Q1 (20 July 2021 Shift 1)

At $20^{\circ}C$, the vapour pressure of benzene is 70 torr and that of methyl benzene is 20 torr. The mole fraction of benzene in the vapour phase at $20^{\circ}C$ above an equimolar mixture of benzene and methyl benzene is ___ $\times 10^{-2}$. (Nearest integer)

Q2 (20 July 2021 Shift 2)

The vapour pressures of A and B at $25^{\circ}C$ are 90 mmHg and 15 mm Hg respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.6, then the mole fraction of B in the vapour phase is $x \times 10^{-1}$. The value of x is ___

(Nearest integer)

Q3 (22 July 2021 Shift 1)

Which one of the following 0.06M aqueous solutions has lowest freezing point?

(1) $Al_2(SO_4)_3$

(2) $C_6H_{12}O_6$

(3) KI

(4) K_2SO_4

Q4 (22 July 2021 Shift 1)

If the concentration of glucose $(C_6H_{12}O_6)$ in blood

is $0.72\ g\ L^{-1}$, the molarity of glucose in blood is _____ $-10^{-3}M$. (Nearest integer)

[Given: Atomic mass of $C = 12, H = 1, O = 16u$]

Q5 (25 July 2021 Shift 1)

CO_2 gas is bubbled through water during a soft drink manufacturing process at 298 K. If CO_2 exerts a partial pressure of 0.835 bar then xmmol of CO_2 would dissolve in 0.9 L of water. The value of x is . (Nearest integer)

(Henry's law constant for CO_2 at 298 K is $1.67 \times 10^3 \text{bar})$

Q6 (25 July 2021 Shift 2)

When 3.00 g of a substance X' is dissolved in 100 g of CCl_4, it raises the boiling point by 0.60 K. The molar mass of the substance X' is gmol^{-1}

(Nearest integer).

$[\text{Given } K_b \text{ for } CCl_4 \text{ is } 5.0 \text{ K kg mol}^{-1}]$

Q7 (27 July 2021 Shift 1)

1.46 g of a biopolymer dissolved in a 100 mL water at 300 K exerted an osmotic pressure of 2.42×10^{-3} bar. The molar mass of the biopolymer is -10^4 g

mol^{-1}. (Round off to the Nearest Integer)

$[\text{Use: } R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}]$

Q8 (27 July 2021 Shift 2)

In a solvent 50% of an acid HA dimerizes and the

rest dissociates. The van't Hoff factor of the acid is $\times 10^{-2}$

(Round off to the nearest integer)

Answer Key

Q1 (78)	**Q2** (1)	**Q3** (1)	**Q4** (4)
Q5 (25)	**Q6** (250)	**Q7** (15)	**Q8** (125)

Q1

$P_B^o = 40 \quad P_T^o = 20 \quad K_B = 0.5 = K_T$

$$\text{Now} \quad y_B = \frac{K_B P_B^o}{K_B P_B^\circ + K_T P_T^\circ}$$
$$= \frac{70 \times 0.5}{70 \times 0.5 + 20 \times 0.5}$$

Q2

Given $P_A^\circ = 90$ mmHg, at 25°C

$P_B^\circ = 15$ mmHg

and $\left.\begin{array}{l} X_A = 0.6 \\ X_B = 0.4 \end{array}\right\} P_T = X_A P_A^\circ + X_B P_B^\circ$

$= (0.6 \times 90) + (0.4 \times 15)$

$= 54 + 6 = 60$ mm

Now mol fraction of B in the vapour phase

i.e. $Y_B = \frac{P_B}{P_T} = \frac{X_B P_B^\circ}{60} = 0.1 = 1 \times 10^{-1}$

therefore: $x = 1$

Q3

$T_f - T_f' = iK_f \cdot m$

For minimum T_f'

'i' should be maximum. $Al_2(SO_4)_3 i = 5$

$C_6H_{12}O_6 \quad i = 1$

$KI \quad i = 2$

$K_2SO_4 \quad i = 3$

Q4

$[Glucose] = \frac{C(gm/\ell)}{M(gm/mol)} = \frac{0.72}{180} = 4 \times 10^{-3}$M

Q5

From Henry's law

$P_{gas} = K_H.X_{gas}$

$n(CO_2) = 0.025$

Millimoles of $CO_2 = 0.025 \times 1000 = 25$

Q6

$$\Delta T_b = K_b \times \text{ molality}$$
$$0.60 = 5 \times \left(\frac{3/M}{100/100}\right)$$
$$M = 250$$

Q7

$\pi = CRT \quad ; \pi = \text{osmotic pressure}$

$C = \text{molarity}$

$T = \text{Temperature of solution let the molar mass be Mgm/mol } 2.42 \times 10^{-3} \text{ bar} = \frac{\left(\frac{1.46\text{ g}}{\text{Mgm/mol}}\right)}{0.1\ell} \times \left(\frac{0.083\ell-\text{bar}}{\text{mol}-\text{K}}\right) \times (300\text{ K})$

$\Rightarrow M = 15.02 \times 10^4 \text{ g/mol}$

Q8

$$
\begin{array}{lcccccc}
 & 2HA \rightleftharpoons & H_2\ A_2HA \rightleftharpoons H^+ + A & & & & \\
\text{Initial moles} & a \times \frac{50}{100} & 0 & a \times \frac{50}{100} & 0 & 0 & \\
\text{Final moles} & 0 & 0.25a & 0 & 0.5a & 0.5a &
\end{array}
$$

Now, $i = \frac{\text{final moles}}{\text{initial moles}} = \frac{0.25a + 0.5a + 0.5a}{0.5a + 0.5a}$
$= 1.25 = 125 \times 10^{-2}$