LAKSHYA JEE

LAKSHYA KO HAR HAAL ME PAANA HAI

SOLUTION

by

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TODAY'S GOAL

Vapour Pressure

Vapour Pressure : Pressure exerted by vapours on liquid surface at equilibrium

Volatile liquid

liquid $\underset{\text{Condensation}}{\overset{\text{evaporation}}{\rightleftharpoons}}$ gas

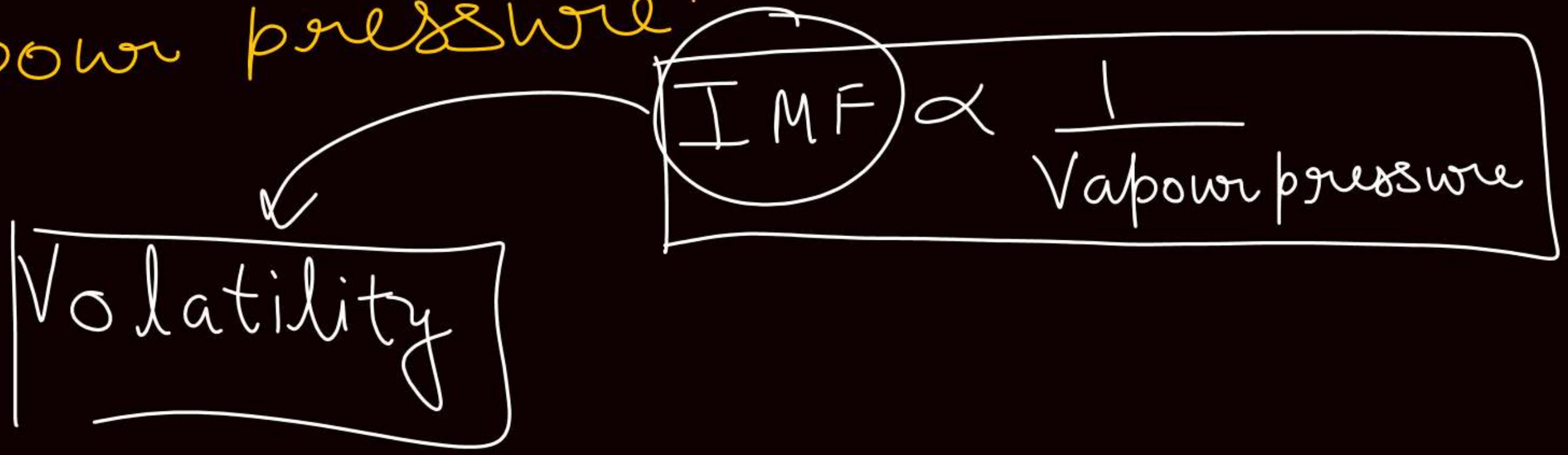
Equilibrium

Rate of evaporation = Rate of Condensation

Factors affecting Vapour pressure.

① Nature of liquid :

Intermolecular forces determine Vapour pressure.



Higher Volatility means intermolecular forces are weak.

C_8H_{18} > C_9H_{20}

n-octane

n-nonane

On moving from left to right IMF increases ∴ V.P. dec.

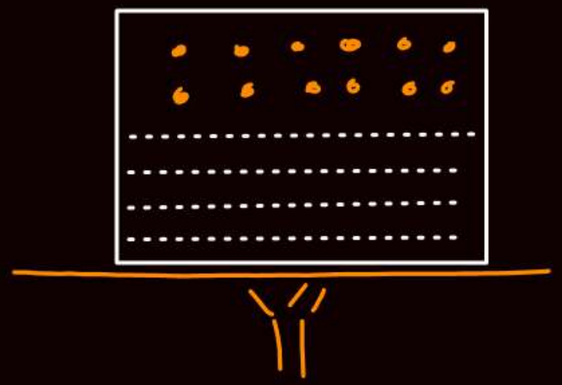
Iso-propyl alcohol > H_2O

(Sanitiser)

V.P. inc.

② Temperature :-

V.P. $\propto$ Temperature.



Relation b/w P & T :-

(Clausius Clapeyron equation)

$$P = K e^{\frac{-\Delta H}{RT}}$$

P = V.P. at Temp. T(in K) | K = Constant depends upon liquid.

ΔH = Enthalpy of Vaporisation

↓

Amount of Heat required to Convert 1 mole of liquid into Vapour.

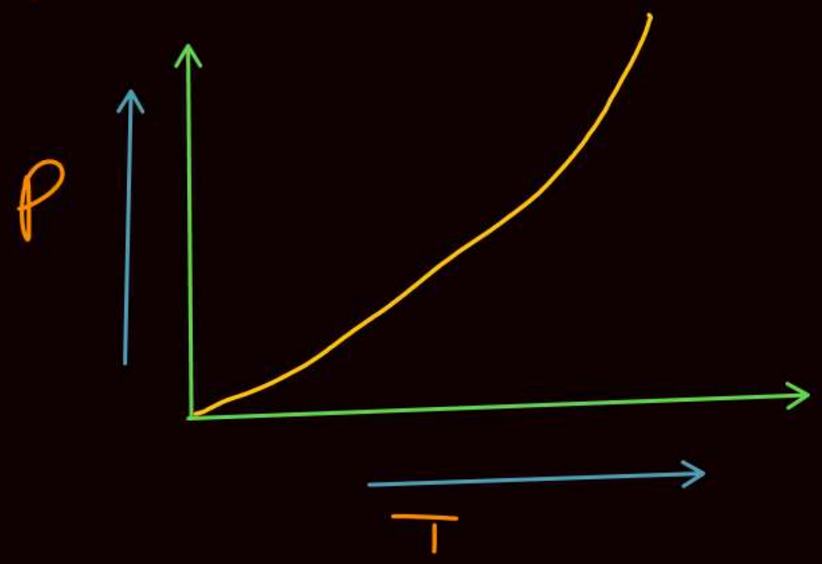
R = Universal gas Constant

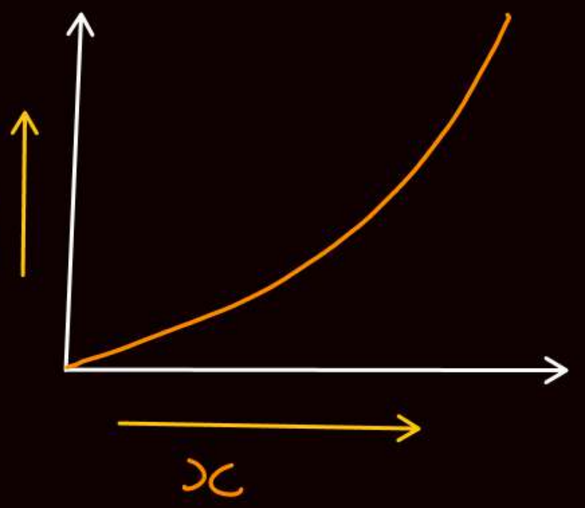
$R = 0.0821$ or $\frac{1}{12}$ L atm K^{-1} mol^{-1} $= 8.314$ J K^{-1} mol^{-1}

$R = 0.083$ L bar K^{-1} mol^{-1} ≈ 2 Cal K^{-1} mol^{-1}

$$P = k e^{-\frac{\Delta H}{RT}}$$

$$P = \check{k} e^{\frac{RT}{\Delta H}} \quad | \quad y = k e^{x}$$





$$P = K e^{\frac{-\Delta H}{RT}}$$

$$e^x = x$$

$$\ln = \log_e = 2.303 \log_{10}$$

$$\ln P = \ln K - \frac{\Delta H}{RT}$$

$$2.303 \log P = 2.303 \log K - \frac{\Delta H}{RT}$$

$$\log P = \log K - \frac{\Delta H}{2.303 RT}$$

at $T = T_1 \Rightarrow P = P_1$

$$\log P_1 = \underline{\log K} - \frac{\Delta H}{2.303 R T_1} \quad -(1)$$

at $T = T_2, \Rightarrow P = P_2$

$$\log P_2 = \underline{\log K} - \frac{\Delta H}{2.303 R T_2} \quad -(2)$$

Subtract eq. ① from eq. ②

$$\log P_2 - \log P_1 = \log K - \log K - \frac{\Delta H}{2.303 R T_2} + \frac{\Delta H}{2.303 R T_1}$$

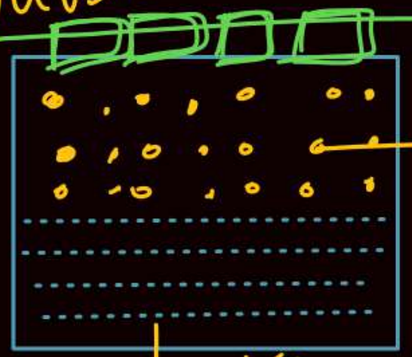
$$\boxed{\log \frac{P_2}{P_1} = \frac{\Delta H}{2.303 R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

↓

Clausius Clapeyron equation.

Boiling point :- Temperature at which liquid V.P. b^{2}com equal to atmospheric pressure.

Outside atmospheric pressure = 1 atm



V.P. = 0.4 atm

Volatile liquid

Boiling point can be Changed by Changing external atmospheric pressure.

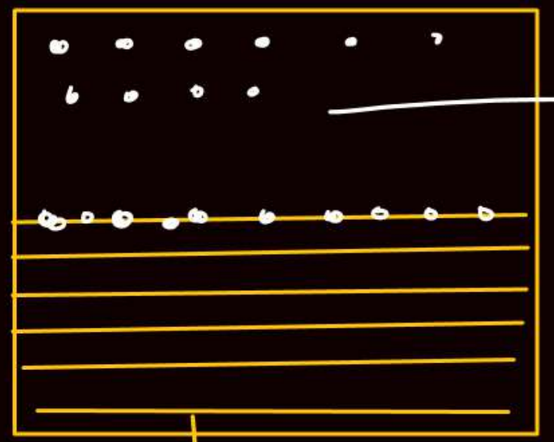
Q liquid X has V.P. = 0.6 atm
liquid Y has V.P. = 0.1 atm.] → Which has higher Boiling point & why?

Ans Y has higher Boiling point due to less V.P.

$$V.P. \propto \frac{1}{B.Pt.}$$

③ Addition of non Volatile solute :-

Sugar, Glucose, Fructose, Urea.

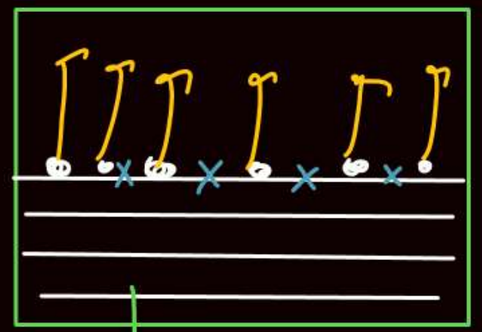


V.P. = 0.7 atm.

Volatile solvent

↓

H_2O.



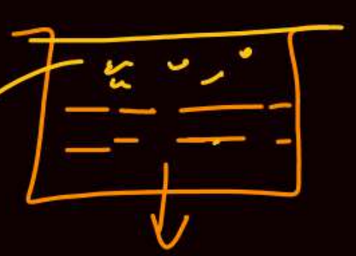
Volatile + n.V.S.

Solvent

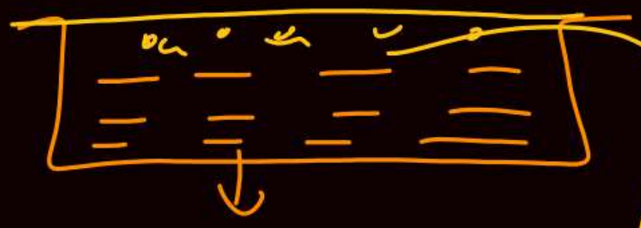
On addition of non-Volatile solute some surface is occupied by it.

$\therefore$ no. of molecules escaping from surface decreases $\therefore$ V.P. dec.

Surface area & Rate of evaporation.



Tea



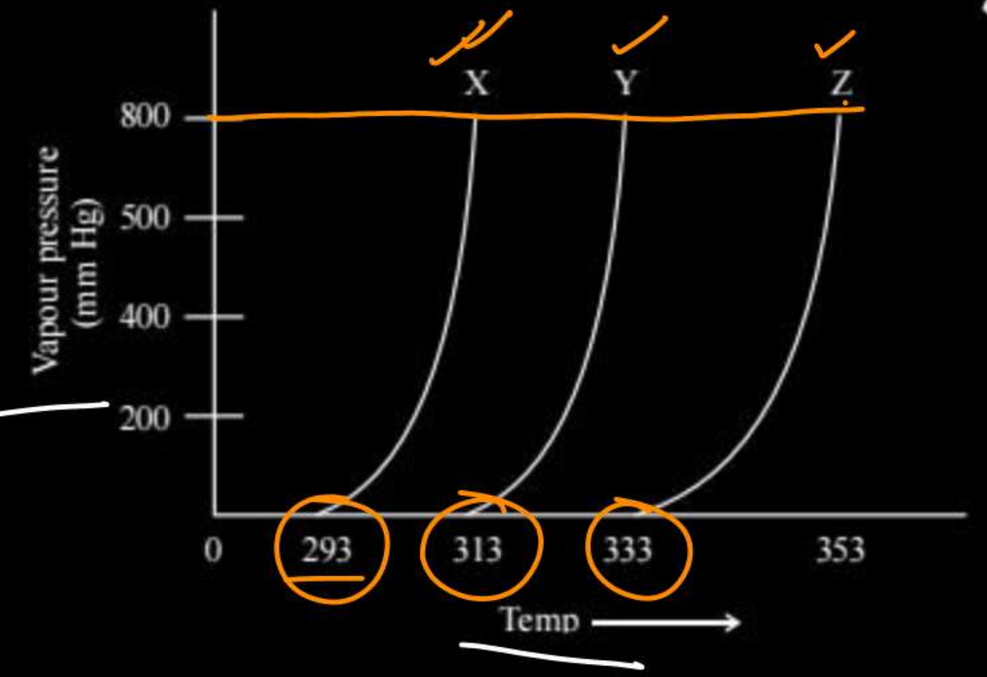
Tea.

3 Crore molecules → 2 min.

3 Crore molecules → 15 min.

A graph of vapour pressure and temperature for three different liquids X, Y, Z is shown below:

[JEEMAINS 20208Jan]



The following inference are made:

A. X has higher intermolecular interactions compared to Y.

B. X has lower intermolecular interactions compared to Y.

C. Z has lower intermolecular interactions compared to Y.

The correct inference (s) is / are:

(a) (C) (b) (B) (c) (A) (d) (A) and (C)

The boiling point of C_6H_6, CH_3OH, $C_6H_5NH_2$ and $C_6H_5NO_2$ are 80°C, 65°C, 184° C and 212°C respectively. Which will show highest vapour pressure at room temperature-

(a) C_6H_6 (b) CH_3OH (c) $C_6H_5NH_2$ (d) $C_6H_5NO_2$

An aqueous solution of methanol in water has vapour pressure-

(a) Equal to that of water

(b) Equal to that of methanol

(c) More than that of water

(d) Less than that of water

Boiling point of water is defined as the temperature at which-

(a) Vapour pressure of water becomes equal to that of atmospheric pressure

(b) Bubbles are formed

(c) Steam comes out

(d) None of the above

The vapour pressure of water depends upon

(a) Surface area of container

(b) Volume of container

(c) Temperature

(d) All

Among the following substances, the lowest vapour pressure is exerted by-

(a) Water

(b) Mercury

(c) Kerosene

(d) rectified spirit

For a sample of liquid in a closed container, which aspect(s) of vaporization depends on the surface area of the liquid?

(P) Rate of vaporization

(Q) Vapour Pressure

(a) P only

(b) Q only

(c) Both P and Q

(d) Neither P nor Q

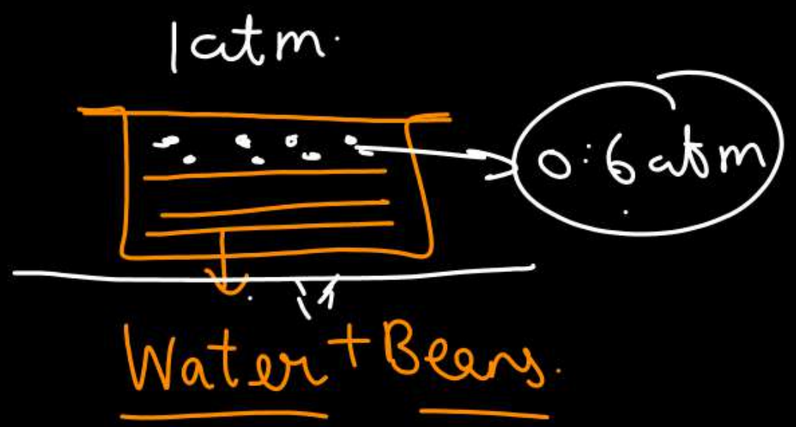
The Beans are cooked earlier in pressure cooker because

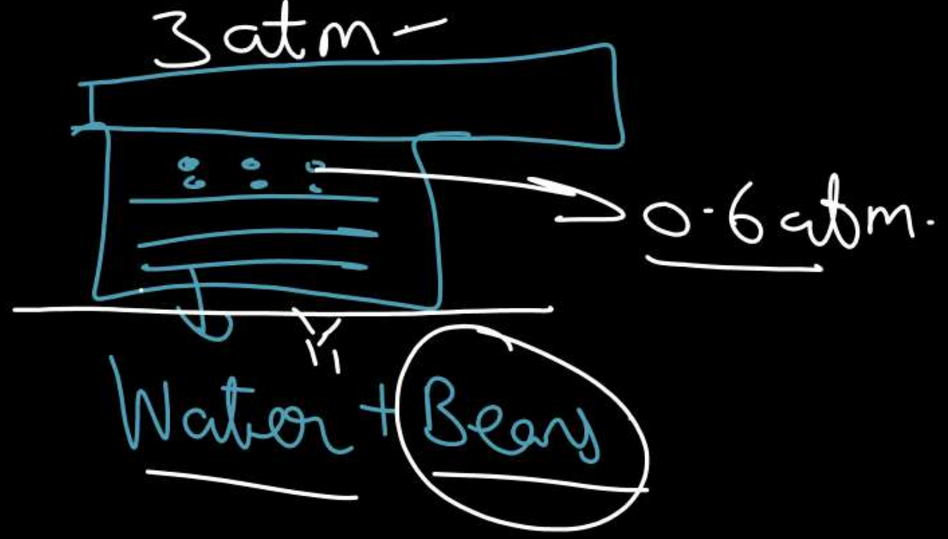
(a) Boiling point increases with increase in pressure

(b) Boiling point decreases with increase in pressure

(c) Extra pressure of pressure cooker softens the beans

(d) Internal energy is not lost while cooking in pressure cooker





An aqueous solution is 1 molal in KI. Which change will cause vapor pressure of solution to increase ?

(a) Addition of NaCl

(b) Addition of Na_2SO_4

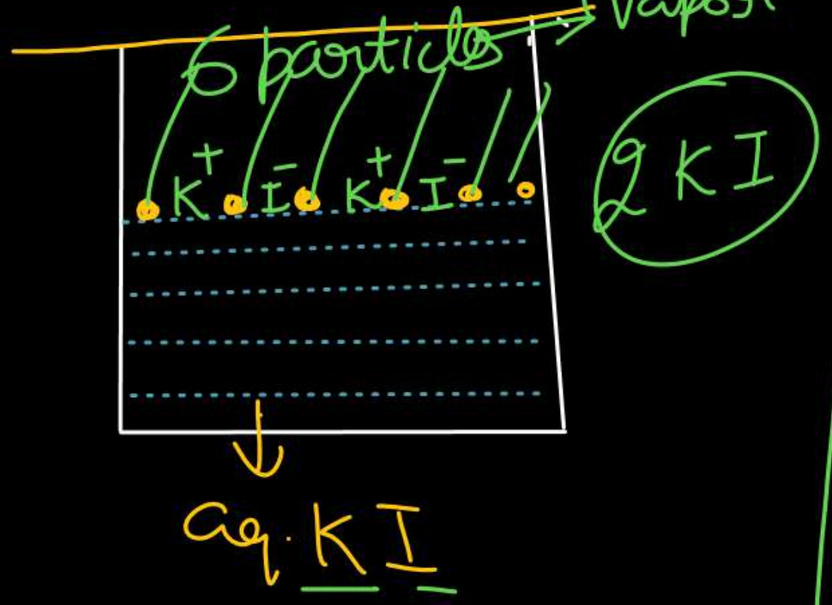
(c) Addition of 1 molal KI

(d) Addition of water

Q Addition of H_gI_2 to KI shows increase in vapour pressure, Why ?

aq.

Ans.



$2KI + HgI_2$

$K_2[HgI_4]$

$2K^+ + 1HgI_4^{2-}$

On addition of HgI_2 to KI it will form $K_2[HgI_4]$ ∴ no. of particles escaping from surface inc ∴ V.P. increases.

Q. Tea is sipped from saucer when it is hot ?

Ans As it will increase surface area.
∴ rate of vaporisation inc. ∴ tea gets cooled quickly.

Q Why is bottle of liq. NH_3 is cooled before opening ?

Ans As it will decrease temperature

$\therefore$ V.P. dec.

Thank You Lakshyians