28774, Chemistry, Other

how many grams of ethylene glycol CH2OHCH2OH must be added to 37.8grams of water to give a freezing point of -0.150

Solution:

The extent of freezing point depression depends only on the solute concentration (molality concentration) that can be estimated by a simple linear relationship with the cryoscopic constant: $\Delta T_F = K_F \cdot C_m$,

Where, ΔT_F - the freezing point depression, is defined as $T_{F\ (pure\ solvent)} - T_{F\ (solution)} = 0-(-0.150)=0.150$;

K_F is the cryoscopic constant, which is dependent on the properties of the solvent, not the solute. For water, K_F = 1.853 K·kg/mol;

C_m - molality concentration (mole per kg of solvent or math equation is: $C_m = \frac{m}{M \cdot m(H_2O)}$).

From this equation the molality of solution is: $C_m = \frac{\Delta T_F}{K_F} = \frac{0.150}{1.853} = 0.081 mol/kg$.

From equation of C_m we calculate the mass of solute: $m=C_m \cdot M \cdot m(H_2O)$.

The molar mass of CH_2OHCH_2OH is: $M(C_2H_6O_2)=12\cdot2+1\cdot6+16\cdot2=62$ g/mol.

The mass of CH_2OHCH_2OH is: $m= 0.081\cdot62\cdot\frac{37.8}{1000}=0.19$ g.

Answer: The mass of ethylene glycol is 0.19 g.