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THERMODYNAMICS

(14) prism — 6

(21) $a/2 = y^{1/3}$ $\boxed{6.023Y}$ amu

$$d = \frac{4 \times 6.023Y \, \cancel{amu}}{(2y^{1/3} \times 10^{-9})^3} \frac{1}{6.023 \times 10^{23}} \times 10^{-3}$$

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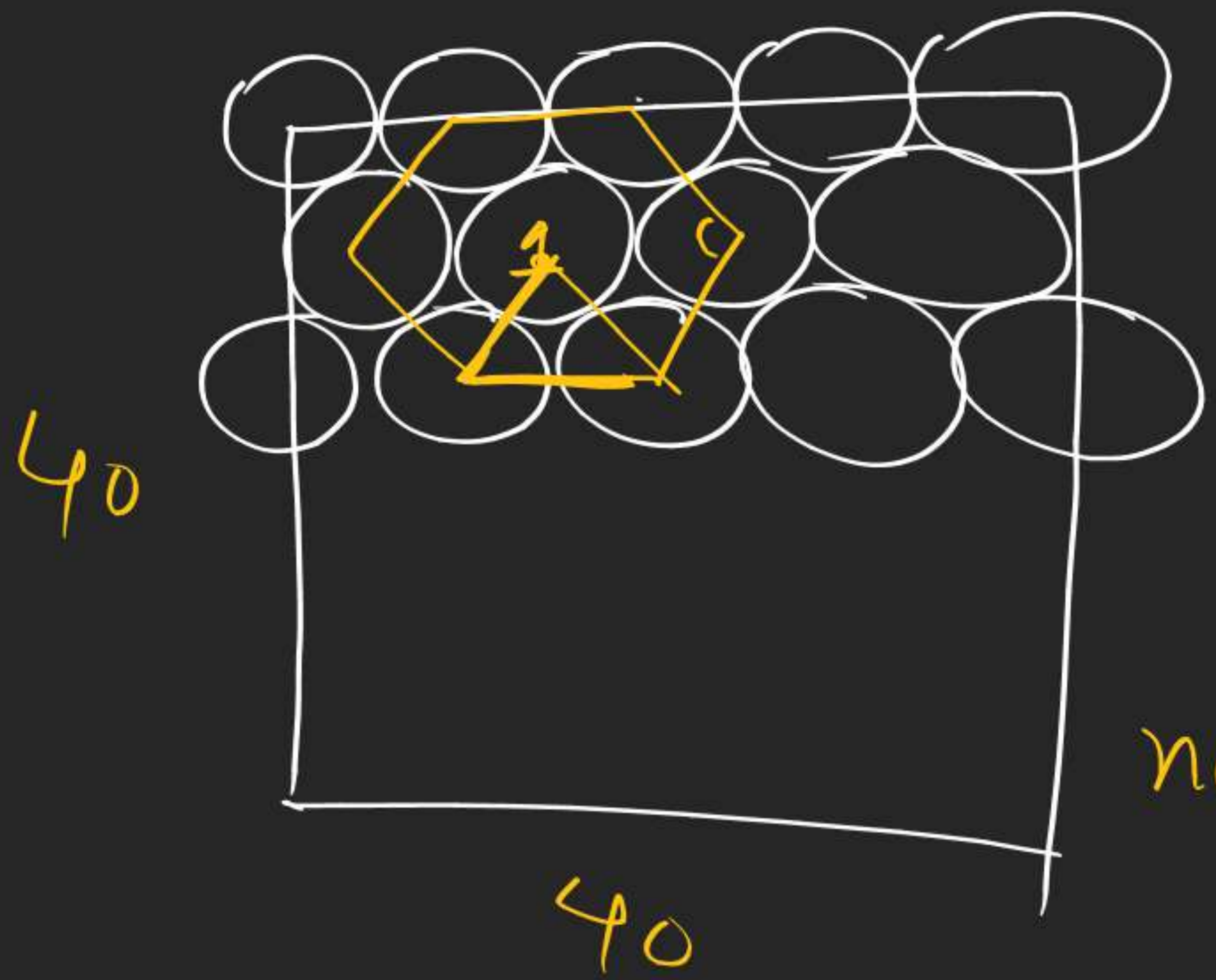

$= 1 + \frac{1}{3} \times 6$

$= 3$

$\text{Area} = \frac{\sqrt{3}}{4}(2r)^2 \times 6$

no. of Marble pieces per unit area $= \left(\dfrac{3}{\frac{\sqrt{3}}{4}(2r)^2 \times 6} \right)$

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Note: A process may be reversible or irreversible for a system but it is always considered to be reversible for surroundings

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Heat (q or Q)

$Q = 50\ kJ$

heat given to the system = 50 kJ
(endothermic)

$Q = -50\ kJ$

heat given by the system = 50 kJ
(exothermic)

Molar heat capacity → amount of heat required to change the temperature of 1 mol substance by 1 kelvin

J/K/mol

Specific heat → J/K/gm

(Molar heat capacity = M × Specific heat)

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heat capacity $\longrightarrow$ J/K

(Extensive properties)

$$q \xrightarrow{1\,mol} dT$$

$$dT \longrightarrow q$$

$$1\,K \longrightarrow \boxed{\frac{q}{dT} = C}$$

$q = C\,dT$

for 'n' moles

$q = n\,C\,dT$

$$\boxed{Q = \int n\,C\,dT}$$

Not applicable for chemical & phase change

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Characteristics of molar heat capacity:→

1. It is temperature dependent for solid, liq and gas.

2. It is process (path) dependent

at const volume $C = C_v$ $q_v = nC_v dT$

" pressure $C = C_p$ $q_p = nC_p dT$

3. for solid & liq $C_v = C_p = C$

4.) for ideal gas $\boxed{C_p = C_v + R}$

for ideal gas

Atomicity	n_{tr}	n_{Rot}	n_{vib}	C_V Ex vib	C_V In vib	C_P Ex vib	C_P In vib	$\gamma = C_P/C_V$ Ex vib	$\gamma = C_P/C_V$ In vib
3. Monoatomic	3	0	0	$\frac{3}{2}R$	$\frac{3}{2}R$	$\frac{5}{2}R$	$\frac{5}{2}R$	$5/3$	$5/3$
6 diatomic	3	2	1	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{2}R$	$\frac{9}{2}R$	$7/5$	$9/7$
9 tri → linear	3	2	4	$\frac{5}{2}R$	$\frac{13}{2}R$	$\frac{7}{2}R$	$\frac{15}{2}R$	$7/5$	$15/13$
tri → non-linear	3	3	3	$3R$	$6R$	$4R$	$7R$	$4/3$	$7/6$
12 tetra → lin	3	2	7	$\frac{5}{2}R$	$\frac{19}{2}R$				
tetra → non-lin	3	3	6	$3R$	$9R$				

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Total degrees of freedom = 3N ← no. of atoms (atomicity)

$$C_V = \frac{n_{tr} + n_{Rot} + 2 \times n_{vib}}{2} \times R$$

Note: n_{vib} d.o.f are considered only when it is mentioned in the question

$$C_V = \frac{n_{tr} + n_{Rot}}{2} R$$

Note as atomicity ↑

C_V ↑

C_p ↑

$\frac{C_p}{C_V} = \gamma$ ↓

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	C_v	C_p	γ
He	$\frac{3}{2}R$	$\frac{5}{2}R$	$5/3$
H_2	$\frac{5}{2}R$	$\frac{7}{2}R$	$7/5$
linear $CO_2(g)$	$\frac{5}{2}R$	$\frac{7}{2}R$	$7/5$
$H_2O(g)$	$3R$	$4R$	$4/3$

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Work (w or W)

$W = 50\ kJ$

Work done on the system = 50 kJ

$W = -50\ kJ$

Work done by the system = 50 kJ