Solution - 9 Raoult's law Fpt/Bpt Changes.

1) * What is the mass of sucrose ($C_{12}H_{22}O_{11}$; MW = 342.3 g/mol) added to 75.0 g H_2O to raise the bpt to 100.35°C? ($K_b = 0.512°C/m$)

$\Delta T_b = K_b (m)$. $(100.35 - 100)°C = 0.35°C$

$m = \frac{\Delta T_b}{K_b} = \frac{0.35°C}{0.512°C/m} = 0.684 m = \frac{\text{mol solute}}{\text{kg solvent}}$ of H_2O

$\text{mol solute} = 0.684 \frac{\text{mol}}{\text{kg}} \times 0.075 \text{ kg } H_2O = 0.0513 \text{ mol}$.

$\therefore MW = 342.3 \text{ g/mol}$. $0.0513 \text{ mol} \times \frac{342.3 \text{ g}}{1 \text{ mol}} = 17.5 \text{ g sucrose}$.

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2) * What mass of glycine (NH_2CH_2COOH; MW = 75 g/mol) must be added to 1.00 L water to make it freeze at −1.1°C? ($K_{f_{H_2O}} = 1.86°C/m$).

$\Delta T_f = K_f (m)$. $0 - 1.1 = 1.1$.

$m = \frac{\Delta T_f}{K_f} = \frac{1.1°C}{1.86°C/m} = 0.591 m = \frac{\text{mol solute}}{\text{kg solvent}}$

$0.591 m = \frac{\text{mol}}{1.00 \text{ kg}}$. $\text{mol} = 0.591 \times 1 \text{ kg} = 0.591 \text{ mol}$.

1 L $H_2O \equiv$ 1 kg.

$0.591 \text{ mol} \times \frac{75 \text{ g}}{\text{mol}} = 44.4 \text{ g glycine}$