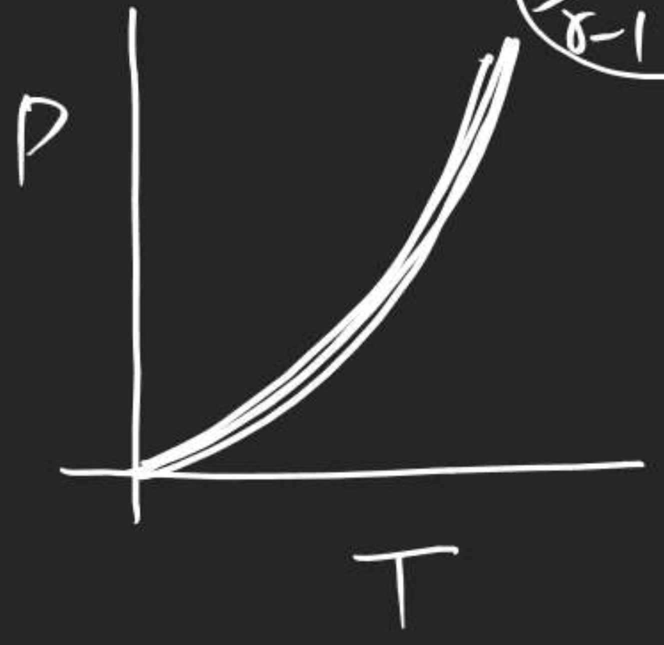
\# $PV^{\gamma} = C$ $\quad$ $TV^{\gamma-1} = C$ $\quad$ $P^{1-\gamma}T^{\gamma} = C$ $\quad$ $P = CT^{\gamma/(\gamma-1)}$

$\frac{\gamma}{\gamma-1} > 1$







H_2	He
$7/5$	$5/3 = \gamma$

$$\frac{dp}{dV} = -\gamma \frac{P}{V}$$

$$y = x^{n}$$

$$T = \frac{C}{V^{\gamma-1}}$$

$n > 0$ parabolic type

$n < 0$ hyperbolic type

polytropic process

$P^{1/x} V = \text{Const}$

$\cancel{P = V + 2}$

$\cancel{P = e^V}$

$PV^x = \text{Const}$

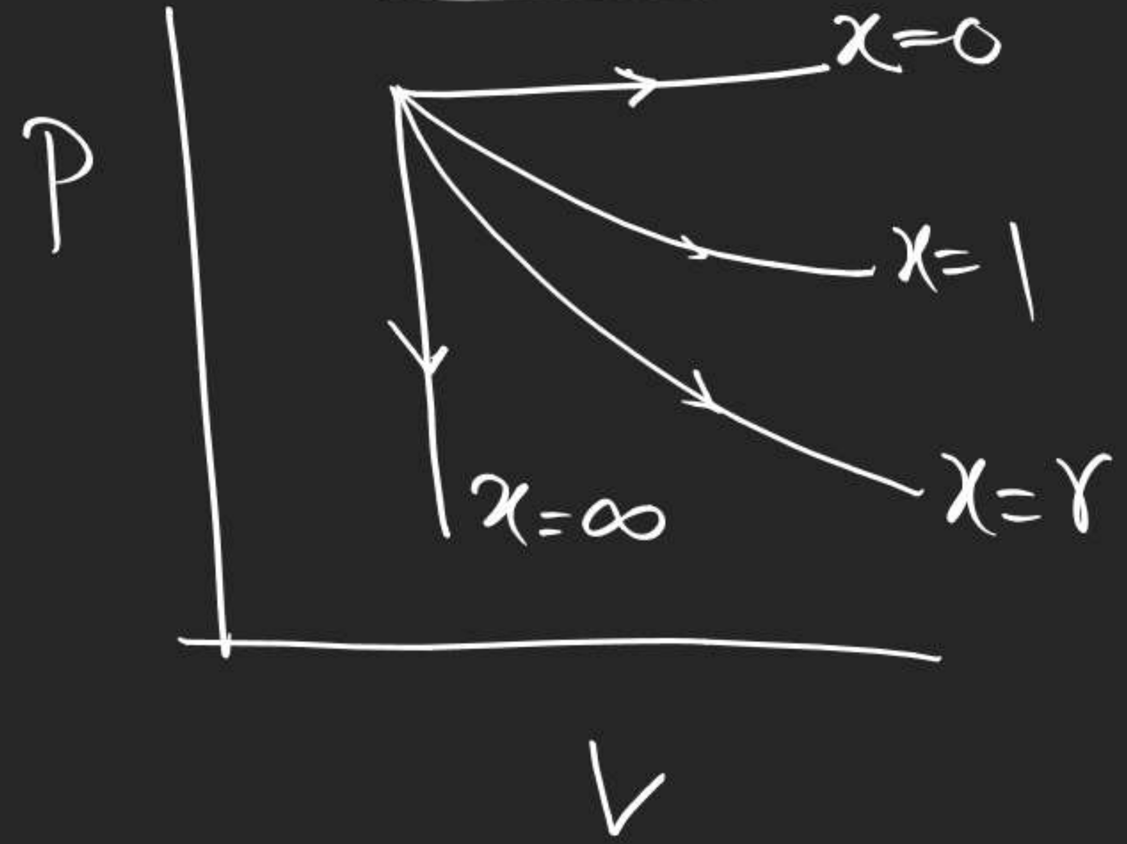
$-\infty \leq x \leq +\infty$

$x = 0$ Isobaric

$x = 1$ Isothermal

$x = \gamma$ Adiabatic

$x = \infty$ Isochoric



$$\boxed{\frac{dP}{dV} = -x\frac{P}{V}}$$

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$\Delta U = nC_v\Delta T$ for ideal gas

$\Delta H = nC_p\Delta T$

$PV^{\gamma} = \text{Const}$

$W = -\int P\,dV$

$$W = \frac{P_2V_2 - P_1V_1}{\gamma - 1} = \frac{nRT_2 - nRT_1}{\gamma - 1}$$

$$= \frac{nR\Delta T}{\gamma - 1}$$

$Q = \Delta U - W$

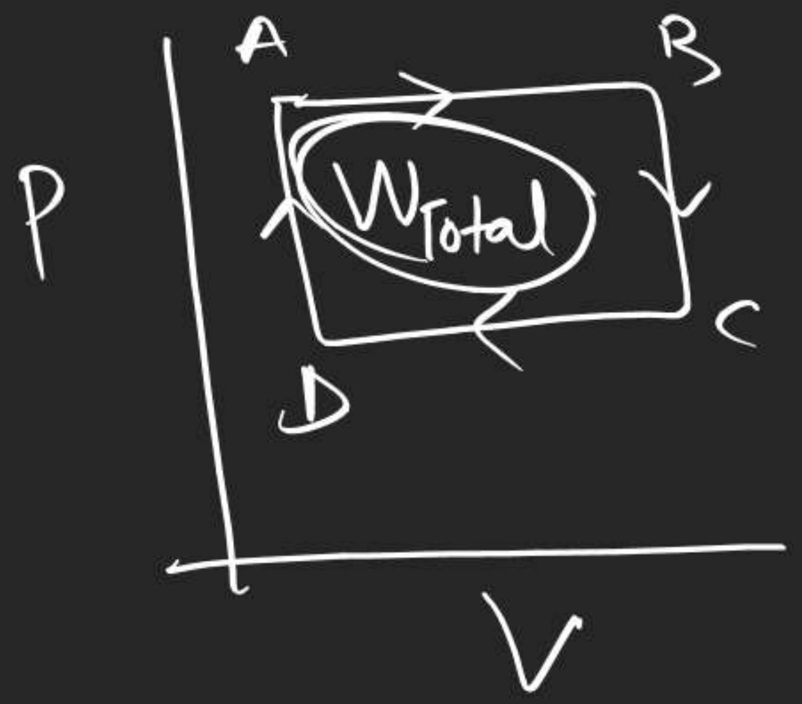
$$\cancel{n}C\cancel{\Delta T} = \cancel{n}C_v\cancel{\Delta T} - \frac{\cancel{n}R\cancel{\Delta T}}{\gamma - 1}$$

$$\boxed{C = C_v - \frac{R}{\gamma - 1}}$$

molar heat capacity

$$\boxed{Q = nC\Delta T}$$

Cyclic process



$\Delta U_{Total} = 0$

$\Delta H_{Total} = 0$

$$W_{Total} = -Q_{Total}$$

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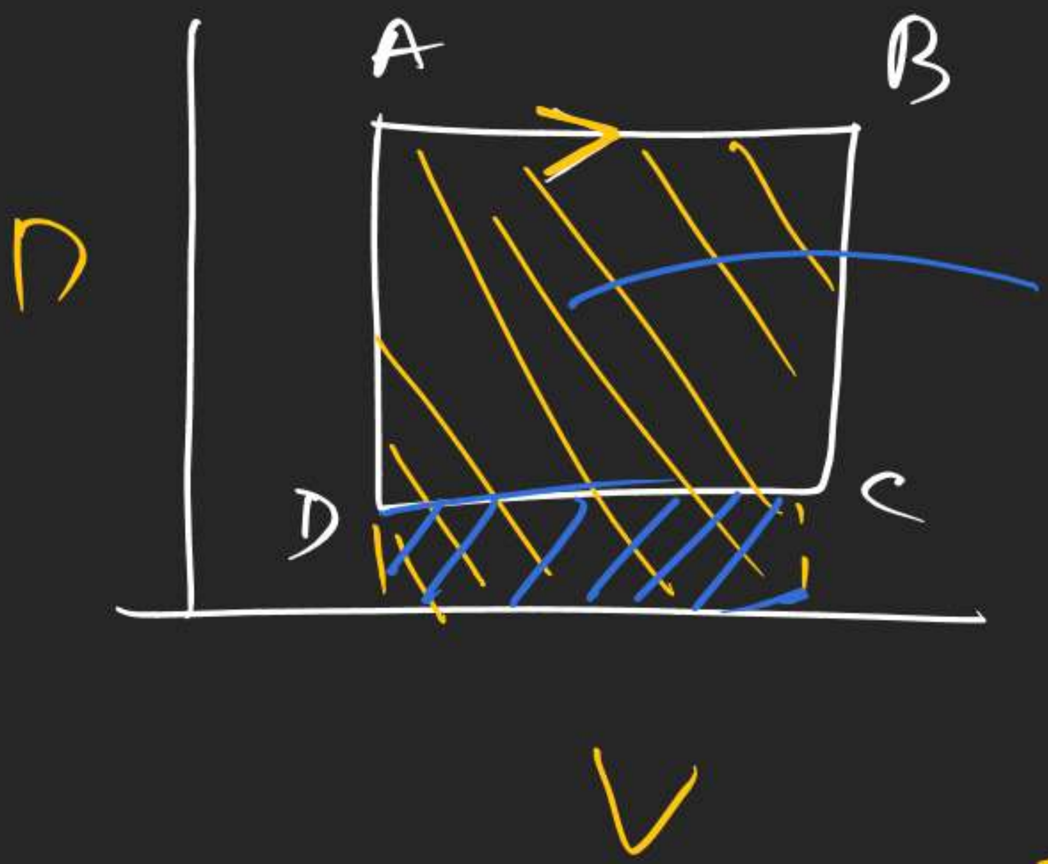
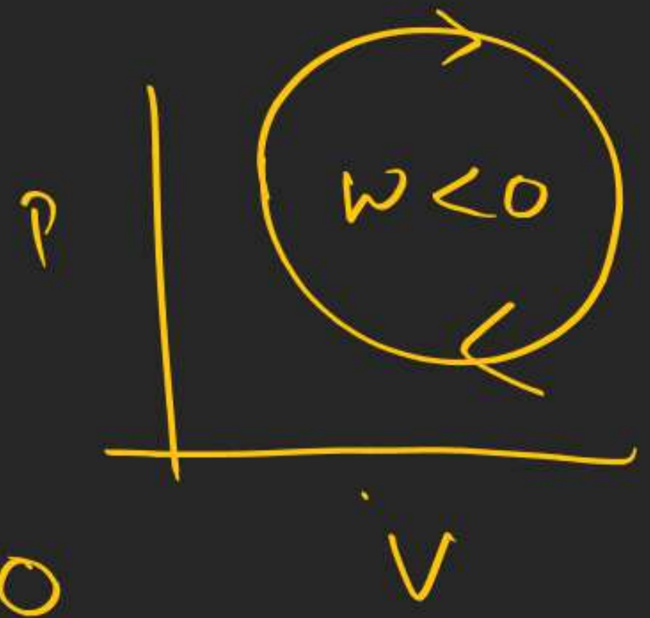


Area enclosed = |W|

clockwise W < 0

Anticlockwise W > 0



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O-L Upto 44