

Answer on Question # 73309 - Chemistry - General Chemistry

Calculate the osmotic pressure of a solution containing 19.65 mg of hemoglobin in 14.2 mL of solution at 17 °C. The molar mass of hemoglobin is 6.5×10^4 g/mol.

Solution

In order to calculate the osmotic pressure of non-electrolytes, we use the van't Hoff Equation:

$$\Pi = MRT,$$

where Π is the osmotic pressure in atm, M is the molar concentration in mol/L, R is the universal gas constant and T is the absolute temperature.

The absolute temperature is:

$$T = ^\circ\text{C} + 273 = 17 + 273 = 290 \text{ K}.$$

The amount of substance of hemoglobin is:

$$n = 19.65 \text{ mg} (1 \text{ g}/1000 \text{ mg}) (1 \text{ mol}/6.5 \times 10^4 \text{ g}) = 3.023 \times 10^{-7} \text{ mol}.$$

The molarity of solution is:

$$M = (3.023 \times 10^{-7} \text{ mol}) / (0.0142 \text{ L}) = 2.13 \times 10^{-5} \text{ mol/L}.$$

The osmotic pressure of the solution is:

$$\Pi = (2.13 \times 10^{-5} \text{ mol/L}) (0.08205 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}) (290 \text{ K}) = 5.07 \times 10^{-4} \text{ atm, or } 51 \text{ Pa}.$$

Answer: 5.07×10^{-4} atm, or 51 Pa.