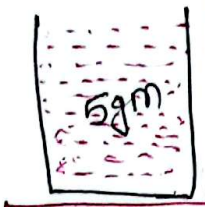
Hygrometry :-

moisture → measurement of moisture present in air.

→ Saturated vapour → कुनै particular tempr मा त्यो भन्दा बढी hold गर्न सक्दैन भने त्यो saturated.

→ Unsaturated vapour → कुनै particular tempr मा त्यो भन्दा बढी hold गर्न सक्छ भने त्यो unsaturated.



Unsaturated.

20°C
↓
2°C — dew point tempr. (eg).

→ Unsaturated लाई saturated बनाउन
- → अरु थप्दै जाने same tempr
- → cool गर्दै जाने dew point (mass same).

→ Unsaturated vap. pressure at room tempr = saturated vap. pressure at dew point

- **Dew point** :- That tempr at which the water vap. present in certain volume of air is just ~~saturate~~ sufficient to saturate it.
  Unit → Kelvin (K)
- **Absolute humidity** :- Actual amount of water vap. present in the unit volume of air at a particular temperature.
  Unit → gm/cc.
- **Relative Humidity (R.H)** :-

$$R.H = \frac{\text{Actual amt of water vapor present in certain volum of air at room tempr } (m)}{\text{Amount of water vapor required to saturate it at same tempr } (M)}$$

$$\therefore \boxed{R.H = \frac{m}{M} \times 100\%}$$

$$R.H = \frac{\text{Unsaturated vap. pressure at room tempr } (p)}{\text{Saturated vap. pressure at room tempr } (P)} \times 100\%$$

$$\therefore \boxed{R.H = \frac{p}{P} \times 100\%}$$

$$\boxed{R.H = \frac{\text{SVP at dew point}}{\text{SVP at room temp}^r} \times 100\%}$$

Q. If R.H = 100%, Room temp^r is ~~30%~~. 30°C. What is dew point?

(a) ~~10%~~ 10°C (b) 20°C ~~(c)~~ 30°C (d) 15°C

$$\cancel{100}\% = \frac{x}{30} \times \cancel{100}\%$$

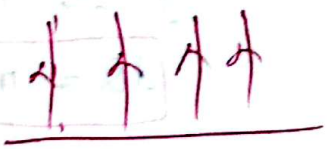
$$\therefore x = 30°C$$

Q. On four different days the temp^r is same but we feel uncomfortable if relative humidity is:—

(a) 10% (b) 20% (c) 50% ~~(d)~~ 90%

20°C

10gm — 20gm



$$R.H = \frac{5}{20} \times 100\% = 25\%$$

$$R.H = \frac{10}{20} \times 100\% = 50\%$$

→ जति धेरै water vap. त्यति धेरै R.H. So, it becomes bad conductor & feels ~~...~~ uncomfortable.

Ideal Gas equation

In general, $\boxed{PV = nRT}$ – for n mole of gas.

for 1 mole of gas,

$$PV = RT.$$

1 mole → R

↓

N_A molecules → R.

100%

↓

1 molecule → $R/N_A \Rightarrow K$ (boltzmann constant).

$$\boxed{K = 1.38 \times 10^{-23}\ J/K}$$

→ $\boxed{PV = \cancel{KRT}\ KT}$ → for 1 molecule of gas.

→ $\boxed{PV = NKT}$ → for N molecules of gas.

no. of mole $(n) = \frac{m}{M}$

$$\therefore PV = \frac{m}{M}RT = m.\frac{R}{M}.T = mrT.$$

$\therefore \boxed{PV = mrT}$ → for 'm' mass of gas.

$PV = rT$ – for unit mass of gas.

→ $PV = nRT$ → for n (mole)
$PV = RT$ → for 1 mole.
$PV = NKT$ → for N molecules.
$PV = KT$ → for 1 molecule.
$PV = rT$ → for unit mass
$PV = mrT$ → for m mass.

Specific heat capacity at constant volume (C_v)

Amount of heat required to raise the temp of unit mass of substance by 1°C or 1K at constant volume.

$$dQ = m C_v dT$$

Molar heat capacity at constant volume (C_v).

Amount of heat required to raise the temp of unit mole of substance by 1°C or 1K at constant volume.

$$dQ = nC_v dT \qquad n = \frac{m}{M}$$

Relation between C_v & C_v

$$dQ = \frac{m}{M} C_v dT$$

$$dQ = m \frac{C_v}{M} dT$$ – compare with $m C_v dT$.

$$\therefore C_v = \frac{C_v}{M}$$

$$C_p = \frac{C_p}{M}$$

$C_p - C_v = R$ → Meyer's relation

$\frac{C_p}{M} - \frac{C_v}{M} = \frac{R}{M}$

$C_p - C_v = r$

$r = R/M$ — constant.

r — Specific gas constant. Varies from molecules to molecule.

Degree of freedom →

Translational degree of freedom (f_t) = 3 (सभी तीनों molecules के (mono, di or tri))

For monoatomic gas molecules

Rotational degree of freedom (f_r) = 0 (As $I = mr^2 = 0$)

For diatomic gas molecule

Rotational degree of freedom (f_r) = 2



For triatomic or polyatomic gas molecule

Rotational degree of freedom (f_r) = 3

· Degree of freedom (F) = $f_t + f_r$

	Mono	Diatomic	Tri or Poly.
	Ar, He.	O_2, H_2	CH_4, NH_3
$f_t \Rightarrow 3$		3	3
$f_r \Rightarrow 0$		2	3
$F \Rightarrow 3$		5	6

→ $C_v = \frac{f}{2}R$ — molar heat capacity.

$C_p - C_v = R$

$C_p = C_v + R$

$C_p = \frac{F}{2}R + R$

$\therefore C_p = \left(1 + \frac{F}{2}\right)R$ — molar heat cap. at const. pressure.

$\gamma = \frac{C_p}{C_v} = \frac{1 + f/2}{f/2} = 1 + \frac{2}{F}$

$\therefore \gamma = 1 + \frac{2}{F}$

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For monoatomic

$C_v = \frac{3}{2}R$

$C_p = \frac{5}{2}R$

$\gamma = 1 + \frac{2}{3} = \frac{5}{3} = 1.66.$

For diatomic

$C_v = \frac{5}{2}R$

$C_p = \frac{7}{2}R$

$\gamma = 1 + \frac{2}{5} = 1.5$

For triatomic or polyatomic

$C_v = 3R$

$C_p = 4R$

$\gamma = 1 + \frac{2}{6} = 1.33.$

Mixing of two non-reacting gases

n_1 M_1 $\quad$ n_2 M_2

→ $$M_{mixture} = \frac{n_1 M_1 + n_2 M_2}{n_1 + n_2}$$

→ $$\rho_{mixture} = \frac{n_1 \rho_1 + n_2 \rho_2}{n_1 + n_2}$$

→ $$T_{mixture} = \frac{n_1 C_{v_1} T_1 + n_2 C_{v_2} T_2}{n_1 C_{v_1} + n_2 C_{v_2}}$$

Tempr.

For same kind (C_v = eq.).

$$T_{mixture} = \frac{n_1 T_1 + n_2 T_2}{n_1 + n_2}$$

$$(C_v)_{mix} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

$$(C_p)_{mix} = \frac{n_1 C_{p_1} + n_2 C_{p_2}}{n_1 + n_2}$$

$$(\gamma)_{mix} = \frac{(C_p)_{mix}}{(C_v)_{mix}} \rightarrow \frac{n_1 + n_2}{\gamma - 1} = \frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}$$

Q. 4gm of He is mixed with 16gm of oxygen. Find $(C_p)_{mix}$, $(C_v)_{mix}$ and $(\gamma)_{mix}$?

→ He - mono.

$n_1 = \frac{4}{4} = 1$.

$(C_v)_1 = \frac{f}{2}R = \frac{3}{2}R$.

O_2 - di

$n_2 = \frac{16}{32} = \frac{1}{2} = 0.5$

$(C_v)_2 = 5/2\,R$.

$$(C_v)_{mix} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

$$= \frac{1 \times 3/2\,R + 1/2 \times 5/2\,R}{1 + 1/2}$$

$$= \frac{3/2\,R + 5/4\,R}{3/2} = \frac{\frac{6R+5R}{4}}{3/2} = \frac{11R \times 2}{4 \times 3} = \frac{11}{6}R.$$

$(C_p)_1 = 5/2\,R$. $(C_p)_2 = 7/2\,R$.

$$(C_p)_{mix} = \frac{1 \times 5/2\,R + 1/2 \times 7/2\,R}{1 + 1/2}$$

$$= \frac{17}{6}R.$$

$$\gamma_{mix} = \frac{(C_p)_{mix}}{(C_v)_{mix}} = \frac{17}{11}$$

~. $$\frac{n_1 + n_2}{\gamma - 1} = \frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}$$

$$\frac{1 + 1/2}{\gamma - 1} = \frac{1}{5/3 - 1} + \frac{1/2}{7/5 - 1}$$

$\therefore \gamma = 17/11$ Ans

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