Answer on the question #68800, Chemistry / Other

Question:

calculate the vapour pressure of aqueous 0.01 M glucose solution at 300 Kelvin temperature the vapour pressure of water is 0.03 bar at 300 Kelvin temperature.

Solution:

According to Raoult's law, the pressure for a single component p_i in an ideal solution is stated as:

$$p_i = p_0 x_i,$$

where p_0 is the vapour pressure of the pure component i and x_i is its molar fraction. Let's calculate the molar fraction of water in 0.01M aqueous glucose solution:

$$x_{aq} = \frac{n_{aq}}{n_{aq} + n_{gc}}$$

$$c_{gc} = \frac{n_{gc}}{V_{sol}}; n_{gc} = c_{gc} V_{sol}$$

Let's substitute the number of the moles of glucose:

$$x_{aq} = \frac{1}{1 + n_{gc}/n_{aq}} = \frac{1}{1 + c_{gc} V_{sol}/n_{aq}}$$

Assuming that the volume of solution is equal to the volume of water:

$$x_{aq} = \frac{1}{1 + \frac{c_{gc} V_{aq}}{n_{aq}}} = \frac{1}{1 + \frac{c_{gc} M_{aq}}{d_{aq}}}$$

$$x_{aq} = \frac{1}{1 + 0.01(M) \cdot \frac{18.01528(g/mol)}{998.2(g/L)}}$$

$$x_{aq} = 0.99981955$$

Finally, we can calculate the vapour pressure:

$$p_{aq} = 0.03(bar) \cdot 0.99981955 = 0.029995(bar)$$

Answer: $0.029995(bar)$