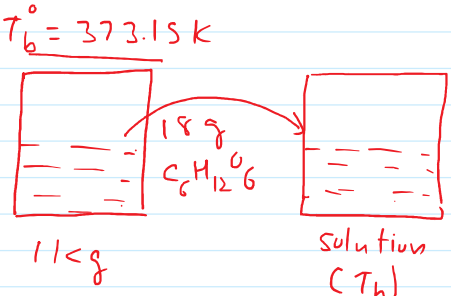
Question

18 g of glucose $C_6H_{12}O_6$ is dissolved in 1kg of water in a saucepan. At what temperature will water boil at 1.013 bar. k_b for water is 0.52 K kg mol^{-1}.

Answer



At 1.013 bar water boils at 373.15 K

$T_b^\circ = 373.15\ K$

$$m = \frac{n_{glucose}}{w_{solvent}\,(in\ kg)} = \frac{w_{glucose}}{M_{glucose} \times w_{solvent}\,(in\ kg)} = \frac{18}{180 \times 1} = 0.1\ m$$

$$\Delta T_b = T_b - T_b^\circ = k_b m$$

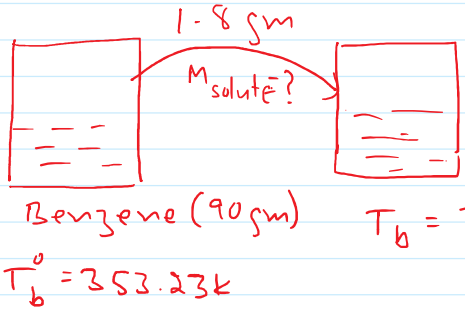
$$T_b - 373.15 = 0.52 \times 0.1$$

$$T_b = 373.2021\ K.$$

Question

The boiling point of benzene is 353.23 k. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11k. Calculate the molar mass of the solute. k_b for benzene is 2.53 k kg mol^{-1}.

Answer



$$\Delta T_b = T_b - T_b^\circ$$

$$m k_b = 354.11 - 353.23$$

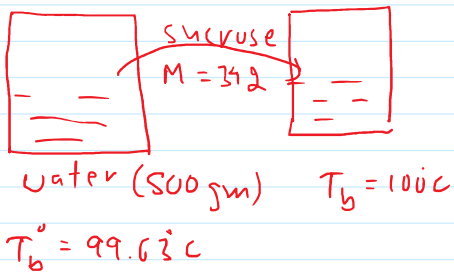
$$\frac{w_{solute} \times 1000}{M_{solute} \times w_{solvent}} \times 2.53 = 0.88$$

$$\frac{1.8 \times 1000}{M_{solute} \times 90} \times 2.53 = 0.88$$

$$M_{solute} = 57.5\ g$$

Question

Boiling point of water at 750 mm Hg is 99.63°C. How much sucrose is to be added to 500 g of water such that it boils at 100°C.



Ans:

$$\Delta T_b = T_b - T_b^\circ$$

$$m k_b = 100 - 99.63$$

$$\frac{w_{solute} \times 1000}{m_{solute} \times w_{solvent}} \times k_b = 0.37$$

$$\frac{w_{solute} \times 1000 \times 0.52}{342 \times 500} = 0.37$$

$$w_{solute} = 121.67\ g$$