

SOAL DAN PEMBAHASAN SIFAT KOLIGATIF LARUTAN

TAHUN PELAJARAN/.....

MATA PELAJARAN : KIMIA

KELAS : XII (DUA BELAS)

1. Sebanyak 18 gram glukosa $C_6H_{12}O_6$ ($M_r = 180$) dilarutkan dalam 180 gram air ($M_r = 18$) pada suhu $29^{\circ}C$, bila tekanan uap air pada suhu itu = 31,90 mmHg maka hitunglah:
- Tekanan uap larutan
 - Penurunan tekanan uap larutan

Pembahasan:

Diketahui:

$$\text{gr } C_6H_{12}O_6 = 18 \text{ gr}$$

$$M_r = 180$$

$$\text{gr } H_2O = 180 \text{ gr}$$

$$M_r = 18$$

$$T = 29^{\circ}C$$

$$P^0 = 31,90 \text{ mmHg}$$

Ditanyakan:

- $P \dots?$
- $\Delta P \dots?$

Jawaban:

$$n C_6H_{12}O_6 = 18/180 = 0,1 \text{ mol}$$

$$n H_2O = 180/18 = 10 \text{ mol}$$

$$X_{H_2O} = n H_2O / n H_2O + n C_6H_{12}O_6 = 10/10+1 = 0,99$$

$$a. P = X_{H_2O} \cdot P^0 = 0,99 \times 31,90 \text{ mmHg} = 31,581 \text{ mmHg}$$

$$b. \Delta P = P^0 - P = 31,90 \text{ mmHg} - 31,581 \text{ mmHg} = 0,319 \text{ mmHg}$$

2. Diketahui 9,6 gram lilin dilarutkan dalam 40 gr CCl_4 pada suhu $25^{\circ}C$ sehingga tekanan uap larutan turun sebesar 0,014 atm. Jika diketahui tekanan uap CCl_4 murni pada suhu $25^{\circ}C = 0,131$ atm dan $M_r CCl_4 = 154$. Berapa M_r lilin tersebut?

Pembahasan:

Diketahui:

$$\text{gr lilin} = 9,6 \text{ gr}$$

$$\text{gr } CCl_4 = 40 \text{ gr}; M_r CCl_4 = 154$$

$$\Delta P = 0,014 \text{ atm}$$

$$P^0 = 0,131 \text{ atm}$$

$$T = 25^{\circ}\text{C}$$

Ditanya: Mr lilin ...?

Jawab:

$$P = P^0 - \Delta P$$

$$P = 0,131 \text{ atm} - 0,014 \text{ atm} = 0,117 \text{ atm}$$

$$n \text{ CCl}_4 = 40/154 = 0,26 \text{ mol}$$

$$X \text{ CCl}_4 = P/P^0 = 0,117/0,131 = 0,893$$

$$X \text{ CCl}_4 = n \text{ CCl}_4 / (n \text{ CCl}_4 + n \text{ lilin})$$

$$0,893 = 0,26 / (0,26 + n \text{ lilin})$$

$$0,232 + (0,893 \cdot n \text{ lilin}) = 0,26$$

$$n \text{ lilin} = (0,26 - 0,232) / 0,893 = 0,031 \text{ mol}$$

$$\text{Mr lilin} = \text{gr/mol} = 9,6/0,031 = 309,7$$

3. 8 gram $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ dilarutkan dalam 60 gram air. ($\text{Mr } \text{C}_{12}\text{H}_{22}\text{O}_{11} = 342$, $K_b \text{ air} = 0,512^{\circ}\text{C} \cdot \text{kg} \cdot \text{mol}^{-1}$, dan $T_b \text{ air} = 100^{\circ}\text{C}$). Hitunglah!

a. ΔT_b larutan

b. T_b larutan

Pembahasan:

Diketahui:

$$\text{gr } \text{C}_{12}\text{H}_{22}\text{O}_{11} = 8 \text{ gr}$$

$$\text{gr } \text{H}_2\text{O} = 60 \text{ gr}$$

$$\text{Mr } \text{C}_{12}\text{H}_{22}\text{O}_{11} = 342$$

$$K_b \text{ air} = 0,512^{\circ}\text{C} \cdot \text{kg} \cdot \text{mol}^{-1}$$

$$T_b \text{ air} = 100^{\circ}\text{C}$$

Ditanyakan:

a. ΔT_b larutan ...?

b. T_b larutan ...?

Jawaban:

$$m \text{ C}_{12}\text{H}_{22}\text{O}_{11} = \text{gr/Mr} \times 1000/p$$

$$m \text{ C}_{12}\text{H}_{22}\text{O}_{11} = 8/342 \times 1000/60 = 0,0234 \times 16,67 = 0,39$$

$$\text{a. } \Delta T_b = K_b \times m = 0,512 \times 0,39 = 0,2^{\circ}\text{C}$$

$$\text{b. } T_b = T_{b \text{ air}} + \Delta T_b = 100^{\circ}\text{C} + 0,2^{\circ}\text{C} = 100,2^{\circ}\text{C}$$

4. Sebanyak 1,41 gram zat organik dilarutkan dalam 20 gr aseton sehingga terjadi kenaikan titik didih $0,5^{\circ}\text{C}$. Berapa Mr zat organik tersebut? ($K_b \text{ aseton} = 1,67^{\circ}\text{C} \text{ kg/mol}$)

Pembahasan:

Diketahui:

$$\text{gr zat organik} = 1,41 \text{ gr}$$

$$\text{gr aseton} = 20 \text{ gr}$$

$$\Delta T_b = 0,5^\circ\text{C}$$

$$K_b \text{ aseton} = 1,67^\circ\text{C kg/mol}$$

Ditanya: Mr zat organik?

Jawab:

$$\Delta T_b = K_b \cdot m$$

$$\Delta T_b = K_b \cdot \text{gr/Mr} \cdot 1000/p$$

$$0,5 = 1,67 \cdot 1,41/\text{Mr} \cdot 100/20$$

$$\text{Mr} = (1,67 \cdot 1,41 \cdot 1000) / (0,5 \cdot 20)$$

$$\text{Mr} = 2.354,7/10 = 235,47$$

5. Jika 50 gram etilen glikol ($\text{C}_2\text{H}_6\text{O}_2$, Mr = 62) dilarutkan dalam 100 gram air. Hitunglah titik beku larutan tersebut! (K_f air = 1,86)

Pembahasan:

Diketahui

$$\text{gr } \text{C}_2\text{H}_6\text{O}_2 = 50 \text{ gr}$$

$$\text{Mr } \text{C}_2\text{H}_6\text{O}_2 = 62$$

$$\text{gr } \text{H}_2\text{O} = 100 \text{ gr}$$

$$K_f \text{ H}_2\text{O} = 1,86$$

Ditanyakan: Tf larutan?

Jawaban

$$m \text{ C}_2\text{H}_6\text{O}_2 = \text{gr/Mr} \times 1000/p = 50/62 \times 1000/100 = 8,06$$

$$\Delta T_f = K_f \times m = 1,86 \times 8,06 = 14,99^\circ\text{C}$$

$$T_f \text{ larutan} = T_f \text{ air} - \Delta T_f = 0^\circ\text{C} - 14,99^\circ\text{C} = -14,99^\circ\text{C}$$

6. Sebanyak 0,4 gr zat X dilarutkan dalam 20 gr benzena, ternyata terjadi penurunan titik beku $0,57^\circ\text{C}$. Berapa Mr zat X! (K_f benzena = $5,10^\circ\text{C kg/mol}$)

Pembahasan:

Diketahui:

$$\text{gr zat X} = 0,4 \text{ gr}$$

$$\text{gr benzena} = 20 \text{ gr}$$

$$\Delta T_f = 0,57^\circ\text{C}$$

$$K_f \text{ benzena} = 5,10^\circ\text{C kg/mol}$$

Ditanya: Mr zat X ...?

Jawab:

$$\Delta T_f = K_f \cdot \text{gr}/\text{Mr} \cdot 1000/p$$

$$0,57 = 5,10 \cdot 0,4/\text{Mr} \cdot 1000/20$$

$$\text{Mr} = (5,10 \cdot 0,4 \cdot 1000) / (0,57 \cdot 20)$$

$$\text{Mr} = 2.040/11,4 = 178,94$$

7. Berapakah tekanan osmosis larutan laftalena dalam benzene yang mengandung 10 gram naftalena ($M_r = 128$) tiap 1 liter larutan pada suhu 15°C ? ($R = 0,082 \text{ L.atm/mol.K}$)

Pembahasan:

Diketahui:

$$\text{gr naftalena} = 10 \text{ gr}$$

$$M_r \text{ naftalena} = 128$$

$$v \text{ benzene} = 1 \text{ L}$$

$$T = 15^\circ\text{C}$$

$$R = 0,082 \text{ L.atm/mol.K}$$

Ditanyakan: π ?

Jawaban:

$$n \text{ naftalena} = 10/128 = 0,078$$

$$M = n/v = 0,078 \text{ mol}/1\text{L} = 0,078 \text{ mol/L}$$

$$T = 15^\circ\text{C} + 273 = 288 \text{ K}$$

$$\pi = M \times R \times T = 0,078 \times 0,082 \times 288 = 1,84 \text{ atm}$$

8. Ke dalam 1 liter larutan ditambahkan 1,82 gr etilen glikol pada suhu 10°C tekanan osmosisnya sebesar 0,68 atm. Hitung M_r etilen glikol tersebut! ($R = 0,082 \text{ L atm/mol K}$)

Pembahasan:

Diketahui:

$$v = 1 \text{ L}$$

$$\text{gr etilen glikol} = 1,82 \text{ gr}$$

$$T = 10^\circ\text{C} = 283 \text{ K}$$

$$\pi = 0,68 \text{ atm}$$

$$R = 0,082 \text{ L atm/mol K}$$

Ditanya: M_r etilen glikol...?

Jawab:

$$\pi = M \cdot R \cdot T$$

$$\pi = (n/v) \cdot R \cdot T$$

$$0,68 \text{ atm} = (n/1\text{L}) 0,082 \text{ L atm/mol K} \cdot 283 \text{ K}$$

$$n = 0,68 \text{ atm L} / 23,206 \text{ L atm/mol}$$

$$n = 0,029 \text{ mol}$$

$$n = \text{gr}/\text{Mr}$$

$$\text{Mr} = 1,82/0,029 = 62,75$$

9. Berapakah faktor Van't Hoff (i) dari larutan HF 0,1 M jika titik beku larutan $-0,197^{\circ}\text{C}$ (K_f air = $1,86^{\circ}\text{C kg/mol}$)

Pembahasan:

Diketahui:

$$m \text{ HF} = 0,1 \text{ M}$$

$$T_f \text{ larutan} = -0,197^{\circ}\text{C}$$

$$K_f \text{ air} = 1,86^{\circ}\text{C kg/mol}$$

Ditanyakan: i?

Jawaban:

$$\Delta T_f = T_f \text{ air} - T_f \text{ larutan} = 0^{\circ}\text{C} - (-0,197) = 0,197^{\circ}\text{C}$$

$$\Delta T_f = K_f \times m \times i$$

$$0,197 = 1,86 \times 0,1 \times i$$

$$i = 0,197/0,186 = 1,06$$

10. Tekanan osmosis larutan MgCl_2 adalah 0,6 atm dan larutan glukosa 0,25 atm. Apabila kedua larutan molaritasnya sama, hitunglah:

a. faktor Van't Hoff

b. derajat ionisasi MgCl_2

Pembahasan:

Diketahui:

$$\pi \text{ MgCl}_2 = 0,6 \text{ atm}$$

$$\pi \text{ glukosa} = 0,25 \text{ atm}$$

Ditanya:

a. i...?

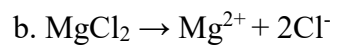
b. α ...?

Jawab:

$$a. i = \pi \text{ elektrolit} / \pi \text{ nonelektrolit}$$

$$i = \pi \text{ MgCl}_2 / \pi \text{ glukosa}$$

$$i = 0,6/0,25 = 2,4$$



$$n = 3$$

$$i = 1 + (n-1)\alpha$$

$$2,4 = 1 + (3-1)\alpha$$

$$\alpha = (2,4 - 1)/2 = 0,7$$