YAKEEN NEET 2.0

2026

Solutions

Physical Chemistry | Lecture -09

By- Amit Mahajan Sir

Topics to be covered

1. Revision of Last Class
2. Depression in Freezing Point
3. Osmosis & Osmotic Pressure
4. Magarmach Practice Questions, Home work from modules

Rules to Attend Class

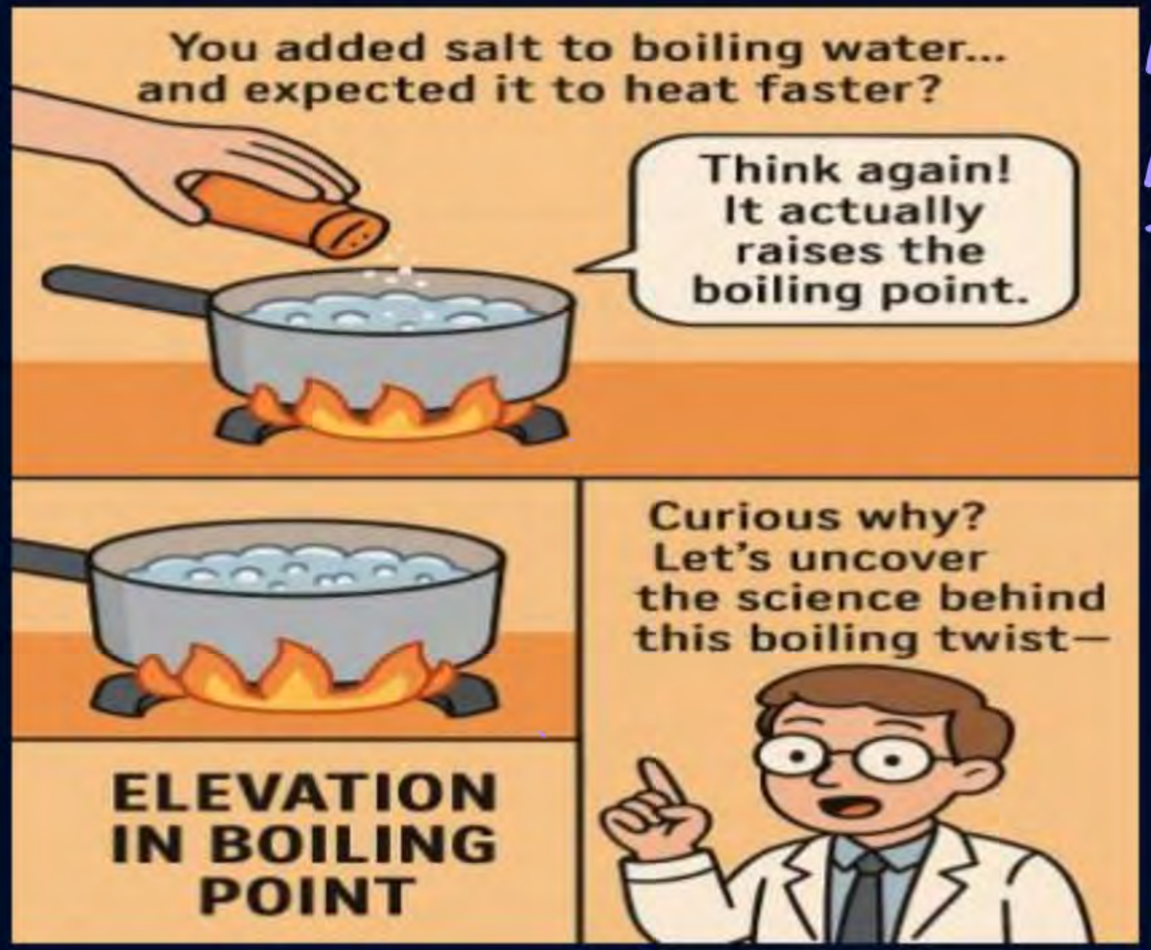
1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your Magarmach Practice Questions.
4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.

Rules to Attend Class

5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision of Last class



$\Delta T_b = T_b - T^\circ$

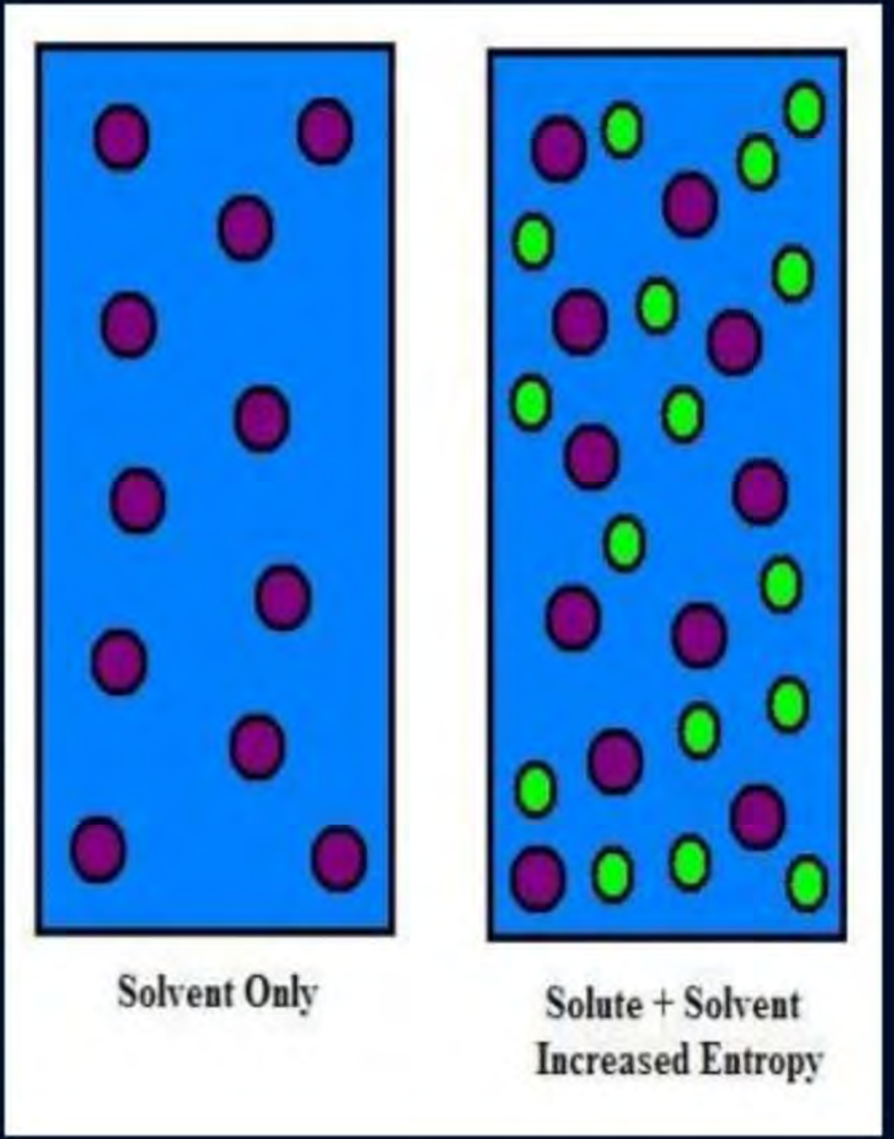
$\Delta T_b \propto m$

$\Delta T_b = K_b m$

$K_b = \frac{R T^{\circ 2}}{1000 l_{vap}}$

$\Delta H_{vap.} = l_{vap} \times M_A$

$l_{vap.} = \frac{\Delta H_{vap}}{M_A}$



Solution → f.pt. → freeze solvent

$-t^{\circ}C$ → water + ice

Solution → (Sugar + water) → soln → f.Pt. (T_s) $= -3^{\circ}C$

\# MIT

$$\Delta T_f = T^{\circ} - T_s = \frac{K_f \, w_B \times 1000}{M_B \times w_A}$$

T_s → f.Pt. of soln

w_A → initial mass of water.

$$\Delta T_f = T^{\circ} - T_s = \frac{K_f \, w_B \times 1000}{M_B \times w_A}$$

T_s → f.Pt. of soln

w_A → mass of water not converted to ice.

QUESTION

Question Explain rast Method.

Ans Rast method → solvent Camphor → K_f high ∴ ΔT_f high

∴ measurement easy

$$\Delta T_f = K_f m$$

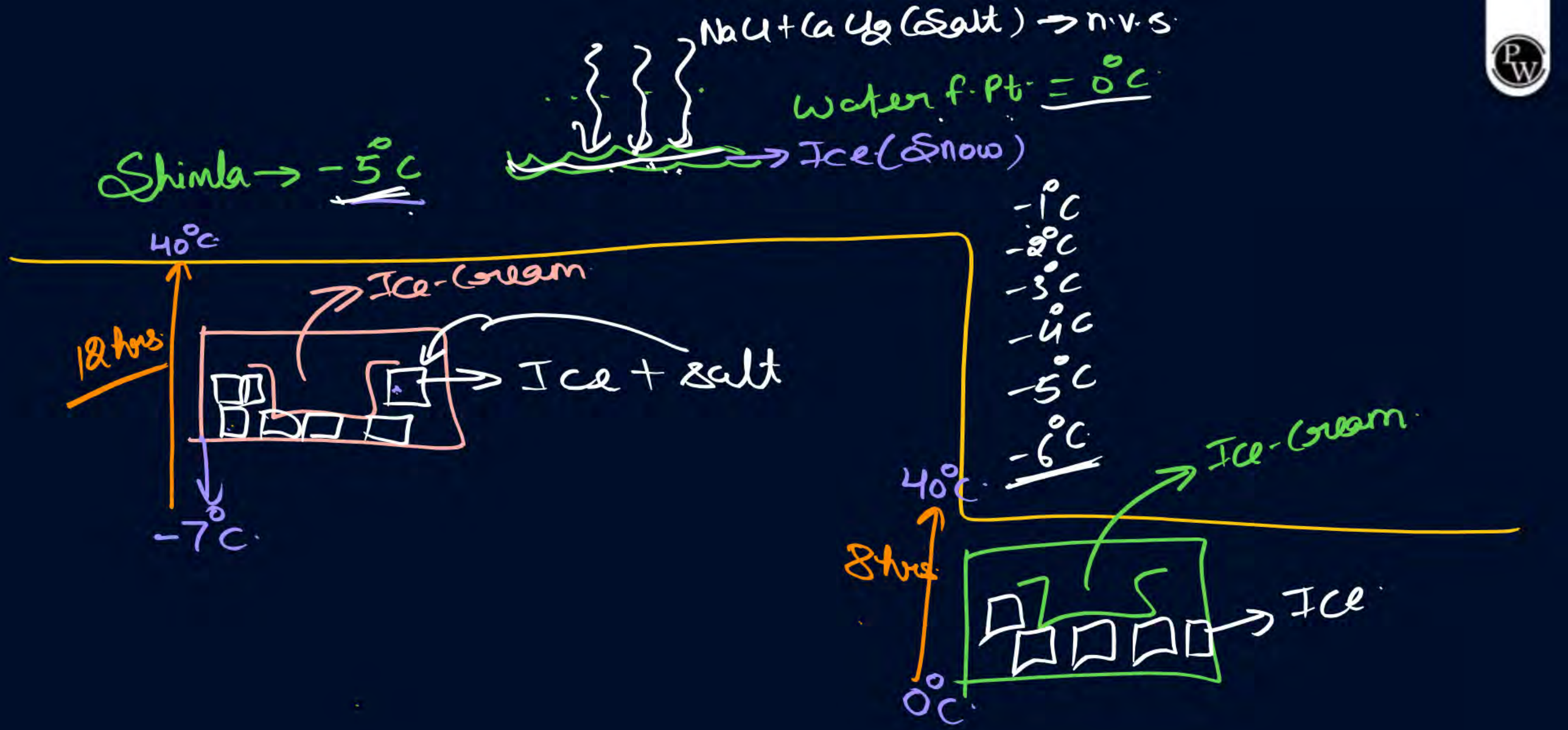
Applications of Depression in Freezing Point

#MIT

① Salt ($NaCl + CaCl_2$) used to clear snow on roads as it depresses f.Pt. of water (soln)

② Glycol or ethylene Glycol (CH_2OH | CH_2OH) added to car radiators to depress the f.pt of water so cars can stand in winter.

③ Salt sprinkled on ice, around ice-cream trolleys so ice cream don't melt.


NaCl + CaCl2 (Salt) → n.v.s
Water f.Pt = 0°C
Ice (&Snow)
Shimla → -5°C
40°C
18 hrs
Ice-Cream
Ice + salt
-7°C
-1°C
-2°C
-3°C
-4°C
-5°C
-6°C
40°C
Ice-Cream
8 hrs
Ice
0°C

QUESTION – (AIIMS 2018, 27 May)

Assertion (A): A non volatile solute is added in liquid solvent then freezing point of mixture decreases.

Reason (R): Vapour pressure decreases by addition of non volatile solute, so equilibrium point where V.P. of solid and V.P. of liquid are equal can reach at lower temperature.

A. If both assertion and reason are correct and reason is correct explanation of assertion.

B. If both assertion and reason are correct but reason is not correct explanation of assertion.

C. If Assertion is correct but reason is incorrect.

D. If both the assertion and reason are incorrect.

QUESTION (NEET 2017)

If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be

$m_2 = 2m_1$

$\Delta T_f = K_f \, m \cdot T$

(A) halved

(B) tripled

(C) Unchanged

(D) doubled

QUESTION – (NEET 2020)

The freezing point depression constant (K_f) of benzene is 5.12 K kg mol^{-1}. The freezing point depression for the solution of molality 0.078 m containing a non-electrolyte solute in benzene is: (rounded off upto two decimal places)

$K_f = 5.12\ K/m$, $m = 0.078\ m$.

$\Delta T_f = K_f\, m$

$= 5.12 \times 0.078 \approx 0.4\ K$.

A. 0.80 K

B. 0.40 K

C. 0.60 K

D. 0.20 K

QUESTION

Pure benzene freezes at 5.45°C. A 0.374 m solution of tetrachloroethane in benzene freezes at 3.55°C. The K_f (°C/ m) for benzene is

$\frac{2000}{400} = 5$

$T^\circ = 5.45^\circ C$ $\quad m = 0.374\ m$

$T_s = 3.55^\circ C$ $\quad K_f = ?$

$\Delta T_f = T^\circ - T_s$

$= 5.45 - 3.55$

$= 1.9^\circ C$

$\Delta T_f = K_f\, m$

$1.9 = K_f \times 0.374$

$K_f = \frac{1.900}{0.374}$

A 0.508

B 5.08

C 50.8

D 508

QUESTION – (AIIMS 2018, 27 May)

Ethylene glycol (B) is used as an antifreeze to reduce freezing point of water to –2.4°C. What mass of antifreeze is required for 2 L water? (K_f water = 1.86 K kg/mol)

(A) 16 kg

(B) 160 g ✓

(C) 1.60 kg

(D) 16 g

$T^\circ = 0^\circ C$

$T_S = -2.4^\circ C$

$w_B = ?$

$V_A = 2\,L = 2000\,ml$

$d_A = 1\,g/ml$

$w_A = 2000\,g$

$K_f = 1.86\,K/m$

$\Delta T_f = T^\circ - T_S = 0^\circ - (-2.4^\circ) = 2.4$

$\frac{8}{2.4} = \frac{3}{14} = \frac{1.86 \times w_B \times 1000}{100 \times 62 \times 2000}$

$M_B\left(\begin{matrix} CH_2OH \\ | \\ CH_2OH \end{matrix}\right) = 24+6+32 = 62$

$w_B = 8 \times 10 \times 2 = 160\,g$

QUESTION

Graphical variation of $\log(\Delta T_f)$ with $\log(m)$ for a dilute solution is (ΔT_f is depression in freezing point and mis the molality)

$\Delta T_f = K_f\, m$

$\log \Delta T_f = \log K_f + \log m$

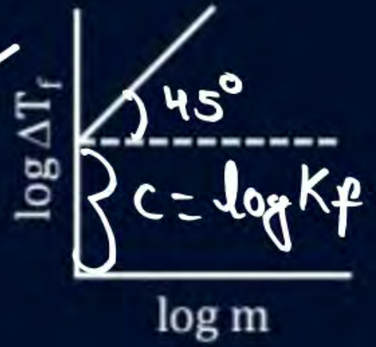
$\downarrow \qquad \uparrow$

$y = c + mx$

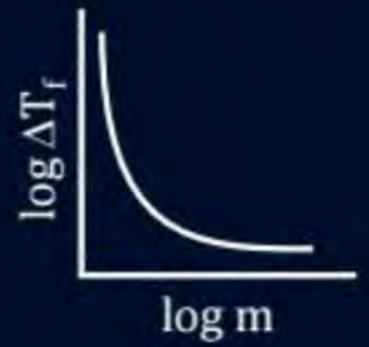
(A)

(B)

(C)



(D)



QUESTION

log & antilog → log table → video

If in previous Question, straight line is inclined at 45° and intercept on log ΔT_f axis is 0.27, then depression in freezing point of 1.10 molal solution is

$\theta = 45^\circ \Rightarrow \tan 45^\circ = 1 = m$

$C = \log K_f = 0.27$

$\Delta T_f = ?$

$m = 1.1$

$\log \Delta T_f = \log K_f + \log m$

$\log \Delta T_f = 0.27 + 1 \log 1.1$

(A) 0.27°

(B) 2.0°

(C) 0.2°

(D) 3.0°

QUESTION – (AIIMS 2018, 26 May)

When 45 g solute is dissolved in 600 g water, freezing point is lowered by 2.2 K, calculate molar mass of solute ($K_f = 1.86$ K kg mol^{-1})

$W_B = 45g$, $M_B = ?$

$W_A = 600g$

$\Delta T_f = 2.2K$

$\Delta T_f = K_f m$

$2.2 = \frac{1.86 \times 45 \times 1000}{100 \, M_B \times 600}$

$M = \frac{45 \times 31}{22}$

$\frac{44 \times 31}{22}$

(A) 63.4 g/mol

(B) 80 g/mol

(C) 90 g/mol

(D) 21 g/mol

$45 \times 31 = 1395$

$22 \overline{)1395} \; 63.4$

132

75

66

90

QUESTION-(JEE main 25th July 2nd Shift-2022)

$\Delta T_f \propto \frac{1}{M_B}$

Two solution A and B are prepared by dissolving 1 g of non-volatile solutes X and Y, respectively in 1 kg of water. The ratio of depression in freezing points for A and B is found to be 1 : 4. The ratio of molar masses of X and Y is:

A) 1 : 4

B) 1 : 0.25

C) 1 : 0.20

D) 1 : 5

$$\frac{(\Delta T_f)_X}{(\Delta T_f)_Y} = \frac{1}{4} \Rightarrow \frac{M_X}{M_Y} = \frac{4}{1} = \frac{1 \times 4}{0.25 \times 4}$$

$$\frac{(\Delta T_f)_X}{(\Delta T_f)_Y} = \frac{K_f \times 1 \times 1000 \times M_Y \times 1000}{K_f \times M_X \times 1000 \times 1 \times 1000}$$

$$\frac{1}{4} = \frac{M_Y}{M_X} \Rightarrow \frac{M_X}{M_Y} = \frac{4}{1}$$

QUESTION – (AIIMS 2016)

A solution containing 1.8 g of a compound (empirical formula CH_2O) in 40 g of water is observed to freeze at –0.465°C. The molecular formula of the compound is: [K_f of water = 1.86 kg K mol^{-1}]

(A) $C_2H_4O_2$

(B) $C_3H_6O_3$

(C) $C_4H_8O_4$

(D) $C_6H_{12}O_6$ ✓

$w_B = 1.8\,g$

$w_A = 40\,g$

$T_f = -0.465^\circ C$

$T^\circ = 0^\circ C$

$\Delta T_f = 0.465^\circ C$

$$0.465 = \frac{1.86 \times 18 \times 1000}{M_B \times 40}$$

M.F. = $(CH_2O)_x$ 93 9

$$x = \frac{M_B}{30} = \frac{180}{30} = 6$$

M.F. = $(CH_2O)_6$

$= C_6H_{12}O_6$

$$M_B = \frac{93 \times 900}{465} = 180$$

QUESTION – (AIPMT 2004)

Camphor is often used in molecular mass determination because

A. it is readily available

B. it has a very high cryoscopic constant

C. it is volatile

D. it is solvent for organic substances

QUESTION

CH3OH

A motor vehicle radiator was filled with 8 L of water to which 2 L of methyl alcohol (density 0.8 g/ml) were added. What is lowest temperature at which vehicle can be parked outdoors without a danger that water in radiator will freeze? (K_f for H_2O = 1.86 K kg mal^{-1})

Ans $V_A = 8000ml$
$d_A = 1 g/ml$
$w_A = 8000 g$

$V_B = 2000ml$
$d_B = 0.8 g/ml$
$\rightarrow w_B = 1600 g$

$M_B = 32$
CH_3OH

$T_f = ?$

$\Delta T_f = \frac{1.86 \times 1600 \times 1000}{1000 \times 32 \times 8000}$

$\Delta T_f = \frac{93}{8} = 11.6^\circ C$

$11.6 = T^\circ - T_f$
$11.6 = 0^\circ - T_f^\circ$
$T_f = -11.6^\circ C$

QUESTION-(JEE main 9th Jan 2nd Shift-2019)

$C_2H_4(OH)_2$ (Antifreeze)

A solution containing 62 g ethylene glycol in 250 g water is cooled to –10°C.

If K_f for water is 1.86 K kg mol^{-1}, the amount of water (in g) separated as ice is:

(A) 64

(B) 32

(C) 16

(D) 48

$w_B = 62\,g$

$M_B = 62\,g$

$w_A = 250\,g$

$T_s = -10^\circ C$

$T^\circ = 0^\circ C$

$\Delta T_f = 10^\circ C$

$$10 = \frac{1.86 \times 62 \times 1000}{100 \times 62 \times w_A'}$$

$w_A' = 186\,g$

ice formed $= 250 - 186$

$= 64\,g$

QUESTION-(JEE main 10th Jan 2nd Shift-2019)

Elevation in the boiling point for 1 molal solution of glucose is 2 K. The depression in the freezing point for 2 molal solution of glucose in the same solvent is 2 K. The relation between K_b and K_f is:

(A) $K_b = 1.5\ K_f$

(B) $K_b = 0.5\ K_f$

(C) $K_b = 2\ K_f$ ✓

(D) $K_b = K_f$

$\Delta T_b = 2K \quad m = 1m$

$\Delta T_f = 2K \quad m' = 2m$

$$\frac{\Delta T_b}{\Delta T_f} = \frac{K_b m}{K_f m'}$$

$$1 = \frac{K_b \times 1}{K_f \times 2}$$

$$K_b = 2K_f$$

QUESTION-(JEE main 12th Jan 1st Shift-2019)

freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is:

A. 2A

B. 3A

C. A

D. 4A

$T_s = T_s' \quad T^0 = T^0$

$\Delta T_f = \Delta T_f'$

$K_f\, m = K_f\, m'$

$\frac{4 \times 1000}{A \times 96} = \frac{12 \times 1000}{M_Y \times 88}$

$M_Y = \frac{96 \times 3 \times A}{88} = \frac{36}{11} A$

QUESTION-(JEE Advance 2017)

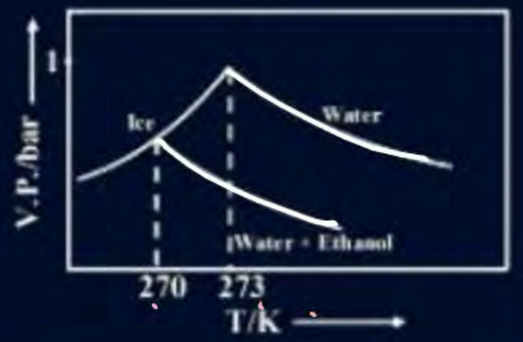
C_2H_5OH
T

Pure water freezes at 273 K and 1 bar. The addition of 34.5 g of ethanol to 500 g of water changes the freezing point of the solution. Use the freezing point depression constant of water at 2 K kg mol^{-1}. The figures shown below represent plots of vapour pressure (V.P.) versus temperature (T).

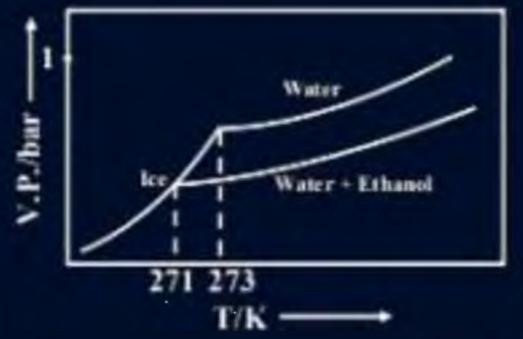
[Molecular weight of ethanol is 46 g mol^{-1}]

Among the following, the option representing change in freezing point is

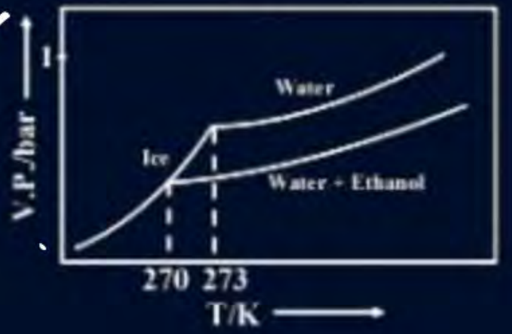
A



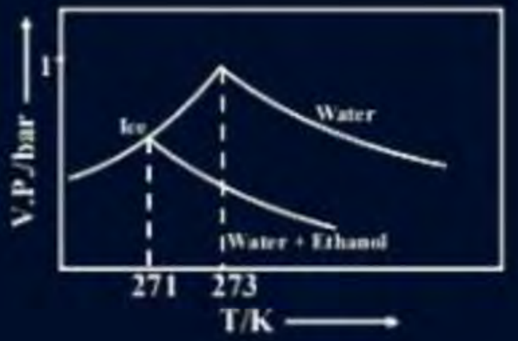
B



C



D



$$\Delta T_f = \frac{2 \times 345 \times 1000}{46 \times 500}$$

$$23$$

$$= \frac{345}{115} = 3K.$$

QUESTION (NCERT)

Two elements A & B form compounds having molecular formula AB_2 & AB_4. When dissolved in 20g of benzene 1g of AB_2 lowers the freezing point by 2.3 K. Whereas 1g of AB_4 lowers the freezing point by 1.3 K. Determine atomic masses of A & B. The molal depression Constant for benzene is 5.1 K Kg mol^{-1}.

at. mass of A = a, B = b

AB_2 $\quad M_B = a + 2b$

$w_A = 20g$

$w_B = 1g$

$\Delta T_f = 2.3\,K$

$$2.3 = \frac{5.1 \times 1 \times 1000}{M_B \times 20}$$

$$M_B = \frac{51 \times 1000}{23 \times 20} = \frac{2550}{23}$$

AB_4 $\quad M_B' = a + 4b$

$w_B' = 1g$

$\Delta T_f' = 1.3\,K$

$$1.3 = \frac{5.1 \times 1 \times 1000}{M_B' \times 20}$$

$$M_B' = \frac{51 \times 50}{13} = \frac{2550}{13}$$

$$a + 2b = 110.86$$
$$+\,a + 4b = +196.15$$

$$-2b \approx -86$$

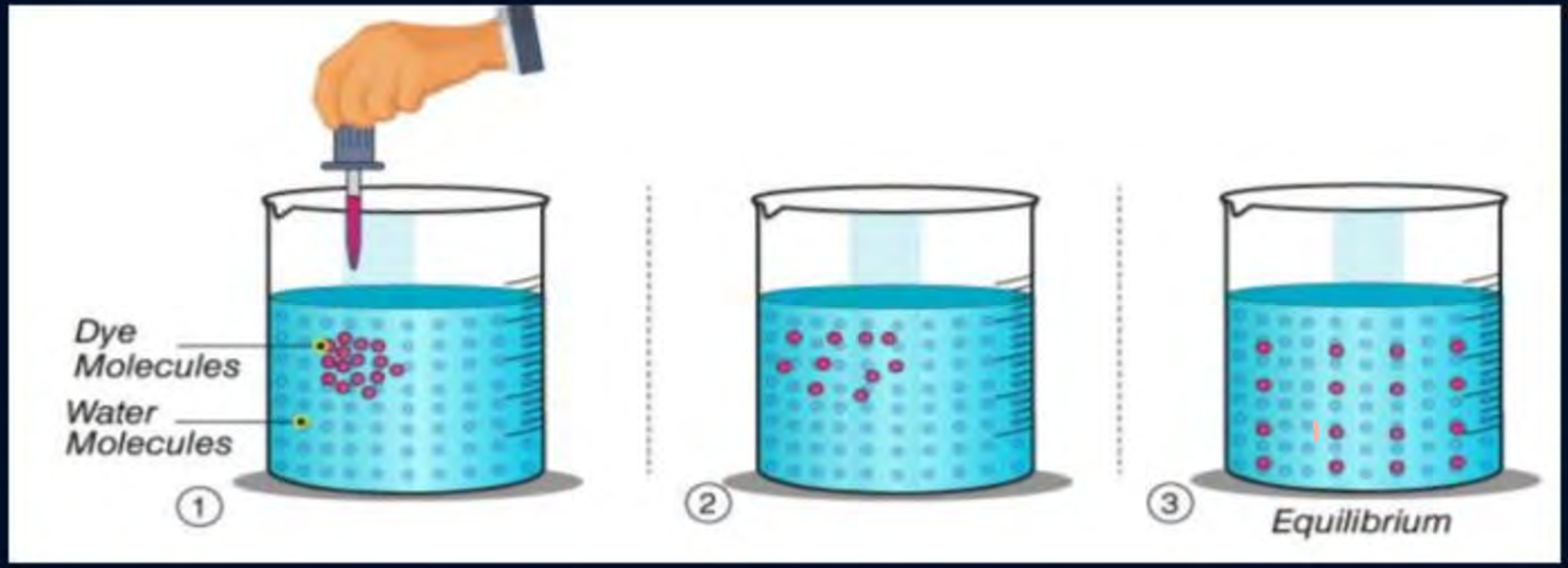
$$b \approx 43$$

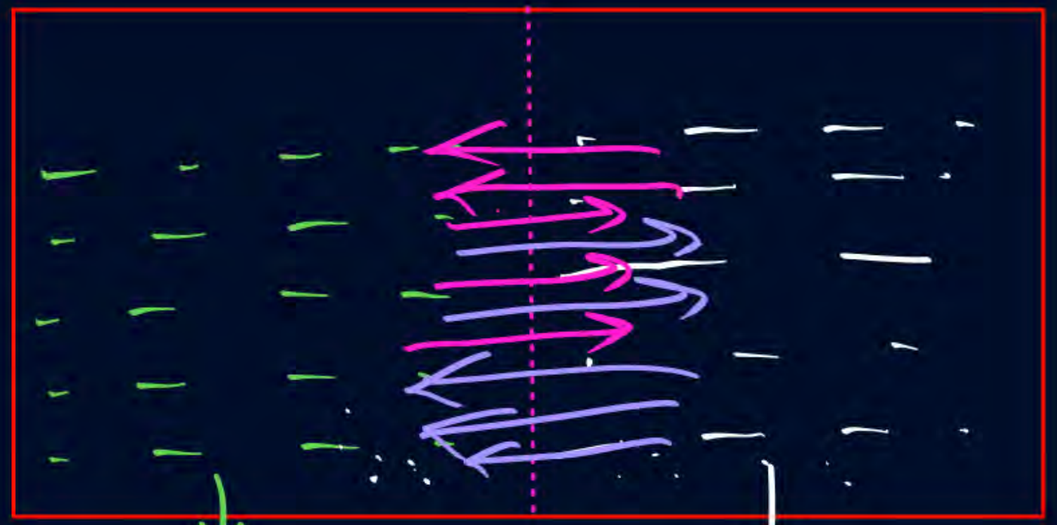
$$a + 2 \times 43 \approx 111$$

$$a \approx 111 - 86 \approx 25$$

Diffusion

Intermixing of particles





$C_1 > C_2$

$C_1 = 0.1\,M\,NaCl$ $\quad$ $C_2 = 0.5\,M\,NaCl$

Solvent particles low Conc. to high Conc
Solute high Conc. to low Conc
] $\Rightarrow C_1 = C_2$

★★★★★ trick

Sprint → Season 1

Home work from modules

Do all questions of Depression in freezing point.

Magarmach Practice Questions (MPQ)

QUESTION

Consider following three solution.

I. 7% aqueous solution of AB_2.

II. 8% aqueous solution of A_2B.

III. 6% aqueous urea solution.

Depression in freezing point of each solution is same and is = 1.86° (AB_2 and A_2B are non-electrolytes) cotomanis also a co Thus,

(A) atomic masses of A and B are in the ratio of 3: 2.

(B) molar mass of AB_2 and A_2B are same

(C) Both of the above are correct

(D) None of the above is correct

QUESTION

Given $K_f/K_b = 2.0$ for a solvent. If depression in freezing point is x°, then elevation in boiling point is

A. 0.5 x°

B. 2 x°

C. 4 x°

D. 0.25 x°

QUESTION – (AIPMT 2006)

1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant K_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by

A. 0.3 K

B. 0.5 K

C. 0.4 K

D. 0.2 K

QUESTION – (AIIMS 2015)

A solution of urea (mol. mass 56 g mol^{-1}) boils at 100.18°C at the atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K kg mol^{-1} respectively, the above solution will freeze at

A. 0.654°C

B. –0.654°C

C. 6.54°C

D. –6.54°C

QUESTION-(JEE main 2022)

K_f for water is 1.86 K kg mol^{-1}. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to –2.8°C?

A 93 g

B 39 g

C 27 g

D 72 g

QUESTION-(JEE main 2021)

Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at –6°C will be (K_f for water = 1.86 K kg mol^{-1}, and molar mass of ethylene glycol = 62 g mol^{-1})

A 804.32 g

B 204.30 g

C 400.00 g

D 304.60 g

QUESTION-(JEE Mains 26th July 2nd Shift 2022)

The elevation in boiling point for 1 molal solution of non-volatile solute A is 3 K. The depression in freezing point for 2 molal solution of A in the same solvent is 6 K. The ratio of K_b and K_f i.e., K_b/K_f is 1 : X. The value of X is _____ (Nearest integer)

QUESTION-(JEE Mains 26th July 2nd Shift 2022)

1.80 g of solute A was dissolved in 62.5 cm^3 of ethanol and freezing point of the solution was found to be 155.1 K. The molar mass of solute A is _____ g mol^{-1}. [Given: Freezing point of ethanol is 156.0 K, Density of ethanol is 0.80 g cm^{-3}, Freezing point depression constant of ethanol is 2.00 K kg mol^{-1}]

THANK YOU