Nishant Jindal

Ideal Gas

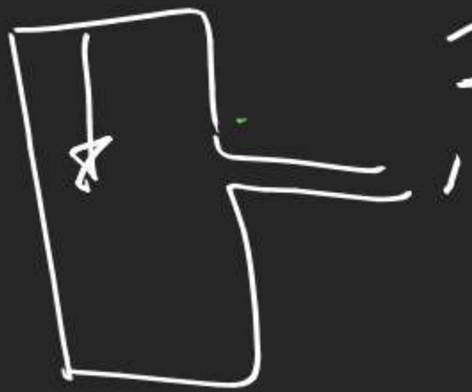
$$\frac{r_A}{r_B} \qquad \frac{r_A}{r_B}$$

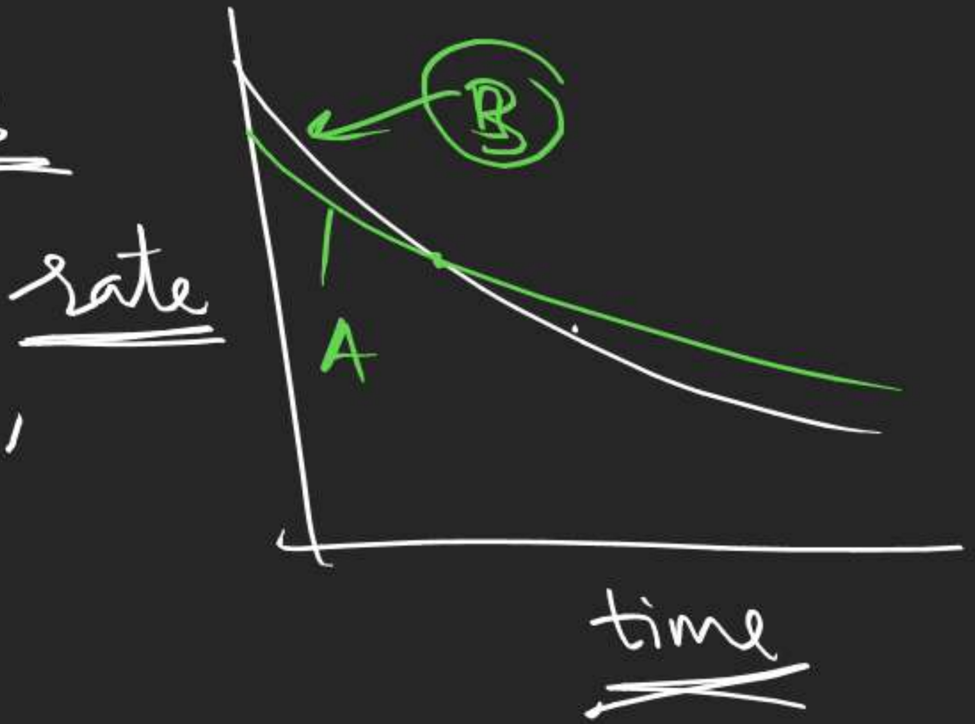
(1) $2A \longrightarrow 3B + 2C$

$$1\,\text{atm} - x \qquad \frac{3x}{2} \qquad x$$

$$= 0.8 \qquad 0.3 \qquad 0.2 = \boxed{1.3\ \text{atm}} \qquad \boxed{0.3 \times 76\ \text{cm}}$$

(4) $M_A > \underline{M_B}$





$$n_t = n_0 e^{-ct}$$

$$-\frac{dn_t}{dt} = n_0 c\, e^{-ct}$$

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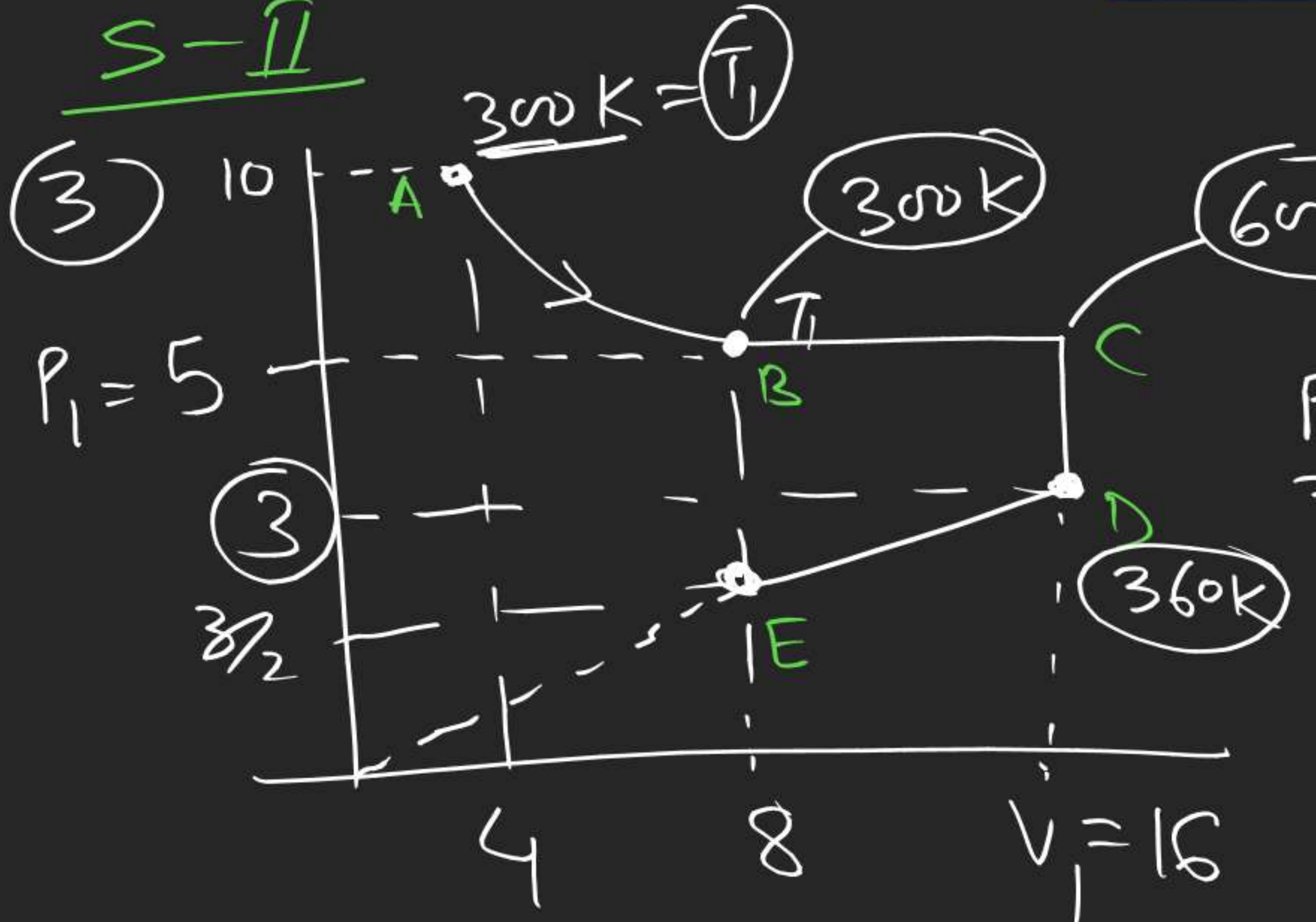
Ideal Gas

S – II

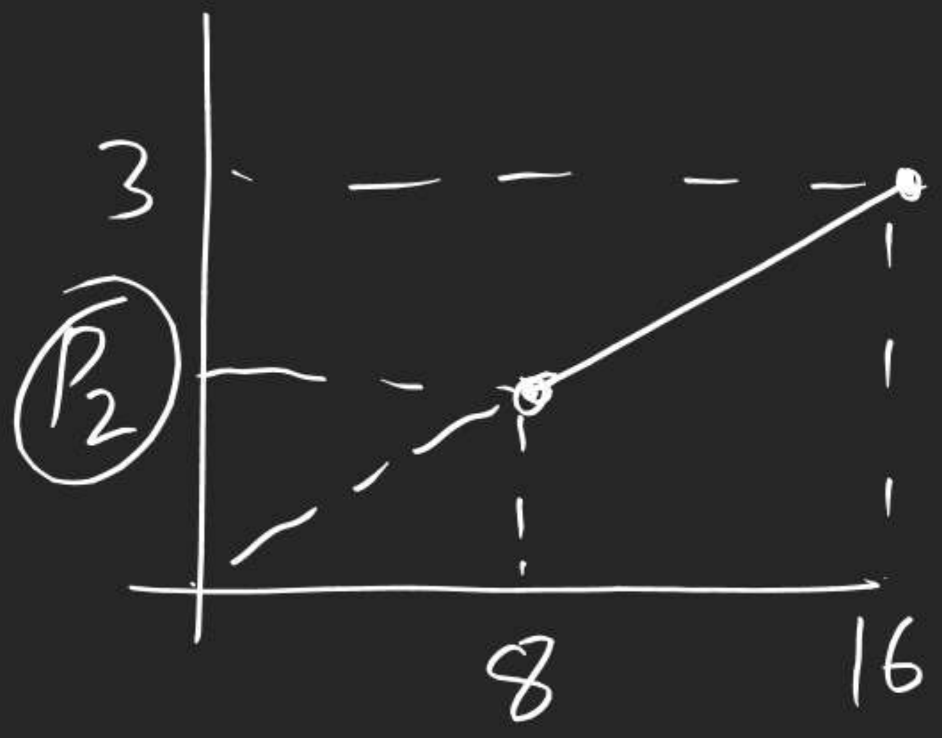
3



$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{5}{600} = \frac{3}{T}$$

$$T = 360$$



$$P = mV$$

$$\frac{P_1}{P_2} = \frac{V_1}{V_2}$$

$$P \propto V$$

$$\frac{P_1}{V_1} = \frac{P_2}{V_2} \qquad \frac{3}{16} = \frac{P_2}{8}$$

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Ideal Gas

$P \propto d$

$P = kd$

$1 = k\,1$

$P = d$

$\frac{4}{3}\pi\left(\frac{d}{2}\right)^3$

$= \frac{1}{6}\pi d^3$

$\frac{P_1V_1}{n_1} = \frac{P_2V_2}{n_2}$

$\frac{1 \times \cancel{\frac{1}{6}\pi} \times 1}{1} = \frac{3 \times \cancel{\frac{1}{6} \times \pi} \times 3^3}{n_2}$

$n_2 = 81$

$36\cancel{\pi} = \frac{1}{6}\cancel{\pi}\, d^3$

$6 = d$

Ideal Gas

5

$$\underset{1-\alpha}{Cl_2} \longrightarrow \underset{2\alpha}{2Cl}$$

$$M_{avg} = \frac{71}{1+\alpha}$$

$$\frac{r_{mix}}{r_{kr}} = 1.16 = \sqrt{\frac{84}{M_{mix}}}$$

$$M_{mix} = M_{avg} = \underline{62.4}$$

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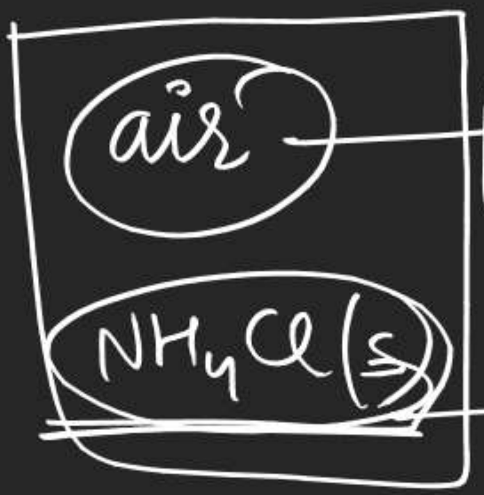
Ideal Gas

6



300K — 1atm

600K — 2 atm

$NH_3 + HCl$

1   1 mol

$$P = \frac{2 \times 0.\cancel{0821} \times \cancel{300} \times 2}{\cancel{24.63}}$$

$= 4\,atm$

1 atm

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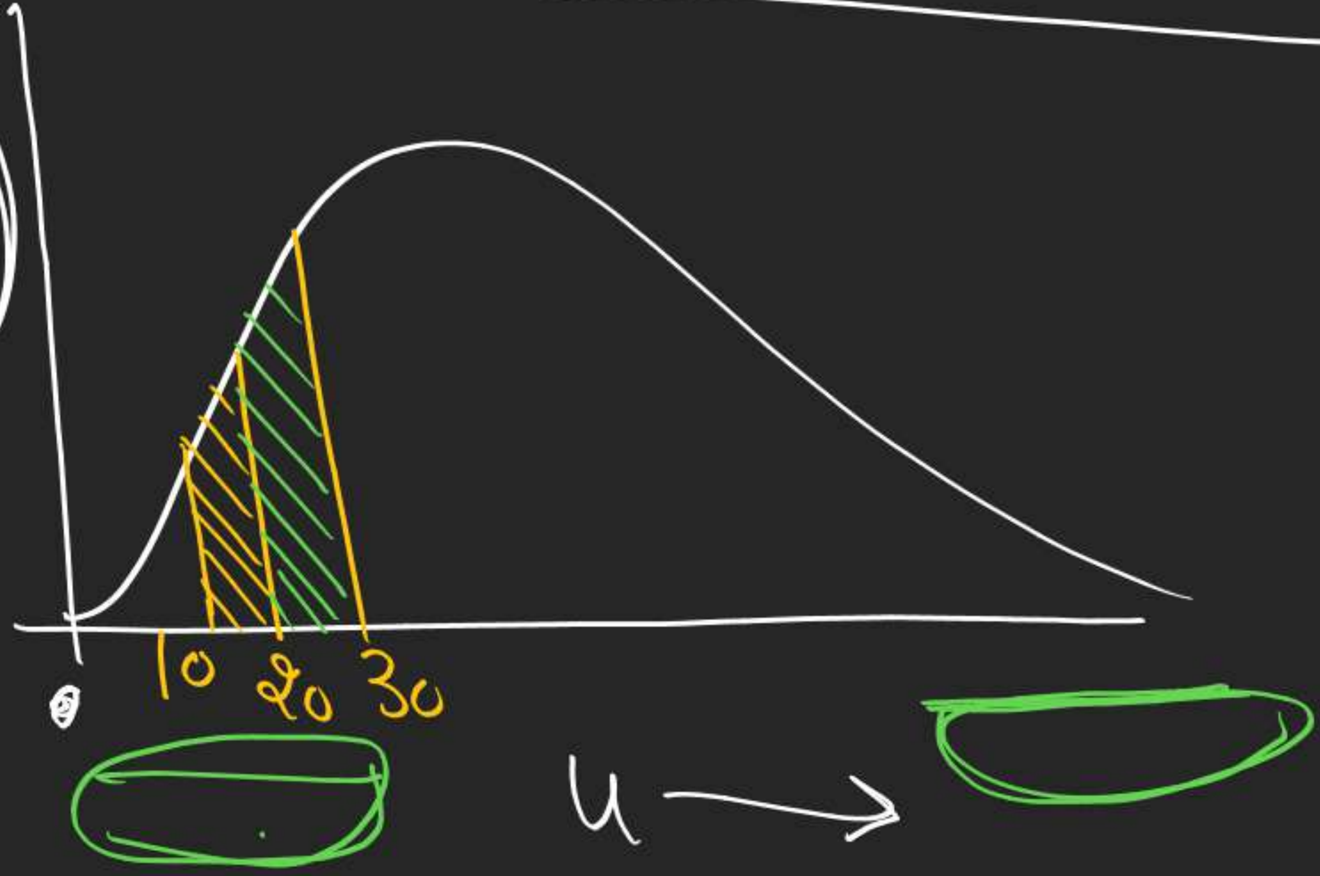
$$dN = 4\pi N \left(\frac{M}{2\pi RT}\right)^{3/2} e^{-Mu^2/2RT}\, u^2\, du$$

$$\boxed{\frac{1}{du}\left(\frac{dN}{N}\right)} = 4\pi \left(\frac{M}{2\pi RT}\right)^{3/2} e^{-Mu^2/2RT}\, u^2$$

$$\frac{1}{du}\left(\frac{dN}{N}\right)$$



① Area $= \int y\, dx$

$$= \int \frac{1}{\cancel{du}} \frac{dN}{N} \cdot \cancel{du}$$

$$= \int \frac{dN}{N}$$

$=$ fraction of particles

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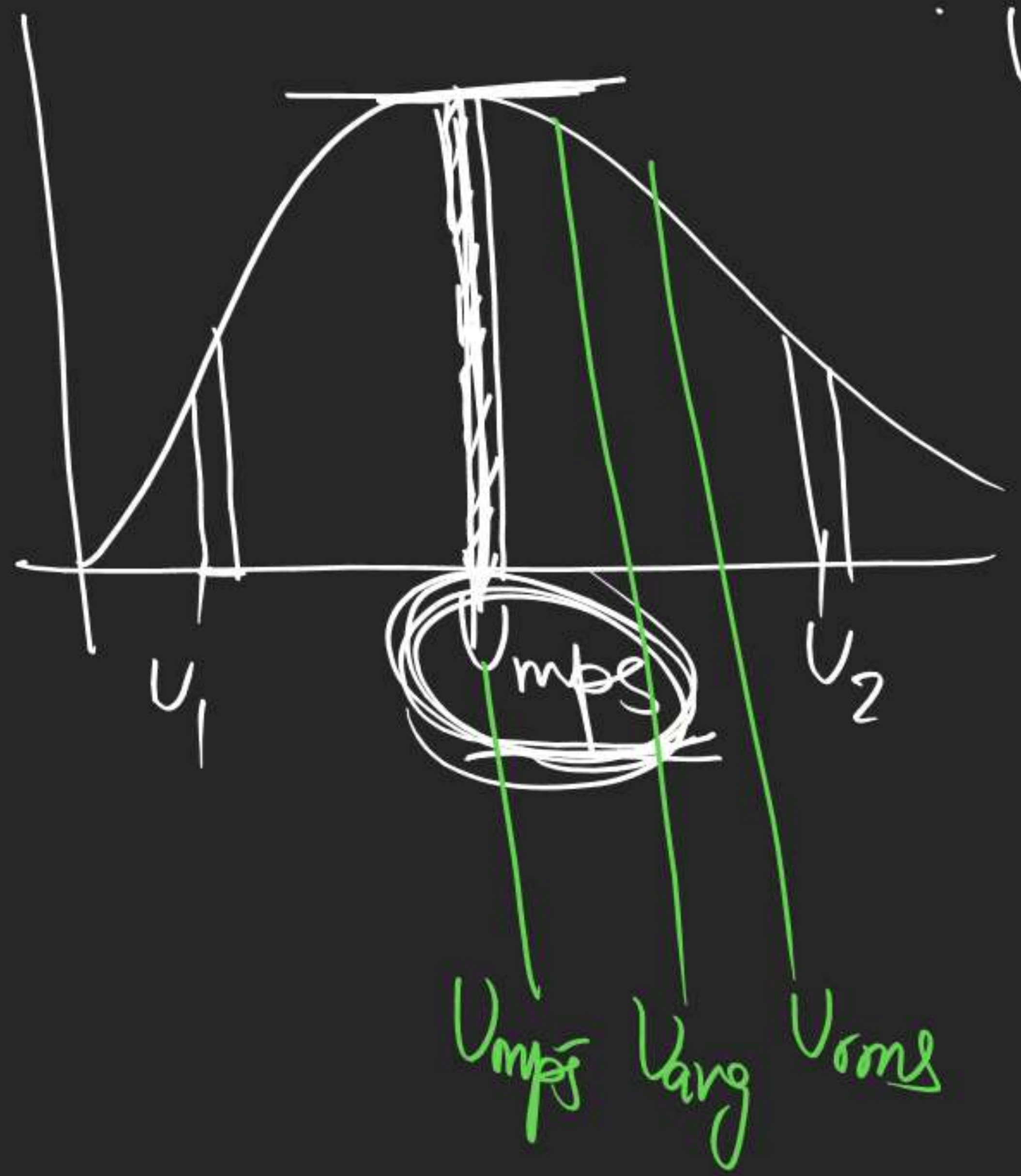
② Total Area = $\int_0^\infty \frac{dN}{N} = 1$

③ 

U_{mps} = most probable speed

$$Y = C\, e^{-Mu^2/2RT} \cdot \underline{u^2}$$

$$\frac{dY}{du} = 0$$

$$\boxed{U_{mps} = \sqrt{\frac{2RT}{M}}}$$

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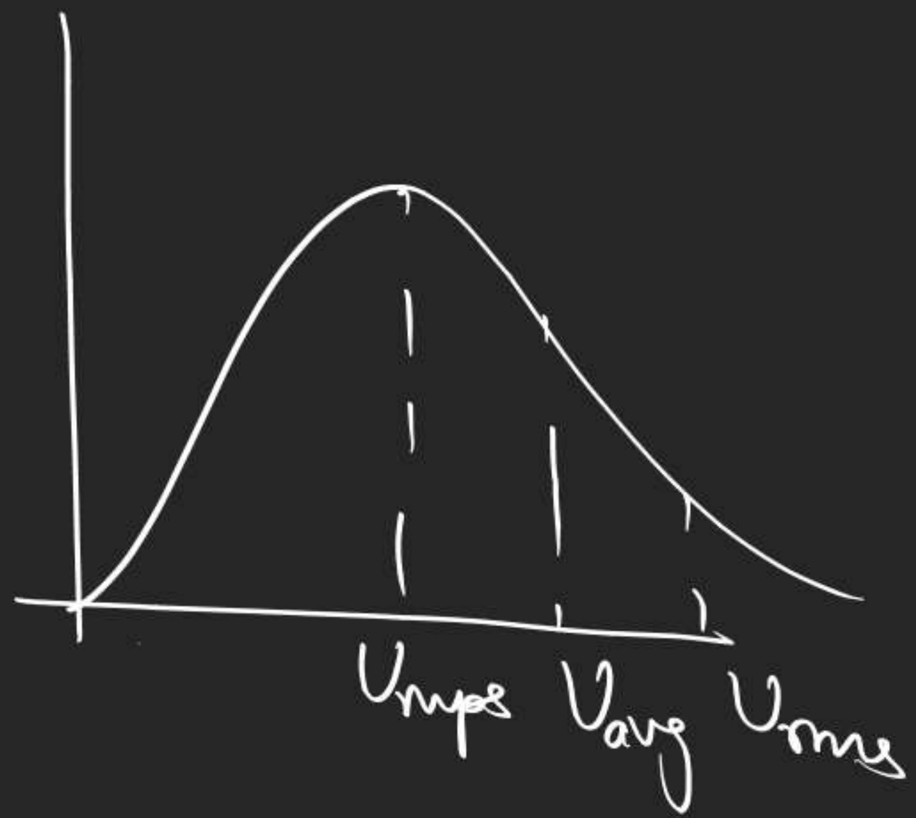
(4)

$$U_{mps} : U_{avg} : U_{rms}$$

$$\sqrt{2} : \sqrt{8/\pi} : \sqrt{3}$$

$$1 : \sqrt{4/\pi} : \sqrt{3/2}$$



5 Variation with Temperature

$T_2 > T_1$

$$\left(\frac{1}{du}\frac{dN}{N}\right) = \underbrace{\boxed{4\pi\left(\frac{M}{2\pi RT}\right)u^2}}_{1^{st}} \cdot \underbrace{e^{-Mu^2/2RT}}_{2^{nd}}$$

$$U_{mps} = \sqrt{\frac{2RT}{M}}$$

as $T \uparrow$ $U_{mps} \uparrow$ but fractional of particles moving with U_{mps} decreases

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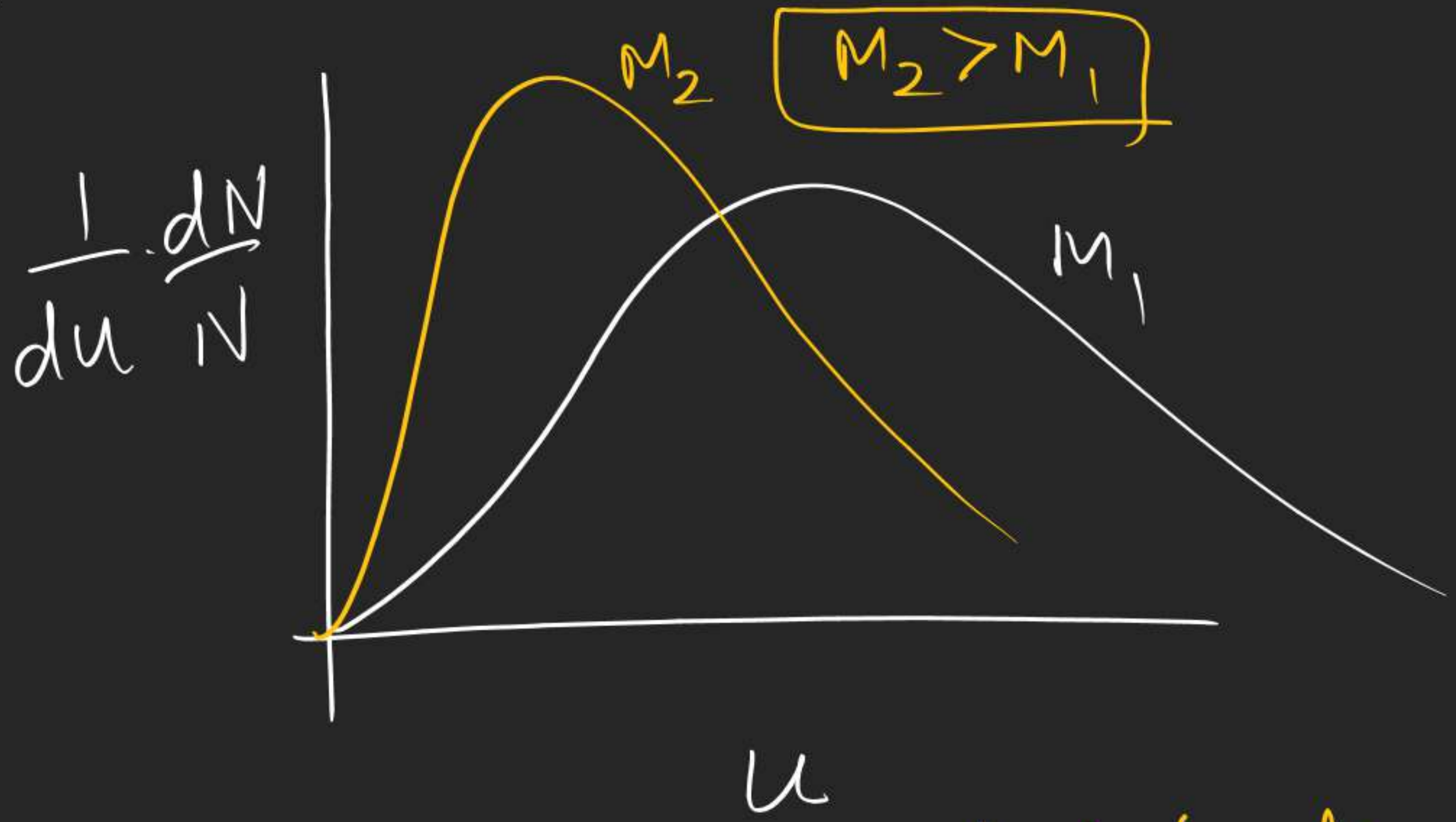
(6) Variation with Molar mass

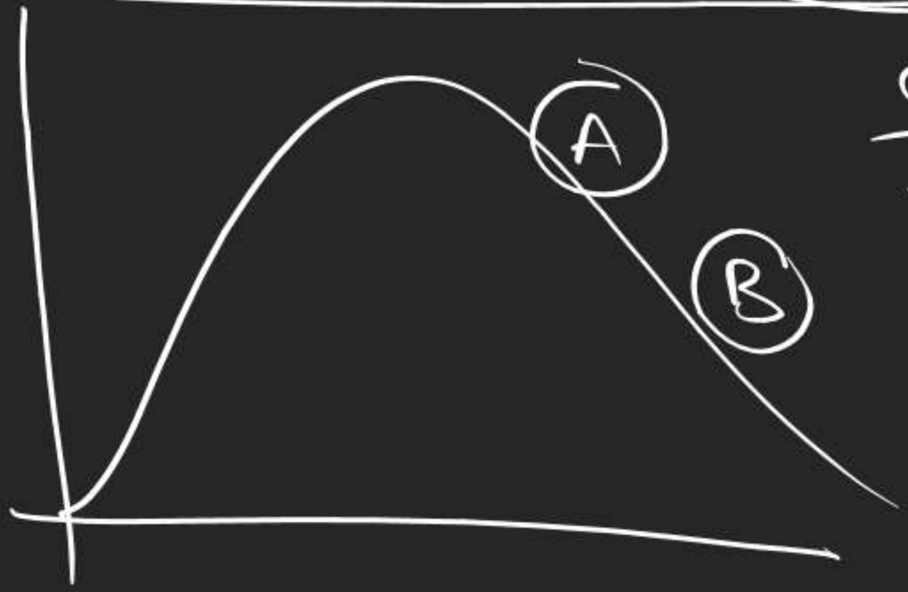


As $M\uparrow$ $U_{mps}\downarrow$ but fraction of particles moving with U_{mps} $\uparrow$es

Q.

$M_A = 20$ $T_A = 300\,K$

$M_B = 40$ $T_B = 600\,K$



Same for both

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$$\frac{dN}{N} = \frac{4\pi}{\pi^{3/2}}\left(\frac{M}{2RT}\right)^{3/2} e^{-Mu^2/2RT}\, u^2\, du$$

if range $du << 1$

Q. find no. of particles having speed betn 1000 to 1001

Soln Since range is very small

$u = 1000$

$du = 1001 - 1000$

$= 1$

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Q. find $\frac{dN}{N}$ having speed betn U_{mps} to $U_{mps} + f\, U_{mps}$

where $(f \ll 1)$

sol^n

$$u = U_{mps} = \sqrt{\frac{2RT}{M}}$$

$$du = f \times U_{mps} = f\sqrt{\frac{2RT}{M}}$$

$$\frac{dN}{N} = \frac{4\pi}{\pi^{3/2}}\cancel{\left(\frac{M}{2RT}\right)^{3/2}} e^{-\frac{M}{\cancel{2RT}}\times\frac{\cancel{2RT}}{\cancel{M}}} \times \cancel{\left(\frac{2RT}{M}\right)} \cdot f \cancel{\left(\frac{2RT}{M}\right)^{1/2}}$$

$$\left(\frac{dN}{N}\right) = \frac{4}{\sqrt{\pi}} e^{-1} \times f$$

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Q. find

$$\frac{\frac{dN}{N} \text{ for } O_2 \text{ at } 300K \text{ from } U_{mps} \text{ to } U_{mps} + f\,U_{mps}}{\frac{dN}{N} \text{ for } N_2 \text{ at } 400K \text{ from } U_{mps} \text{ to } U_{mps} + f\,U_{mps}}$$

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$\Rightarrow$ Total $KE = \frac{1}{2}mu_1^2 + \frac{1}{2}mu_2^2 \cdots\cdots$

$= \frac{1}{2}mN\left(\frac{u_1^2 + u_2^2 \cdots u_N^2}{N}\right)$

$= \frac{1}{2} mN_A \frac{N}{N_A} U_{rms}^2$

$\boxed{KE \text{ of } n \text{ moles} = n \times \frac{3}{2}RT}$

Total KE of n moles $= n \times \frac{1}{2} M U_{rms}^2 = n \times \frac{1}{2} \cancel{M} \frac{3RT}{\cancel{M}} = n \times \frac{3}{2}RT$

k = Boltzman Const

$k = R/N_A$

$\boxed{KE_{1 mol} = \frac{3}{2}RT}$

$\boxed{KE_{1 molecule} = \frac{3}{2}\frac{RT}{N_A} = \frac{3}{2}kT}$

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0-1 39- 58

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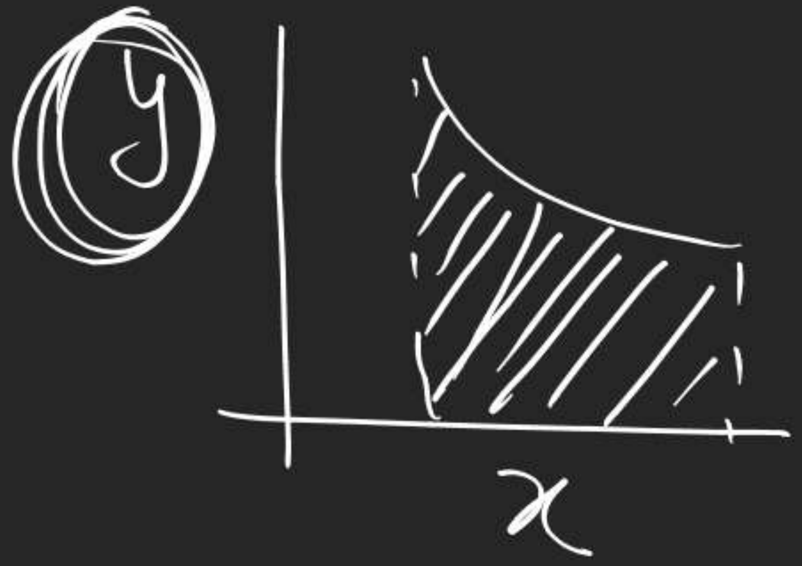
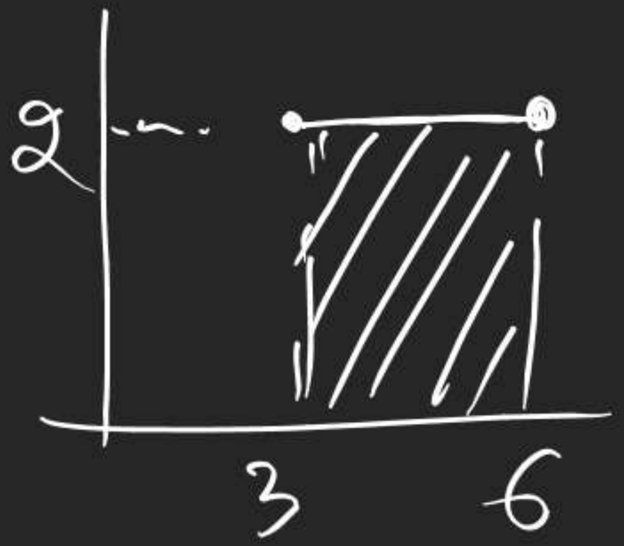


$$\text{Area} = \int_{x_1}^{x_2} y\,dx$$



$$\text{Area} = \int y\,dx$$
$$= 2\int dx$$
$$= 2(6-3)$$
$$= 6$$