Elevation in Boiling point

Molal Boiling Point elevation Constant (Ebullioscopic constant) for water:

1 mole of non electrolyte & non volatile solute dissolved per kg of water raises the Boiling point upto 0.52^{o}C

Temperature Curve

AB - VP of pure solvent

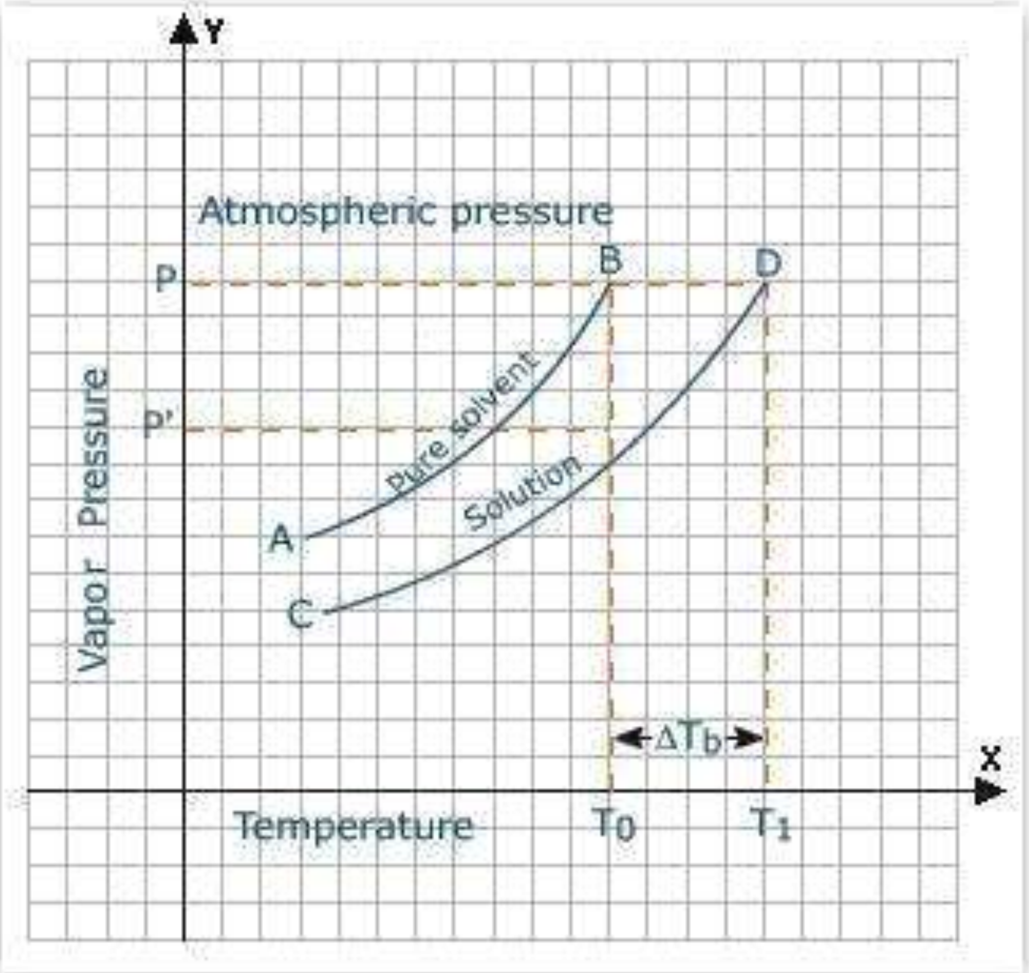
P^o = VP of pure solvent

T_o = B.P of pure solvent

CD - VP of solution

T_1 = B.P of Solution

ΔT_b = Difference of two B.P



- The magnitude of boiling point elevation is directly proportional to Molality of solution(m)

- The constant K_b is called Molal constant for Boiling point Elevation of Ebullioscopic constant

$\Delta T_b = T_1 - T_o$

$\Delta T_b \propto m$

$\Delta T_b = K_b\ m$ --------(i)

When molality = 1m

$\Delta T_b = K_b$

“Elevation of boiling point when 1 mol of non-volatile, non-electrolyte solute is dissolved in 1 kg of solvent is called molal boiling point elevation constant”

K_b depends only on nature of solvent and not on the solute

Molality of solution is given by: $$m = \frac{W_2 \times 1000}{M_2 \times W_1}$$

Substituting value in Equation (i): $$\Delta T_b = K_b \times m = K_b \times \frac{W_2 \times 1000}{M_2 \times W_1}$$

$$M_2 = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$$

Determination of Boiling Point by Lands Berger's Method

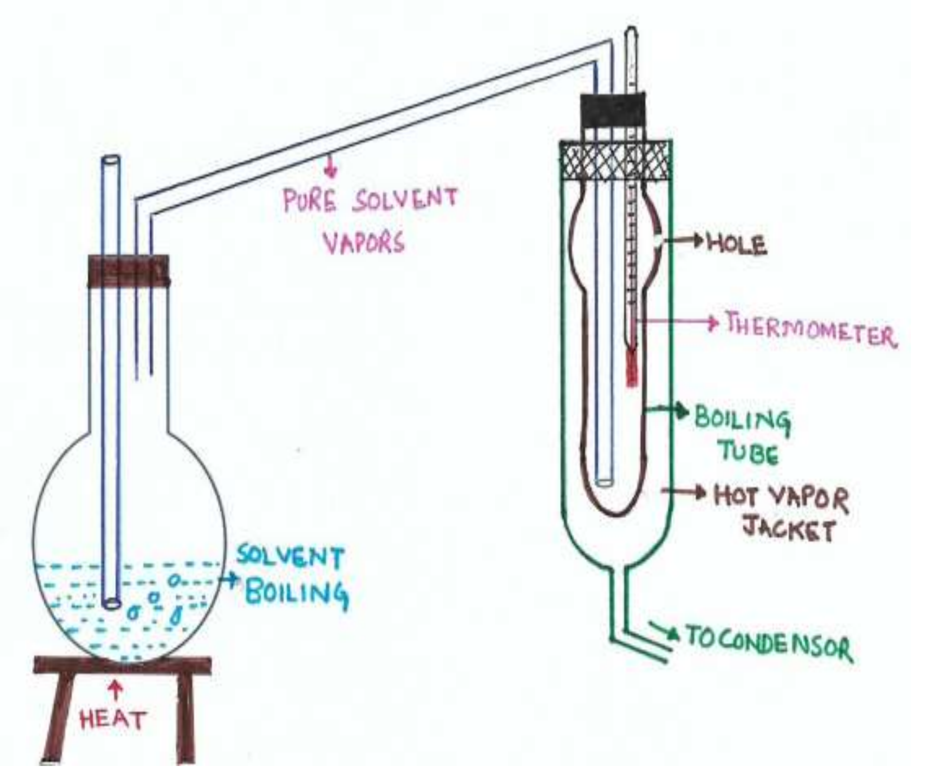
Land Berger's Apparatus

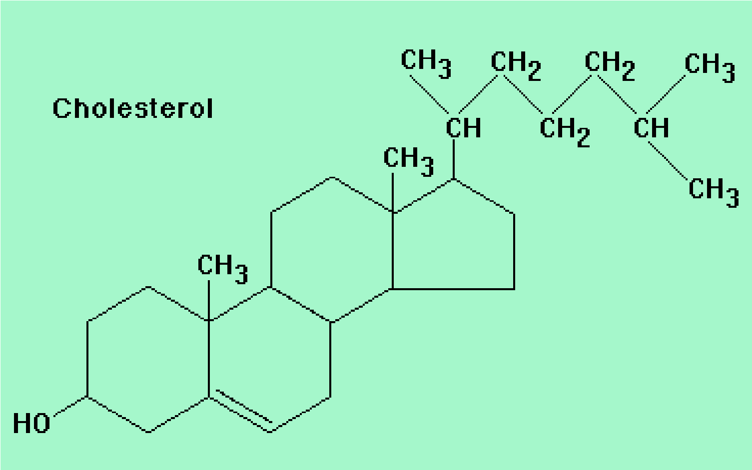
A. A graduated inner tube with a hole in its side

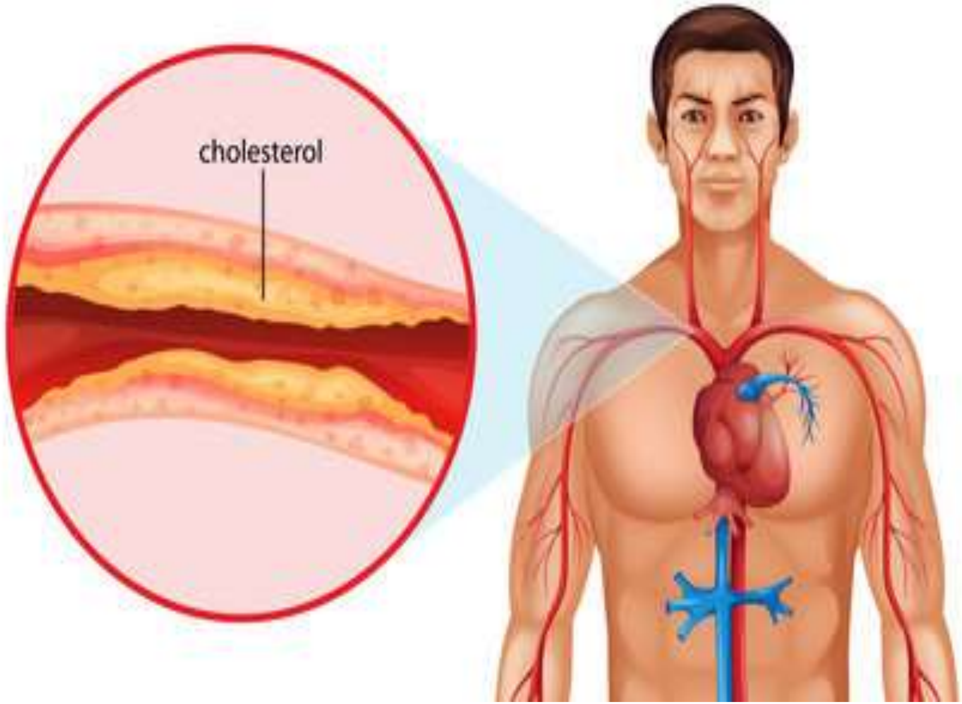
B. A boiling flask which sends the solvent vapors into the inner tube through a nose head

C. An outer tube which receives solvent vapors coming out from the side hole of the inner tube

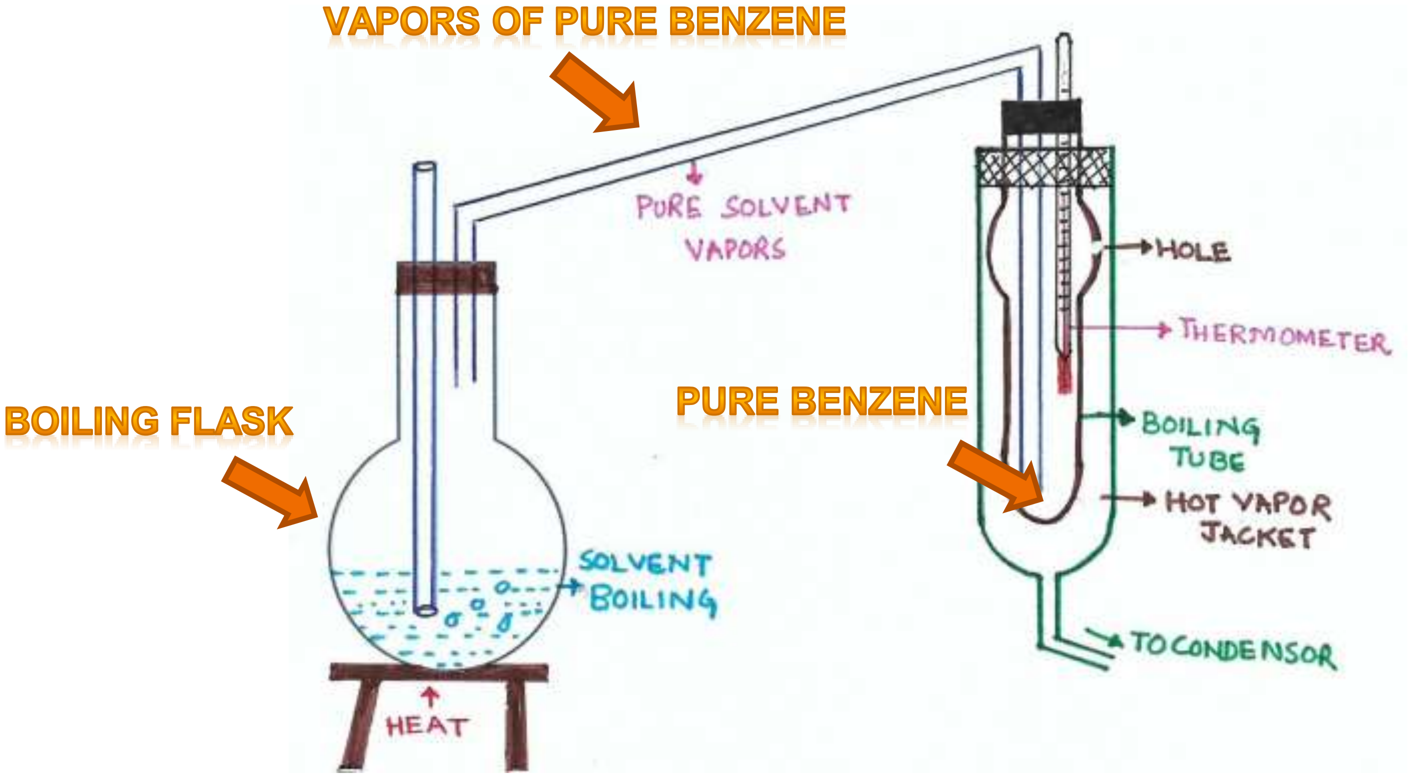
D. A beckmann's thermometer which can read up to 0.01K



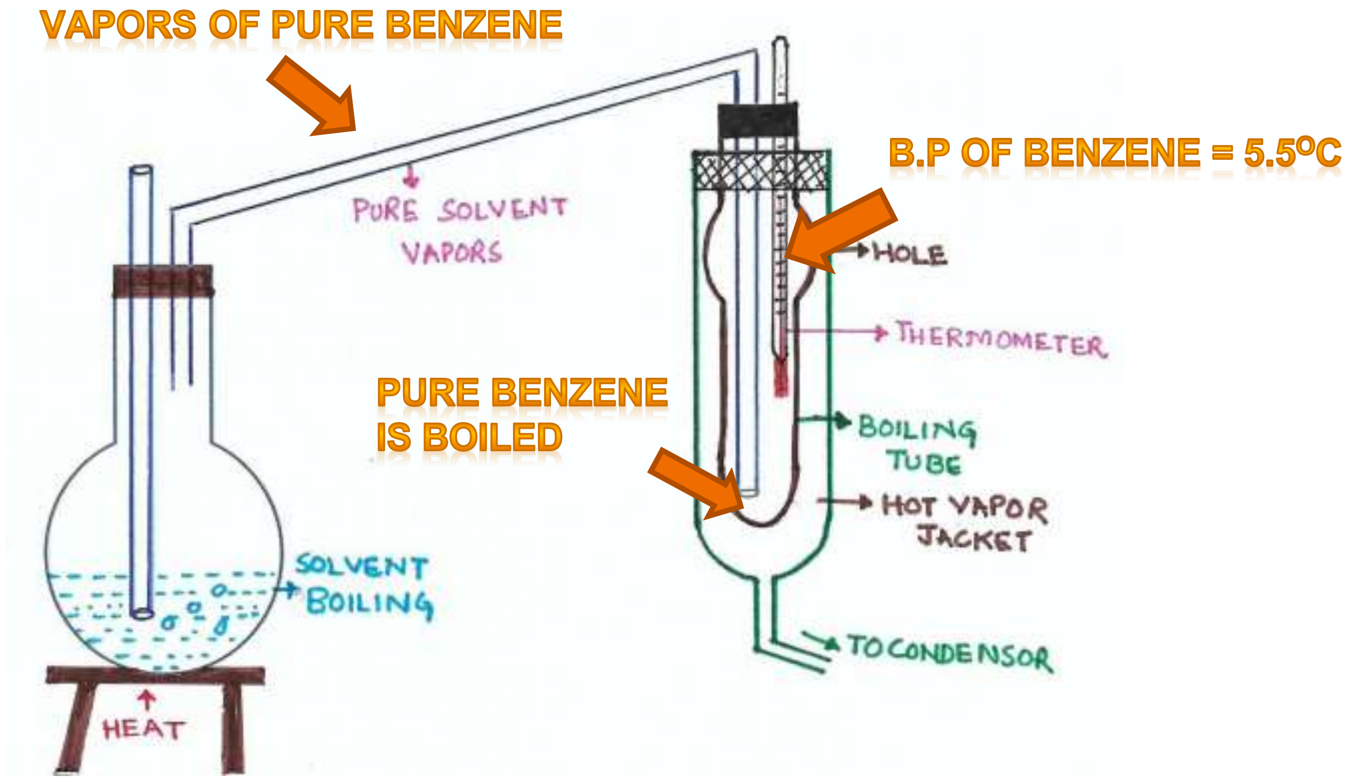




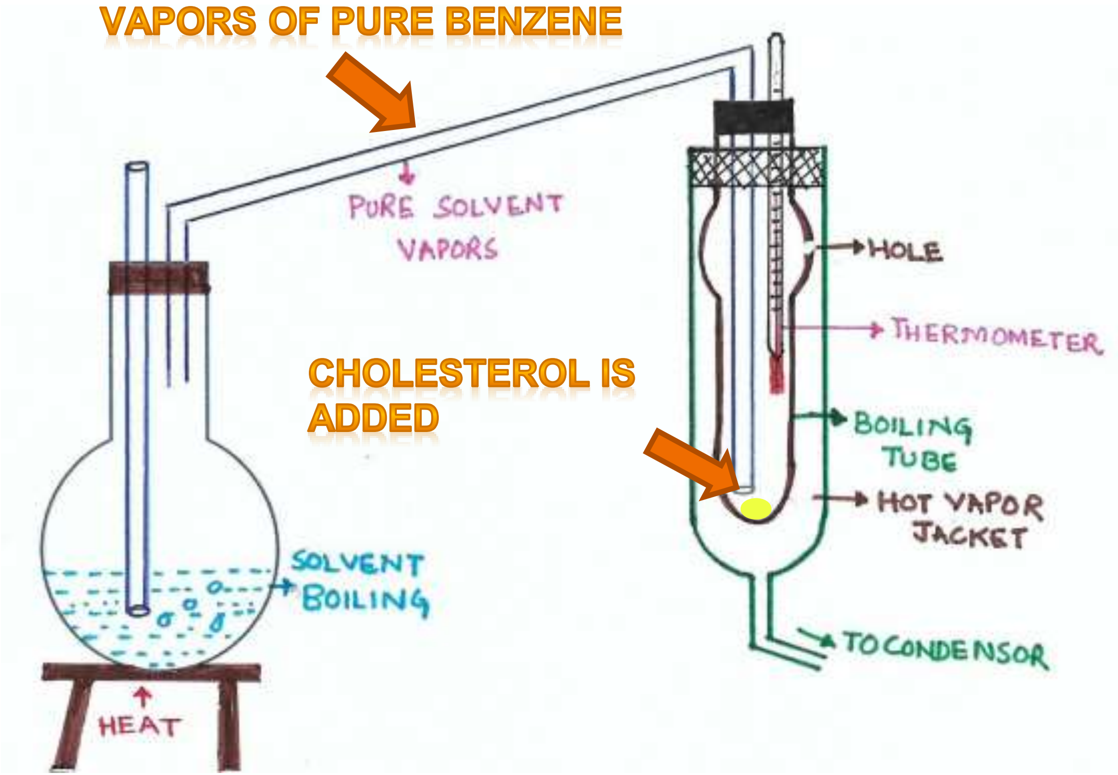
Cholesterol is an important compound in our body. Its excess has been implicated as a cause of heart attack.



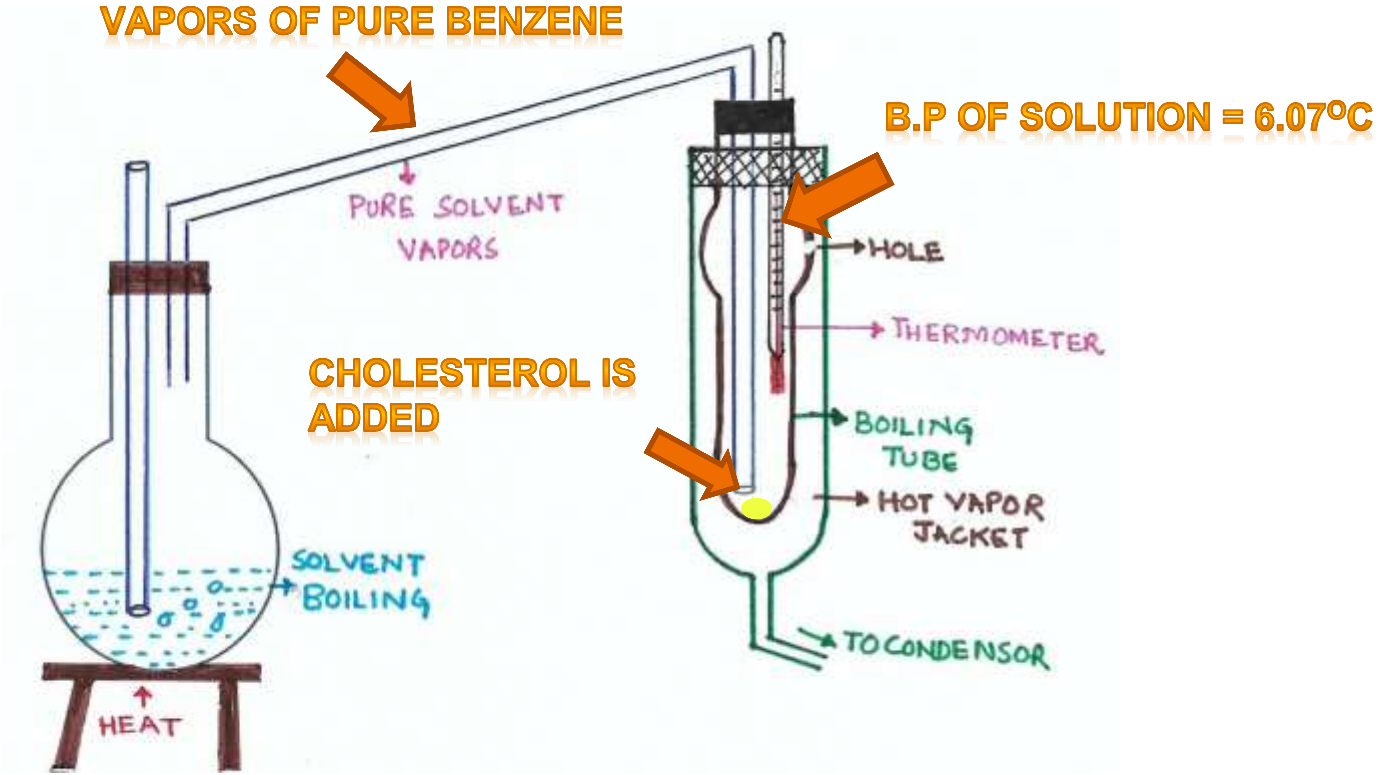
Take 10 cm^3 of pure benzene (solvent) in the inner tube. Boil benzene in the boiling flask. Pass its vapors through the benzene in the inner tube.



These vapors will boil the benzene in the inner tube by their latent heat of condensation. Record the temperature at which benzene in the inner tube is boiled.



Stop the supply of vapors temporarily. Drop 4.5 g of Cholesterol in the inner tube. Pass vapors of benzene from the boiling flask again to boil the solution.



Record boiling point of solution in the inner tube. Now stop the supply of vapors. Note the volume of solution.

Volume of solution = V = 121.5 cm^3

Density of solution = d = 0.897 g/cm^3

Mass of cholesterol = W_2 = 4.5 g

Mass of benzene = W_1= ?

B.P of Benzene = T_1= 5.5° C

B.P of solution = T_2= 6.07° C

K_b of Benzene = 5.12

Molecular mass of cholesterol = M_2=?

As,

$$d = \frac{m}{v}$$

$$\therefore m = d \times v$$

$$\therefore Mass\ of\ solution = d \times v = 0.897 \times 121.5 = 108.99\ g$$

$$Mass\ of\ Benzene\ (W_1) = Mass\ of\ solution - Mass\ of\ cholesterol\ (W_2)$$

$$W_1 = 108.99 - 4.5 = 104.486\ g$$

As,

$$\Delta T_b = T_2 - T_1$$

$$\therefore \Delta T_b = 6.07 - 5.5 = 0.57^o C$$

Now,

$$M_2 = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$$

$$M_2 = \frac{5.12 \times 4.5 \times 1000}{0.57 \times 104.486} = 386.86\ gmol^{-1}$$

End of Lesson