

**M**  
1 The solubility of  $O_2$  gas is  $2.80 \times 10^{-4}$  M in the surface water of a lake at sea level at a pressure of 1 atm and temperature of  $25^\circ\text{C}$  and the mole fraction of  $O_2$  is 0.20. Calculate the molarity of  $O_2$  in the surface water of a lake at the top of a mountain where the pressure is 0.80 atm and the temperature is  $25^\circ\text{C}$  and the mole fraction of  $O_2$  is 0.15.

- A)  $2.44 \times 10^{-4}$  M B)  $1.95 \times 10^{-4}$  M C)  $1.79 \times 10^{-4}$  M D)  $1.68 \times 10^{-4}$  M

2 The solubility of nitrogen gas in water at  $25^\circ\text{C}$  and its partial pressure at 0.76 atm is  $5.2 \times 10^{-4}$  mol/L. What is the partial pressure of nitrogen (in atm) at which its solubility in water is  $1.71 \times 10^{-3}$  mol/L at  $25^\circ\text{C}$ ?

- A) 2.7 B) 2.5 C) 2.3 D) 2.1

3 Benzene,  $C_6H_6$ , and toluene,  $C_7H_8$ , form ideal solution that has a total vapor pressure of 1.0 atm. What is the mole fraction of benzene in this solution, knowing that the vapor pressure of pure benzene is 1.326 atm and that of pure toluene is 0.532 atm? (all vapor pressures given are measured at exactly the same temperature).

- A) 0.56 B) 0.59 C) 0.62 D) 0.64

4 A solution of 0.150 g of lysozyme (a non-electrolyte and non-volatile hormone) in 210 ml of a solution has an osmotic pressure of 0.953 torr at  $25^\circ\text{C}$ . Calculate (in g/mol) the molar mass of lysozyme.

- A) 24385 B) 216674 C) 17124 D) 13936

5 The osmotic pressure of 0.01 M  $MgSO_4$  solution at  $25^\circ\text{C}$  is 0.318 atm. Calculate the van't Hoff factor (i) for  $MgSO_4$  (an electrolyte) at this concentration.

- A) 1.5 B) 1.4 C) 1.3 D) 1.2

6 What is the mass (in kg) of urea,  $(NH_2)_2CO$ , (non-electrolyte and non-volatile) that must be dissolved in 10.0 kg of water to give a solution that freezes at  $-10^\circ\text{C}$ . ( $K_f$  water =  $1.86^\circ\text{C/m}$ )

- A) 3.23 B) 3.47 C) 4.12 D) 4.34

7 A solution containing 10.0 g of  $CaCl_2$  (an electrolyte) in 100.0 g of water freezes at  $-4.1^\circ\text{C}$ . What is the van't Hoff factor of this solution? ( $K_f$  water =  $1.86^\circ\text{C/m}$ ).

- A) 2.85 B) 2.68 C) 2.59 D) 2.45

8 A solution prepared from 100.0 g of non-volatile non-electrolyte solute in 5.5 mole of toluene ( $C_7H_8$ ) has a vapor pressure of 0.161 atm at  $60^\circ\text{C}$ . What is the molecular weight (in g/mole) of the solute knowing that the vapor pressure of pure toluene at  $60^\circ\text{C}$  is 0.184 atm?

- A) 127.3 B) 132.5 C) 145.6 D) 154.8

9 The molar mass of hemoglobin (a non-electrolyte) is  $6.8 \times 10^4$  g/mole. What is the osmotic pressure (in mmHg) at  $27^\circ\text{C}$  of a solution of 8.0 g hemoglobin in 200 mL of water?

- A) 9.0 B) 11.0 C) 13.0 D) 14.0





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The solubility of nitrogen gas " $N_2$ " in water at  $20^\circ\text{C}$  and 520 mmHg is  $5.0 \times 10^{-4}$  mol/L. The Henry's law constant (in mol/L.atm) at  $20^\circ\text{C}$  for the solubility of nitrogen gas in water is:

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- A)  $7.3 \times 10^{-4}$       B)  $7.1 \times 10^{-4}$       C)  $6.9 \times 10^{-4}$       D)  $6.7 \times 10^{-4}$
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11

At  $25^\circ\text{C}$ , the vapor pressure of the cyclohexane liquid " $C_6H_{12}$ " is 70.0 mmHg and that of the toluene liquid " $C_7H_5CH_3$ " is 22.0 mmHg. The mole fraction of toluene in an ideal solution of cyclohexane and toluene that has a vapor pressure equals to 53.2 mmHg at  $25^\circ\text{C}$  is:

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- A) 0.25      B) 0.28      C) 0.31      D) 0.35
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12

An aqueous solution is prepared from 40.0 g of lithium fluoride " $LiF$ " (a nonvolatile ionizable electrolyte) in 200.0 g of water. Given  $K_b$  water =  $0.52^\circ\text{C}/m$  and the van't Hoff factor of this lithium fluoride solution = 1.20, the boiling point elevation of this solution (in  $^\circ\text{C}$ ) is:

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- A) 5.2      B) 4.8      C) 4.4      D) 4.2
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13

A nonvolatile nonelectrolyte compound having a molar mass equals to 18000 g/mol is dissolved to give 100 mL aqueous solution that has an osmotic pressure equals to 26 mmHg at  $27^\circ\text{C}$ . The mass (in g) of this compound dissolved in this solution is:

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- A) 2.1      B) 2.3      C) 2.5      D) 2.7
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