Colligative properties of sea water

The colligative molality of sea water is 1.1 **m** and its density Is 1.02 gm/cm^3. Given that the vapor pressure of pure water is 25 mmHg at 298 K calculate the following:

A. The vapor pressure of sea water
B. The freezing point of sea water
C. The boiling point of sea water

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A. The vapor pressure of sea water

Solution: We need the mole fraction of sea water in order to use Raoult's law. First we calculate the mole fraction of the solute:

$$x_2 = \frac{n_2}{n_2 + n_1}$$

Fortunately, this is easy starting from the molality

$$x_2 = \frac{1.1\,mol}{1.1\,mol + 55.56\,mol}$$

And we obtain

$$x_2 = 0.0194$$

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A. The vapor pressure of sea water

Then we use the mole fraction of the solute to obtain that of the solvent.

$$x_2 = 0.0194$$

$$x_1 = 1 - x_2 = 0.9805$$

And finally we use this value in Raoult's law

$$P_1 = x_1 P_1^*$$

to obtain

$$P_1 = (0.9805)(25\, mmHg) = 24.5\, mmHg$$

Colligative properties of sea water

The colligative molality of sea water is 1.1 **m** and its density Is 1.02 gm/cm^3. Given that the vapor pressure of pure water is 25 mmHg at 298 K calculate the following:

B. The freezing point of sea water is obtained from the freezing point depression formula.

$$\Delta T = K_f\, \boldsymbol{m} = -\left(1.86\ \frac{^oC}{molal}\right)(1.1\ m)$$

which gives us

$$T = -\,2\ ^oC\ \ or\ 271\ K$$

C. The boiling point elevation is.

$$\Delta T = K_b\, \boldsymbol{m} = \left(0.5\ \frac{^oC}{molal}\right)(1.1\ m) = 0.5\ ^oC$$

$$T = 100.5\ ^oC\ \ or\ 373.5\ K$$